**Academic Catalog 2017 - 2018 / Graduate**

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Programs, Policies & Courses

This online academic catalog provides the latest information on all graduate areas of study and degree programs at the University of Massachusetts Lowell and supersedes all previous versions of the catalog.

Gainful Employment Information (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)

Bachelor’s to Master’s Programs

Earn Two Degrees in as Little as Five Years

- Eligibility
- Course Credits
- How to Apply

In order to encourage outstanding UMass Lowell undergraduate degree students to continue their studies towards an advanced degree, qualified students may apply for the Bachelors to Masters Degree Option (Bachelor’s to Master’s programs include the Fast Track to Teaching and Plus 1 programs.)

This option carries distinct benefits. Graduate Record Examination (GRE) scores are not required (except in the Graduate School of Education), GMAT is waived for applicants for the Masters in Business Administration (MBA) with a 3.2 or higher GPA and the application fee is waived. In addition, many departments offer course credit benefits. (For detailed information regarding specific course credit benefits, please see the Graduate Coordinator in the respective masters degree granting department.)

- Information on the GRE / GMAT / MAT Waivers (https://www.uml.edu/Grad/gre-mat-waivers.aspx)

Eligibility

Any UMass Lowell undergraduate junior or senior with a grade point average of 3.0 or better may apply to a Masters degree program at UMass Lowell under the Accelerated Bachelors to Masters Degree Option. However, to be accepted into this option the following minimum conditions must be met (individual departments may have more stringent requirements):

1. The student must have a cumulative grade point average of 3.0 or above at the time the baccalaureate degree is conferred in order to maintain eligibility for this option.
2. The student must apply for and receive his/her baccalaureate degree before matriculating into the graduate program.
3. Once accepted a student is expected to begin his/her graduate studies in the semester immediately following conferral of the baccalaureate degree unless the student submits a written request for deferral. A student is allowed to defer for a maximum of one year from the date of acceptance. For example, if accepted for the Spring 2015 semester, an individual can defer to either the Fall 2015 or Spring 2016 semesters. A student defers acceptance by submitting a written request to the Office of Graduate Admissions (mailto:Graduate_Admissions@uml.edu). All deferral requests must specify which semester the student wishes to enroll. Any applicant accepted to the Bachelors to Masters Degree Option who opts not to enroll in at least one course within the graduate department to which they have been accepted in the semester immediately following conferral of the bachelors degree and who does not submit a deferral request forfeits his/her rights to benefits under this program. Should the student decide to begin his/her studies at a later time he/she will be required to take the GRE, pay an application fee, and have his/her application reassessed.

Course Credits

The graduate degree granting department may allow course credit benefits; however, the following requirements apply:

1. Any graduate courses taken by a baccalaureate degree student that are credited towards the Masters degree must have been obtained with a grade of B or better.
2. Only courses of 5000 level or higher may count toward the Masters degree.
3. As defined by the graduate degree granting department, a maximum of 12 graduate credits (5000 level or above) may be used for the masters degree provided these graduate credits were taken in excess of the university minimum of 120 baccalaureate degree credits, or, for programs requiring fewer than 33 credits, a maximum of
up to six credits of graduate (5000 level or higher) courses may be used by a student in the Accelerated Bachelor’s to Master’s Degree Option for both the graduate and undergraduate degrees; or, for program requiring 33-35 credits, at the discretion of the affected department, a maximum of up to nine credits of graduate (5000 level or higher) courses may be used by a student in the Accelerated Bachelor’s to Master’s Degree Option for both the graduate and undergraduate degrees; or, for programs requiring 36 or more credits, at the discretion of the affected department, a maximum of up to twelve credits of graduate (5000 level or higher) courses may be used by a student in the Accelerated Bachelor’s to Master’s Degree Option for both the graduate and undergraduate degrees.

4. Students must petition to have specific courses (5000 level or above) taken during their undergraduate career apply towards their graduate degree via an Academic Petition.

How to Apply

Applicants are requested to fill out the Online Application (https://sa-webapp-prd.erp.umasscs.net/psc/webapp/EMPLOYEE/HRMS/c/UM_WEBAPP_MEN U.UM_ADM_APP_LOGIN.GBL?instituition=UMLOW&CareerGRAD&CenterGRAD)& and submit requisite materials to the Office of Graduate Admissions (https://www.uml.edu/default.aspx) (Cumnock Hall - North Campus), normally in the second semester of their third year as an undergraduate (up until the last day of classes in their final semester before graduation). Application forms and details on applying may also be obtained by contacting the Graduate Admissions Office at 978-934-2390.

Master’s Programs Offered

Listed by Degree Earned

- Master of Arts
- Master of Business Administration
- Master of Education
- Master of Music
- Master of Public Health
- Master of Science
- Master of Science in Engineering
- Education Specialist

Master of Arts (MA)

- Community Social Psychology
- Criminal Justice
- History
- Peace & Conflict Resolution
- Security Studies

Master of Business Administration (MBA)

- General Business
- Accounting
- Business Analytics
- Entrepreneurship
- Finance
- Healthcare
- Information Technology
- International Business
- Managerial Leadership
- Marketing

Master of Education (M.Ed.)

- Curriculum & Instruction
- Educational Administration
- Reading & Language

Master of Music (MM)

- Music Education
• Sound Recording Technology

Master of Public Health (MPH)

- Public Health (https://www.uml.edu/Health-Sciences/Public-Health/Programs-of-Study/masters/MPH.aspx)
- Epidemiology
- Global Environmental Sustainability & Health
- Healthcare Management
- Nutrition
- Population Health

Master of Science (MS)

- Accounting
- Autism Studies
- Biological Sciences
  - Applied Biotechnology (PSM)
  - Biotechnology Biosafety (PSM)
  - Environmental Biotechnology (PSM)
  - Project Management for Life Sciences (PSM)
- Biomedical Engineering & Biotechnology (https://www.uml.edu/Catalog/Graduate/UMass-system/Biomedical-engineering-biotech/Default.aspx#)
- Biomedical & Biotechnology (PSM)
- Business Analytics
- Chemistry
  - Chemistry & Polymer Science (PSM)
  - Pharmaceutical Biochemistry (PSM)
- Clinical Laboratory Sciences
- Clinical Lab Science (PSM)
- Computer Science
  - Bio/Chemical Informatics
  - Software Entrepreneurship (PSM)
- Co-op Option in Engineering (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Engineering Management
- Entrepreneurship
- Environmental Studies
  - Atmospheric Sciences (PSM)
  - Environmental Engineering Sciences (PSM)
- Finance (https://www.uml.edu/Catalog/Graduate/Business/master)
- Health Informatics & Management
- Information Technology
- Marine Sciences & Technology
- Mathematics
- Nursing
- Public Health
- Radiological Science & Protection
- Security Studies
- Work Environment

Master of Science in Engineering (M.S.E.)

- Chemical Engineering (PSM, PSE)
- Civil Engineering (PSM, PSE)
- Computer Science (PSM, PSE)
- Environmental Engineering (PSM, PSE)
- Engineering Management (PSM, PSE)
- Finance (PSM, PSE)
- Global Environmental Sustainability & Health
- Healthcare Management
About Graduate Certificates

Most graduate certificate are comprised of four courses designed to provide specific knowledge and expertise vital to today's changing and complex needs in the workplace. In most cases courses may be applied toward a degree program.

Requirements to Complete a Graduate Certificate

The courses to complete the certificate must be completed within a five year period with a minimum 3.0 grade point average, and with no more than 3 credits below B. Courses completed for one certificate may not be used for another certificate.

Certificate Application Process

Individuals must complete a simplified application and provide an official undergraduate transcript indicating that a baccalaureate degree has been awarded. GRE's are not required. NOTE: If your bachelor's degree is from outside of the U.S., you may be required to take the TOEFL examination.

Download Graduate Certificate Application (pdf) (https://www.uml.edu/docs/Graduate%20Certificate%20App%20Only%20082016_tcm18-3292.pdf)

Doctoral Programs Offered

Listed by Degree Earned

- Doctor of Education
- Doctor of Engineering
- Doctor of Nursing Practice
- Doctor of Philosophy
- Doctor of Physical Therapy
- Doctor of Science

- Leadership in Schooling (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Language Arts & Literacy (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Mathematics & Science Education (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)

- Business Management Curriculum
- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Energy Engineering
- Mechanical Engineering
- Mechanical Engineering/Chemical Engineering
- Mechanical Engineering/Civil & Environmental Engineering
- Mechanical Engineering/Energy Engineering
- Mechanical Engineering/Manufacturing
- Mechanical Engineering/Manufacturing Engineering
- Plastics Engineering

- Applied Psychology and Preventative Science (http://www.uml.edu/Catalog/Graduate/FAHSS/Psychology/DoctoralAppliedPsychology.aspx)
- Biomedical Engineering & Biotechnology
- Business Administration Technology
Doctor of Physical Therapy (DPT)

- Physical Therapy [link]
- Energy Conversion
  (https://www.uml.edu/Catalog/Graduate/Engineering/Electrical-Computer-Engineering/Graduate-Certificates.aspx)
- Environmental Atmospheric Science
- Environmental Biotechnology
  (https://www.uml.edu/Catalog/Graduate/sciences/Biology/Graduate-Certificate.aspx)
- Environmental GeoScience
- Family Studies
  (https://www.uml.edu/Catalog/Graduate/FAHSS/psychology/Certificate-Program.aspx)
- Field Programming Gate Array
- Financial Management
  (http://www.uml.edu/Catalog/Graduate/Business/Graduate-Certificate.aspx)
- Forensic Criminology
  (https://www.uml.edu/Catalog/Graduate/FAHSS/Criminology/Certificate-Program.aspx)
- Foundations of Business
  (https://www.uml.edu/Catalog/Graduate/Graduate-Certificate.aspx)
- Health Informatics
  (https://stage.uml.edu/Catalog/Graduate/Health-Sciences/Public-Health/Graduate-Certificate.aspx#)
- Health Management
- Human Computer Interaction
  (https://www.uml.edu/catalog/graduate/sciences/computer-science/graduate-certificate.aspx#Human-Computer-Interaction)
- Integrated Engineering Systems
  (https://www.uml.edu/Catalog/Graduate/Engineering/Electrical-Computer-Engineering/Graduate-Certificates.aspx) (interdisciplinary)
- Manufacturing Engineering
  (http://www.uml.edu/Catalog/Graduate/Engineering/Mechanical-Engineering/Graduate-Certificates.aspx#1)
- Materials Sciences &Engineering
  (https://www.uml.edu/Catalog/Graduate/Engineering/Chemical-Engineering/Graduate-Certificates-in-Chemical-Engineering.aspx)
- Medical Imaging and Instrumentations
- Medical Plastics Design &Manufacturing
  (https://www.uml.edu/Catalog/Graduate/Engineering/Plastics-Engineering/Certificate-Programs.aspx)
- Microelectromechanical Systems/Nanoelectromechanical Systems
  (interdisciplinary)
- Microwave and Wireless Engineering
  (https://www.uml.edu/Catalog/Graduate/Engineering/Electrical-Computer-Engineering/Graduate-Certificates.aspx)
- Modeling, Simulation, and Control of Systems and Processes
  (https://www.uml.edu/Catalog/Graduate/Engineering/Chemical-Engineering/Graduate-Certificates-in-Chemical-Engineering.aspx)
- Molecular &Cellular Biotechnology
  (https://www.uml.edu/Catalog/Graduate/sciences/Biology/Graduate-Certificate.aspx)
- New Venture Creation
  (https://www.uml.edu/Catalog/Graduate/Graduate-Certificate.aspx)
- Nutritional Sciences
  (https://www.uml.edu/Catalog/Graduate/Health-Environment/Clinical-Lab-Nutritional-Sci/Certificate-Program.aspx)
- Peace and Conflict Resolution
  (https://www.uml.edu/Catalog/Graduate/FAHSS/PACS/Graduate-Certificate.aspx)
- Pharmaceutical Science
- Photonics &Opto-Electronic Devices
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- Professional Leadership
  (http://www.uml.edu/Catalog/Graduate/Programs/Professional-Leadership.aspx)

- Public Health Laboratory Sciences
  (https://www.uml.edu/Catalog/Graduate/Health-Environment/Clinical-Lab-Nutritional-Sci/Certificate-Program.aspx)

- Public Health Studies
  (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Public-Health/graduate-certificate-phs.aspx)

- Radiological Health Physics & General Work Environment Protection
  (https://www.uml.edu/Catalog/Graduate/sciences/Physics/Graduate-Certificates-in-Physics.aspx)

- Renewable Energy Engineering (interdisciplinary)
  (https://www.uml.edu/Catalog/Graduate/Engineering/Mechanical-Engineering/Graduate-Certificates.aspx)

- Security Studies
  (https://www.uml.edu/Catalog/Graduate/FAHSS/Criminal-Justice/Certificate-Program.aspx)

- Structural Dynamics and Acoustic Modeling Techniques
  (https://www.uml.edu/Catalog/Graduate/Engineering/Mechanical-Engineering/Graduate-Certificates.aspx)

- Supply Chain and Operations Management
  (http://www.uml.edu/Catalog/Graduate/Business/Graduate-Certificate.aspx)

- System Models and Management
  (https://www.uml.edu/Catalog/Graduate/sciences/Computer-Science/Graduate-Certificate.aspx)

- Victim Studies
  (https://www.uml.edu/Catalog/Graduate/FAHSS/Criminal-Justice/Certificate-Program.aspx)

- VLSI & Microelectronics
  (https://www.uml.edu/Catalog/Graduate/Engineering/Electrical-Computer-Engineering/Graduate-Certificates.aspx)

- Wind Energy Engineering
  (https://www.uml.edu/Catalog/Graduate/Engineering/Mechanical-Engineering/Graduate-Certificates.aspx#WEG)

### Professional Science Master's (PSM)

What differentiates the PSM from the core Master's degree?

The Professional Science Master's (PSM) is an innovative, non-thesis degree option designed for students to pursue advanced training in science, health or engineering while simultaneously developing professional leadership skills highly valued by employers. PSM programs typically consist of 8 core courses in science, health or engineering, 3 professional courses in leadership, communication and project management, a paid internship or professional development project and a reflective seminar. PSM programs have been developed in concert with industry in response to employer demands for specific skills and knowledge above and beyond the core science curriculum.

In contrast to typical Masters degrees, which require a thesis as a step toward preparation for an academic career, PSM programs are designed as terminal degrees that prepare candidates to compete in the global market. In essence, PSM programs are the MBAs of the 21st century. The National PSM Association offers networking and professional workshops to promote continued career development for PSM alumni across the country.

What PSM programs are available at UMass Lowell?

UMass Lowell offers 19 PSM programs. Graduates earn a Masters degree in Science with a PSM Option in the fields indicated below.

**Biological Sciences**
(http://www.uml.edu/Catalog/Graduate/Sciences/Biology/Default.aspx)

- Applied Biotechnology
- Environmental Biotechnology
Biosafety

Project Management in Life Sciences

Biomedical Engineering and Biotechnology

Chemistry

Chemistry and Polymer Science
Pharmaceutical Biochemistry

Clinical Laboratory Sciences

Chemistry

Atmospheric Sciences
Geosciences
Marine Sciences

Costal and Ocean Administration, Science and Technology

Mathematics

Industrial Mathematics

Physics

Radiological Sciences

Professional Leadership

Work Environment

Cleaner Production & Pollution Prevention
Environmental Epidemiology
Ergonomics and Safety
Occupational & Environmental Hygiene

For more information regarding PSM programs at UMass Lowell contact William Smith (mailto:william_smith@uml.edu).

Recommended PSM Science Courses:

Students should consult with faculty advisers to determine best course choice for their career advancement needs. All PSM students should include at least 1 course (basic or enhanced) that incorporates communication into their curriculum. Course descriptions can be found on the Recommended Courses (https://www.uml.edu/docs/PSM%20Online%20Course%20Descriptions%2007012014_tcm18-149327.pdf) (pdf).

Doctoral Degree Requirements

Doctoral Degree Requirements

Doctoral Research

Dissertation Committee
Dissertation Credits
Dissertation Preparation
Dissertation Defense

Doctoral Degree Requirements

Procedure for Opting Out with a Master’s Degree

Doctoral Research

In addition to the other requirements of the University, a candidate for a doctoral degree must complete an acceptable dissertation. The dissertation must satisfy the following criteria:

1. It should demonstrate the candidate’s intellectual competence and maturity in the field of concentration;
2. It should make an original and valid contribution to knowledge; and
3. It should be an individual achievement and the product of independent research.

Although doctoral dissertations may result from a project
involving collaboration of several scholars, the individual contribution of each doctoral candidate must be substantial, clearly identifiable, and presented separately. The Committee will judge the completed dissertation in terms of the candidate’s ability to review and make critical use of the literature; to formulate a problem, develop appropriate methodology, and work systematically toward a solution; and to summarize the material or data and draw conclusions from them. The writing should be of publishable quality.

Dissertation Committee

After a student has chosen an area of research and a research supervisor, a Dissertation Committee is selected by the student and his or her research advisor in accordance with the policy of the department. The Dissertation Committee shall consist of at least three members, one of whom is the research supervisor and at least two of whom shall be from the student’s major department. An outside expert from industry or another university may be a member of the committee, but that individual must possess academic credentials which would qualify him or her to serve as a member of the University of Massachusetts Lowell faculty. The responsibilities of the Dissertation Committee shall be to:

1. Approve the research topic;
2. Supervise the progress of the dissertation;
3. Read, evaluate, and approve or disapprove of the written dissertation;
4. Hear, evaluate and approve or disapprove of the oral defense of the dissertation;
5. Report the completion of all dissertation requirements to the department and the Registrar’s Office.


Dissertation Credits

If the graduate student requires the use of University resources to continue his or her dissertation but has completed the required number of credits for doctoral research, he or she may sign up for 3, 6, or 9 credits of Continuing Graduate Research (see General Policies).

Graduate students who have completed all the requirements except the writing and defense of the dissertation and who do not need to use university resources must register for Continued Matriculation (CM.601.201) and pay a fee each semester until they graduate.

Note: International students on F-1 or J-1 visas must be registered for a minimum of nine credits each semester. Contact the International Students and Scholars Office for more information.

Dissertation Preparation

Every graduate student who completes a dissertation is required to bear the cost of binding two copies of the manuscript for the University’s files. Copywriting is optional and available for an additional fee.

Dissertation Defense

Two weeks prior to the dissertation defense, announcements of the defense, listing the graduate student’s name, dissertation title, and place and time of the defense, must be submitted to the chairperson of the department, the college dean, the Registrar’s Office and posted and distributed throughout the university. The defense is open to the public.

Doctoral Degree Requirements

The doctoral degree is conferred upon graduate students who have met all the requirements listed below:

1. The student must successfully complete the graduate courses in the major field, including the GPA requirement, and the number of course and dissertation credits required by the particular program.
2. If indicated, the language requirement specified by the major department must be satisfactorily completed.
3. A qualifying examination, oral and/or written, conducted by the major department, must be passed before any work is begun on the dissertation. If the student fails the qualifying examination he or she may, at the discretion of the department, be permitted a second and final opportunity. At this point, having completed steps 1 through 3, the student is admitted to candidacy for the doctorate.
4. A dissertation based upon the results of original research, and which is satisfactory to the Dissertation Committee of the major department, must be completed.
5. A final oral dissertation defense conducted by the Dissertation Committee, based primarily upon, but not necessarily limited to, the contents of the candidate’s dissertation must be passed. The examination cannot be scheduled until all members of the Dissertation Committee are present. The defense is open to the public.
Committee have had seven working days in which to read the dissertation. The oral examination is to be conducted by the Dissertation Committee, whose membership may be augmented by the non-voting faculty. In order to pass the defense, the candidate may not receive more than one dissenting vote from the members of the Dissertation Committee.

6. All financial obligations (tuition, fees, and expenses) must be satisfied as evidenced by the completion and submission of a Graduate Degree Clearance form to the Registrar’s Office.

Procedure for Opting Out with a Master’s Degree

Students accepted into a doctoral program who elect to instead obtain the master’s degree and leave the university must follow the following procedure:

1. The student must file an Academic Petition requesting to be changed from the doctorate to the master’s degree program.
2. The student must complete all required courses for the master’s degree, compile a minimum 3.0 grade point average, successfully defend his/her thesis, and complete the clearance process at the Registrar’s Office.
3. All graduate courses (and undergraduate course work used for graduate credit), whether taken for the original doctoral program or for the master’s degree, will be included in the grade point average and listed on the student’s graduate transcript.

Financial Information

University-related costs include tuition and mandatory fees. Please contact The Solution Center for more tuition and fee information (https://www.uml.edu/thesolutioncenter/bill/tuition-fees/Graduate/in-state.aspx).

- New England Regional Program
- Health Insurance
- Veterans
- Residency Classification
- Overdue Accounts

New England Regional Student Program

Massachusetts and the university participate in a reciprocal program in which qualified and legal residents of other New England states may attend graduate school in an approved program at the University of Massachusetts Lowell and pay 150 percent of the Massachusetts in-state tuition charges. (All other applicable fees apply.) Applicants are considered for unique and distinctive graduate level studies not available in their home state university system. Full details regarding eligible programs are available from the New England Board of Higher Education, 45 Temple Place, Boston, Massachusetts 02111 (617-357-9620), or at the University Graduate Admissions (https://www.uml.edu/Grad/default.aspx) office (www.uml.edu/grad (https://www.uml.edu/Grad/default.aspx)). See the tuition costs for the New England Regional Program (https://www.uml.edu/thesolutioncenter/bill/tuition-fees/Graduate/NE-Regional.aspx).

*UMass Lowell also participates in the Proximity Allowance of the New England Regional Program. This program allows New Hampshire residents from selected towns within a 20 mile radius of UMass Lowell to be eligible for a tuition discount for most majors. Please visit www.uml.edu/admissions/proximity (http://www.uml.edu/Grad/Costs/default.aspx) for details.

Health Insurance

Mandatory on-campus (accident) insurance is charged to all graduate students. All graduate students enrolled in 9 or more credit hours will be charged for health insurance as required by state law. Graduate students may waive student health insurance charges if they maintain comparable insurance coverage and complete an insurance waiver form by the required deadline. Forms are available in the Office of Graduate Admissions and Accounts Receivable Office, Dugan Hall, UMass Lowell South. Family health insurance plans are also available with options for coverage of spouses and/or spouses and dependent children.

International Students: As authorized under the insurance laws for higher education students in Massachusetts (section 275 of Chapter 151 of the Acts of 1996), the University of Massachusetts Lowell requires that all international students must enroll in the University’s Student Health Insurance Plan.

Veterans

The Veterans Administration has approved the University of Massachusetts Lowell for undergraduate study. Visit the Office of Veterans Services (https://www.uml.edu/student-services/Veterans/default.aspx) for more information.
RESIDENCY CLASSIFICATION

Rules for Determination of Domicile

University tuition rates are established on the basis of official state residency as determined by a student’s true “domicile.” “Domicile” is defined as a person’s true, fixed and permanent home and place of habitation where he or she intends to remain permanently or for an indefinite time. Massachusetts residency for tuition purposes is not acquired by mere physical presence in Massachusetts while a person is carrying on a course of study at the University. A student’s residency status is based on a determination of one’s domicile at the time of entry or re-entry to the University. A student may apply to be reclassified at any time and must provide detailed documentation to support the claim that he or she met the requirements for Massachusetts residency for tuition purposes at the time of his or her entry as a student. One notable exception is made for students who marry Massachusetts residents while enrolled in a course of studies. The complete set of rules are attached to the application for reclassification (https://www.uml.edu/Enrollment/Residency/Classification-Reclassification.aspx).

Payment of Bills

Graduate students will be permitted to attend classes and to utilize university facilities only after they have cleared all their financial obligations to the university. Financial obligations include indebtedness for library and parking fines, rental payments and repayment of emergency loans. All bills are payable in advance by check or money order and are due as specified on the student invoice. Major credit cards are also accepted. All payments of fees and tuition should be made payable directly to the University of Massachusetts Lowell. A student in debt to the university at the end of any semester or summer session is not permitted to register again at the university until his or her indebtedness has been discharged. In addition, student transcripts and diplomas will not be released unless all indebtedness has been discharged.

Pay My Bill (https://www.uml.edu/thesolutioncenter/bill/default.aspx)

Overdue Accounts

Should it be necessary to utilize the services of a collection agency or attorney for an overdue student account, the student will be liable for any and all legal fees, commissions, and associated service charges.

Payment Plans

The University of Massachusetts Lowell offers a low-cost, interest-free payment option. This plan allows students to budget the annual cost of tuition and fees over a ten month period. Visit the Solution Center (https://www.uml.edu/thesolutioncenter/bill/eBill/payment-options.aspx) for more information on payment options.

University Charges

University-related costs include tuition and mandatory fees. Please contact the Solution Center (https://www.uml.edu/thesolutioncenter/bill/tuition-fees/Graduate/default.aspx) for more information on tuition and fees.

Financial Assistance & Assistantships

FINANCIAL ASSISTANCE

Applying for Financial Aid

Other Types of Assistance

The Solution Center (https://www.uml.edu/thesolutioncenter/financial-aid/default.aspx)

University Crossing Lobby
220 Pawtucket Street, Suite 131
Lowell, MA 01854
Telephone: 978-934-2000
Office Hours: Monday - Friday: 8:30 a.m. to 5 p.m.

Applying Financial Aid

The University requires students to file a Free Application for Federal Student Aid (FAFSA). Students may apply for the FAFSA online at www.FAFSA.ed.gov. It is recommended that students save time by requesting personal identification numbers called Federal Student Aid PINs before the student applies for aid. The PIN can be used to electronically sign the FAFSA, electronically sign certain loan contracts, and access online information about federal student aid the student has received. The PIN must be requested online at www.studentaid.ed.gov (https://www.studentaid.ed.gov/sa/fafsa/filling-out/fsaid).

Copies of students and spouses federal income tax, W2 forms and other forms may be requested by the Financial Aid Office to verify information provided on the FAFSA. Many forms requested are available on The Solution Center website (https://www.uml.edu/thesolutioncenter/forms/Financial-Aid-Forms.aspx). All information requested by the Financial Aid Office is required to complete the application process and is held in strictest confidence.

Eligibility Requirements

To receive financial aid from the various student aid programs, a student must:
• Have demonstrated financial need to qualify for need-based aid programs. Need is defined as the cost of attendance minus the expected family contribution derived from filing the FAFSA. Students may also be eligible for non-need based aid programs, such as the Federal Direct Unsubsidized Loan program and meritorious awards.
• Be a U.S. citizen or eligible non-citizen.
• Have a valid Social Security Number.
• Make satisfactory academic progress.
• Have a high school diploma or a General Education Development (GED) certificate, pass a test approved by the U.S. Department of Education, meet other standards the state of Massachusetts establishes that are approved by the U.S. Department of Education, or complete a high school education in a home school setting that is treated as a home school or private school under state law.
• Be a matriculated student enrolled in a degree granting or approved certificate program. Students enrolled in non-degree programs are not eligible for financial aid.
• Be enrolled at least half-time each semester. (Minimum of six credits for graduate students).
• Cannot be in default or in over payment on a federal student loan.
• Register with the Selective Service, if required

(www.sss.gov (http://www.sss.gov))

Determining Financial Need:

Demonstrated financial need is the difference between the cost of attendance and the expected family contribution. The cost of attendance (COA) includes direct expenses such as tuition and fees, and also includes indirect such as room, board, books and transportation. The expected family contribution (EFC) is determined by the federal needs analysis formula and is calculated by completing a Free Application for Federal Student Aid (FAFSA).

Types of Financial Aid:

William D. Ford Federal Direct Subsidized/Unsubsidized Loan Program: The primary source of financial aid recommended for graduate students is the William D. Ford Federal Direct Student Loan Program. This program allows the student to borrow up to $20,500 per year at a low interest rate in subsidized and/or unsubsidized loans. Eligibility for a subsidized? or unsubsidized? direct loan is determined from the information provided on the FAFSA. A student may receive a subsidized loan and an unsubsidized loan for the same enrollment period. A subsidized loan is awarded on the basis of financial need. A student will not be charged any interest before repayment begins or during authorized periods of deferment. An unsubsidized loan is not awarded on the basis of need. A student will be charged interest from the time the loan is disbursed until it is paid in full. If a student allows the interest to accumulate, it will be capitalized?that is, the interest will be added to the principal amount of the loan and additional interest will be based upon the higher amount. For more information about graduate student aid contact visit the Solution Center at www.uml.edu/thesolutioncenter

William D. Ford Federal Direct PLUS Loan Program:

A non-need based federal loan offers up to the cost of attendance minus financial aid per academic year to qualified graduate students and parents/stepparents of undergraduate dependent students. Interest rate is fixed and repayment begins 45-60 days after the second disbursement. Refer to the Direct Loan web site (http://www.ed.gov/offices/OSFAP/DirectLoan/index.html) for current interest rates. A FAFSA is not required to apply for the PLUS loan; however, students are encouraged to file a FAFSA so that they can receive the maximum aid available. Parents may download an application online from The Solution Center (https://www.uml.edu/thesolutioncenter/Forms/Financial-Aid-Forms.aspx). Applications should be returned to the financial aid for processing. This is a loan that needs to be repaid by the parent/stepparent.

Other Types of Assistance:

Federal Professional Nurse Traineeship Grant Program: Federally funded grant available to graduate nursing students. Award amounts vary and are dependent upon funding. Please contact the School of Nursing for more information.

Federal Teach Grant: Federally funded grant available to qualifying graduate education majors enrolled in coursework or plan to complete coursework toward a career in teaching in a high need subject area. Contact the Graduate School of Education for more information.

Deans Fellowships: $2,000 awards granted to eligible, newly admitted full-time, in-state Masters candidates not receiving a teaching or research assistantship.

Provosts Fellowships: $4,000 awards granted to eligible, newly admitted full-time, out-of-state and international Masters candidates not receiving a teaching or research assistantship.

ASSISTANTSHIPS
Teaching and Research Assistantships

A limited number of teaching and research assistantships are available for matriculated, full-time (minimum of 9 credits/semester) graduate students. All assistantships are subject to the agreement between UMass Lowell and UAW/Graduate Employees Organization. Teaching assistantships are assigned by the student’s department; therefore, queries regarding teaching assistantships should be directed to the departmental graduate coordinator (https://www.uml.edu/Grad/Accepted-Students/coordinators.aspx) or chairperson (see www.uml.edu/Grad/coordinators.aspx for a list). Research assistantships are available through special arrangements with individual research advisers. Individuals interested in research assistantships should contact departmental faculty members concerning the availability of this form of financial aid.

Qualifying for an Assistantship

To ensure that assistantships are awarded to the most qualified individuals, the University has established the following requirements:

1. No teaching/research assistantship may be awarded to a graduate student with incompletes, F’s, or U’s on his or her transcript.
2. No teaching/research assistantship may be awarded to a graduate student who fails to maintain good academic standing (a grade point average under 3.0 on the official transcript). See the Academic Standing information at www.uml.edu/catalog/graduate/policies/Academic_Stand ing.htm.
3. No University-funded teaching/research assistantship may be awarded to a master’s degree candidate if he/she has completed the total number of credits required for his/her program.
4. Level III teaching/research assistantships may only be awarded to graduate students who have reached doctoral candidacy (i.e. completed all course work, oral/written and language examinations) and are enrolled in dissertation research.

Teaching and Research Assistants are awarded either a semester or a yearly contract. The current negotiated agreement between The University of Massachusetts Lowell Board of Trustees and the Graduate Employee Organization is posted on the Human Resources website. Current stipend levels may be found there as well.

Graduate Student Assistantships

A limited number of student assistantships may be available in the departments. Students in this category are paid an hourly rate and are obligated to pay their own tuition and fees. All queries concerning assistantships should be directed to the graduate coordinator (https://www.uml.edu/Grad/Accepted-Students/coordinators.aspx) (www.uml.edu/Grad/coordinators.aspx for a list). Research assistantships are available through special arrangements with individual research advisers. Individuals interested in research assistantships should contact departmental faculty members concerning the availability of this form of financial aid.

Master’s Degree Requirements

Advising

General Requirements for the Master's Degree

Research Option for the Master's Degree

Research Project

Thesis

ThesisCommittee

Thesis Preparation

Thesis Defense

Students Continuing on to a Doctoral Program

Advising

An entering graduate student should meet with the departmental graduate coordinator as soon as possible after arrival on campus. The coordinator will:

1. Help design and then approve the student’s complete program leading to the master’s degree.
2. Recommend course credits from within and outside the University for transfer into the student’s degree program.
3. Monitor the student’s progress toward the degree, which must be completed within a five-year time period in most programs (See Time for Limit for Degree Completion).

General Requirements for the Master’s Degree
To be recommended for a masters degree, a candidate must satisfy all requirements of the University and the specific requirements of the department in which he or she is enrolled. The requirements of the University are listed below, and the specific requirements established by the various departments may be found in the section describing the particular programs.

A candidate for the master’s degree must complete the following within five years of matriculation in order to receive the degree: (Note: Master’s degrees which require 45 or more credits have a limit of six years.)

1. A course of study designed by the department in which he or she is enrolled and approved by the University. The course of study must have a minimum of 30 credit hours of graduate work including, where applicable, a thesis or project in the student’s chosen field.

2. A student must successfully pass an oral or written examination on his or her complete master’s program if required by the department.

3. Satisfactory grades in all subjects offered for the degree must be earned (See Academic Standing).

4. All financial obligations, including tuition, fees, and expenses, must be satisfied as evidenced by completion and submission of a signed Graduate Degree Clearance form to the Registrar’s Office.

Research Option for the Master’s Degree

If required by the program, a student must complete a master’s project or a thesis. The proposal must be approved by the department in which the student is enrolled and the final project or thesis must be of graduate level quality.

Project

The project must consist of a scholarly investigation, such as a review, report, synthesis, design or experiments in the student’s field resulting in a comprehensive written document. Usually, if a student chooses the project option, he or she is required to take additional course credits. Each project is awarded only three to four credits and is intended to be completed within the time limit of one semester. If the work for a project is not completed by the end of the semester, the instructor will give the student an Incomplete which is to be treated the same as an incomplete for a regular course.

Thesis

The requirements for a thesis are much more extensive, including the completion of acceptable research and its defense before a thesis committee. The completed thesis must conform to the format specified in the "Thesis Guide" which is available in the Registrar’s Office. The time required for completion may vary; if a student has not completed the thesis by the end of the semester, but is making satisfactory progress, he or she is given the grade of "PR". If the student requires the use of university resources to continue thesis research, but has completed the required number of credits for the master’s thesis, he or she may sign up for 3, 6, or 9 credits of Continuing Graduate Research (see Course Descriptions). However, if the student is not using University resources, but is in the process of writing the thesis, he or she may register for Continued Matriculation for the semester(s) during which the work is completed. Continued Matriculation is available to international students only under special circumstances. International students should contact the International Student Office for more information and to make sure they comply with visa and immigration regulations.

Upon successful completion of the thesis, the grade of "S" will be awarded for the all semesters in which the student is registered for thesis research. Only the Registrar’s Office can issue this grade.

Thesis Committee

As soon as a student has chosen an area of research, a Thesis Committee is selected by the student and his or her research advisor in accordance with the policy of the department. The Thesis Committee shall consist of at least three members, at least two of whom shall be from the student’s major department. One member of the committee shall be the student’s thesis advisor. An outside expert, such as the supervisor of a research project conducted at an industrial setting or a faculty member from another institution, may be a member of the committee, but that individual must possess academic credentials which would qualify him or her to serve as a member of the University of Massachusetts Lowell faculty. The responsibilities of the Thesis Committee shall be to:

1. Approve the research topic.
2. Supervise the progress of the thesis.
3. Read, evaluate and approve or disapprove of the written thesis.
4. Hear, evaluate and approve or disapprove of the oral defense of the thesis.
5. Report the completion of all thesis requirements to the department and the Registrar’s Office.
Thesis Preparation

Every graduate student who completes a thesis is required to bear the cost of binding two copies of the manuscript for the University's files. Copy writing is optional and available for an additional fee.

Thesis Defense

Two weeks prior to the thesis defense, announcements of the defense listing the candidate's name, thesis title, and place and time of the defense, must be submitted to the chairperson of the department, the college dean, and the Registrar's Office, and posted and distributed throughout the University. The defense is open to the public.

For Students Continuing on to a Doctoral Program

Students accepted into a master’s degree program who decide to continue on for the doctorate but want to first complete their master’s degree must adhere to the following procedure.

1. The student must complete all required courses, compile a 3.0 grade point average, and successfully defend his/her thesis, if required.
2. The student must complete the Registrar’s Office clearance process for the master’s degree.
3. A student is prohibited from enrolling in doctoral research until he or she has completed the clearance process for the master’s degree.
4. The student must then apply to the doctoral program by completing the standard Graduate Admissions application process.
5. Official admission into a doctoral program and receipt of a letter of acceptance are contingent upon completion of the clearance process for the master’s degree.

Admission Requirements

The general requirements for admission to graduate study at the University are listed below.

1. The applicant must show official evidence of having earned a baccalaureate degree or its U.S. equivalent from an accredited college or university. If an international transcript does not adequately demonstrate that an applicant has the equivalent of an American bachelor’s or master’s degree, the Office of Graduate Admissions will require such verification by an independent service such as the Center for Educational Documentation (http://www.cedevaluations.com/), (www.cedevaluations.com) Boston, MA (617-338-7171).
2. The degree must have been earned with a satisfactory scholastic average to demonstrate that the applicant has had adequate preparation for the field in which graduate studies are to be undertaken.
3. The applicant must have obtained a satisfactory score on the appropriate entrance examination required for admission by the program or department to which admission is sought. The official score report must be submitted; a photocopy of the examinee’s report is unacceptable. Unless otherwise stated under a specific program description, the required examination is the Graduate Record Examination General Test.
4. The Commonwealth of Massachusetts requires that all full-time graduate students (9 or more credits) must be immunized against measles, mumps, rubella, tetanus, and diphtheria. In addition, all students in programs in the
health professions, regardless of age or enrollment status, must show proof of immunization. Students will not be permitted to register for courses at the University unless proof of immunization has been sent directly to the Director of Health Services (http://www.uml.edu/student-services/health/).

University of Massachusetts Lowell, Lowell, MA 01854 (978-934-4991).

Departmental Requirements

The rules, regulations, and policies delineated by the University constitute only the minimum requirements for admission, retention, and graduation. Each department may have additional requirements mandated by the unique nature of its programs. It is the responsibility of the graduate student to be aware of the minimum requirements of the University and, in addition, to fulfill the special requirements of the particular program in which he or she is enrolled.

Learning Outcomes Assessment Policy

In keeping with the University's commitment to excellent educational experiences and high-quality programs for its students, and consistent with practices at other institutions within the state and nationally, UMass Lowell routinely engages in the assessment of student learning at the course, program, institution ans systems levels. The learning outcomes assessment process may include a variety of methods such as standardized tests, student surveys and focus groups, campus developed instruments, and a review of student work. In circumstances beyond the individual course level, the identity of the student will be protected. In circumstances beyond the individual course level, the identity of the student will be protected. The student’s name, grade or other identifying information will be removed before the student work is reviewed. Selected student work may be subject to review by a limited cohort of higher educational personnel, primarily faculty. Assessment of student learning is undertaken primarily for the purpose of improving student learning, curriculum development, instructional improvement, and enhancing student academic success. Assessment activities will have absolutely no effect on a student’s grade, academic standing, ability to transfer, or ability to be graduated. UMass Lowell will take all necessary steps to ensure the confidentiality of all student records and student work reviewed through this process in accordance with FERPA regulation.

Application Procedure

- Departmental Requirements
- Application Procedure for Graduate Admissions
- Conventional Application
- Application Deadline
- Types of Admission
- Status as a Graduate Certificate Candidate
- Non Degree Status
- Graduate Readmission/Deferral Policy

General Admissions Requirements

The general requirements for admission to graduate study at the University are listed below.

1. The applicant must show official evidence of having earned a baccalaureate degree or its U.S. equivalent from an accredited college or university. If an international transcript does not adequately demonstrate that an applicant has the equivalent of an American bachelor’s or master’s degree, the Office of Graduate Admissions will require such verification by an independent service such as the Center for Educational Documentation (http://www.cedevaluations.com/), (www.cedevaluations.com) Boston, MA (617-338-7171).

2. The degree must have been earned with a satisfactory scholastic average to demonstrate that the applicant has had adequate preparation for the field in which graduate studies are to be undertaken.

3. The applicant must have obtained a satisfactory score on the appropriate entrance examination required for admission by the program or department to which admission is sought. The official score report must be submitted; a photocopy of the examinee’s report is unacceptable. Unless otherwise stated under a specific program description, the required examination is the Graduate Record Examination General Test.

4. The Commonwealth of Massachusetts requires that all
full-time graduate students (9 or more credits) must be immunized against measles, mumps, rubella, tetanus, and diphtheria. In addition, all students in programs in the health professions, regardless of age or enrollment status, must show proof of immunization. Students will not be permitted to register for courses at the University unless proof of immunization has been sent directly to the Director of Health Services, University of Massachusetts Lowell, Lowell, MA 01854 978-934-4991.

Departmental Requirements

The rules, regulations, and policies delineated by the University constitute only the minimum requirements for admission, retention, and graduation. Each department may have additional requirements mandated by the unique nature of its programs. It is the responsibility of the graduate student to be aware of the minimum requirements of the University and, in addition, to fulfill the special requirements of the particular program in which he or she is enrolled.

Application Procedure for Graduate Admission

Applicants to graduate programs are encouraged to apply online. Apply now with our Online Application. (https://sa-webapp-prd.erp.umasscs.net/psc/webapp/EMPLOYEE/HRMS/c/UM_WEBAPP_MENU.UM_ADM_APP_LOGIN.GBL&instituion=UMLOW&CertiCareerGRAD&CenterGRAD%2727?&

- Conventional Application
- Application Deadline
- Types of Admission
- Status as a Graduate Certificate Candidate
- Non-Degree Status
- Graduate Readmission/Deferral Policy
- Acceptance of Foreign or American Master’s Degree Toward Doctoral Requirement
- Transfer Credit
- Graduate Equivalency Credit

Master’s &Doctoral Application Information

Application forms and materials may be obtained from:

The Office of Graduate Admissions
University of Massachusetts Lowell

Cumnock Hall, Suite 110
One University Avenue
Lowell, MA 01854
978-934-2390 or 1-800-656-GRAD
www.uml.edu/grad (https://www.uml.edu/Grad/default.aspx)

A non-waivable and non-refundable application fee must be received before the application is processed. Each applicant must file the following documents:

1. A completed application form.
2. Official transcripts of all undergraduate and graduate records.
3. Three letters of recommendation written by individuals qualified to judge the ability of the applicant to carry on graduate work and research.
4. Official scholastic test scores specified for various degree programs at the University (see individual departmental requirements). An applicant who has earned a graduate degree from an accredited university may petition the department graduate coordinator to waive the scholastic test requirements (e.g. GRE).
5. The official score report for the “Test of English as a Foreign Language” (TOEFL) for students from countries where English is not the national language. If the TOEFL bulletin cannot be obtained locally, students should write well in advance to:

Test of English as a Foreign Language
Box 6151
Princeton, NJ 08541-6151, U.S.A.

All test scores must be official and sent directly by the testing agency.

Application Deadline

The University of Massachusetts Lowell Graduate Admissions Office has a "rolling admissions" policy. However, some programs have early, fixed application deadlines. Consequently, the applicant is strongly urged to contact the department of interest to determine the last date on which applications may be received. In general, early applications will ensure that all materials are processed on time and that a student who wishes to apply for a teaching assistantship will be given due consideration. Many programs will fill available openings several months before the beginning of the semester. A student who has been accepted into a graduate program...
must attend within a year of acceptance or may, at the discretion of the department, be required to submit a new application. Application files for individuals who do not matriculate will be retained for only two years from the date of application.

Types of Admission

A student may be admitted to graduate study at the University of Massachusetts Lowell under one of the two classifications listed below.

1. Matriculated status: A student who has met all requirements for admission to a degree program and who has been recommended by the department in which he or she proposes to study as a degree candidate.

2. Matriculated with conditions: A student who has not fully met the requirements stipulated by the program may be admitted as a prospective candidate for a degree with specified conditions to be met in the future. Such a student must have as an initial objective the satisfactory completion of all requirements for full matriculation.

Graduate Certificate Candidate Application Information

Graduate certificate programs are designed for students holding a baccalaureate degree in a field related to the certificate program. A student who wishes to apply to a certificate program must complete the Graduate Certificate Application (https://www.uml.edu/Grad/programs/about-certificates.aspx), submit the appropriate application fee, and submit an official transcript indicating the conferral of a Bachelor’s degree. The graduate record exam (GRE) and letters of recommendation are not required.

A student in a certificate program who wishes to enroll in a master’s or doctoral program is ineligible to receive credit towards a degree until he or she files a formal application and is then admitted as a matriculated student.

The maximum number of graduate credits a student may complete while enrolled in a graduate certificate is 12 credits.

Non-Degree Status

An individual without advanced degree objectives may take courses in certain programs with non-degree status. A student who wishes to take courses as a non-degree student must submit an official transcript indicating the conferral of a Bachelor’s degree. A student in non-degree status is ineligible to receive credit towards a degree until he or she files a formal application and is then admitted as a matriculated student.

The maximum number of graduate credits a student may complete with non-degree status is 12 credits.

NOTE: International students are not eligible for non-degree status.

Graduate Readmission/Deferral Policy

1. A matriculated student who formally withdraws in good standing from the university may request readmission within two years by completing only the cover page of the graduate application.

2. A newly accepted student dropped from a graduate program for failure to register may be re-admitted by submitting a new application cover page and fee within two years of acceptance date.

3. A matriculated student who fails to maintain continuous enrollment and has not formally withdrawn may be readmitted by submitting a new application cover page and fee within two years of being dropped from the program.

4. A student may request a deferment of enrollment up to one year beyond the date when he or she was scheduled to begin his or her graduate program. If the one-year time period is exceeded, the student must submit a new application and fee. Deferral must be requested before the start of the semester for which the student is accepted.

Professional Leadership Certificate

About the Program

The Professional Leadership certificate is a useful credential for science, engineering and technology professionals in the private and public sectors who wish to advance to managerial and/or move to more business related positions within their organizations. This is a 12 credit (four courses, three credits per course) program.

Admission Requirements

1. Bachelors degree in science, engineering, technology or mathematics.

2. Minimum of two years post-baccalaureate work
Curriculum

This program consists of four masters level courses (3 credits each), with three courses in the professional leadership area and one advanced course in the individuals field of expertise. For qualified individuals, the 12 earned graduate credits are transferable to a related Professional Science Masters graduate program with the approval of the appropriate graduate program coordinator.

Required Professional Courses: (three credits each all are online courses)

- PSM 535 Project Management for Science Professionals
- PSM 545 Professional and Scientific Communication
- PSM 555 Professional Science Leadership

One business course may be substituted for one of the above courses, with approval of the program advisor.

Required Science, Engineering, or Technology Course (three credits) One graduate level course within the students academic discipline, to be chosen with the approval of the appropriate Graduate Coordinator, is required.

Contact

Email:

Deborah White
(mailto:Deborah_White@uml.edu)

Phone: 978-934-2173

UMass System Graduate Programs

UMass Lowell offers two intercampus programs drawing on the strengths of the whole UMass System.

Marine Science

- Biomedical Engineering & Biotechnology Program

Colleges & Degrees of Graduate Study

- Manning School of Business
- Graduate School of Education (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- College of Engineering
- College of Fine Arts, Humanities & Social Sciences
- School of Health & Environment
- College of Sciences
- UMass System Graduate Programs

Graduate Programs

UMass Lowell offers more than three dozen master’s programs, including Education Specialist (Ed.S.) post-graduate programs. Many of our programs have non-thesis options. If you're not ready to matriculate into a full program, consider our certificate programs. If you are looking for a doctoral program, we offer more than two dozen in a wide range of disciplines.

Online Graduate & Undergraduate Degrees & Part-Time Programs

UMass Lowell offers a number of

graduate degrees and certificates (http://continuinged.uml.edu/degrees/Graduate.htm) and

part-time undergraduate degrees and certificates (http://continuinged.uml.edu/degrees/Undergraduate.htm) entirely online, or as a mix of online and on-campus courses through its Division of Online and Continuing Education. By making the courses available online - during the evening and on weekends - the University makes it easier for busy professionals to fit education into their lives.
General Regulations for Graduate Students

Each University student is subject to two sets of academic regulations - those of the University as a whole, which are cited in this section, and the academic rules of the college and program in which he or she is enrolled. The academic rules of colleges and programs are listed in sections devoted to college programs.

In registering for courses, each student assumes full responsibility for knowledge of and compliance with the definitions, regulations, and procedures for the University, as set forth in this publication. Moreover, in accepting admission to the University, each student assumes responsibility for knowledge of and compliance with the definitions, regulations, and procedures of the University pertaining to his or her student status as set forth in the appropriate UML publications.

Students who have questions about the interpretation or application of University academic policy should consult the dean of their college or the Vice Provost for Graduate Education.

Academic Integrity Policy

UNIVERSITY OF MASSACHUSETTS LOWELL POLICY AND PROCEDURES RELATING TO STUDENT ACADEMIC INTEGRITY AND MISCONDUCT

I. Statement of Principles: The University has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty. Students are responsible for the honest completion and representation of their work, for the appropriate citation of sources, and for respect of others academic endeavors. Academic dishonesty is prohibited in all programs of the university.

II. Academic Misconduct Subject to Disciplinary Action:

(1) Academic misconduct is an act in which a student:

(a) Seeks to claim credit for the work or efforts of another without authorization or citation;
(b) Uses unauthorized materials or fabricated data in any academic exercise;
(c) Forges or falsifies academic documents or records;
(d) Intentionally impedes or damages the academic work of others;
(e) Engages in conduct aimed at making false representation of a students academic performance; or
(f) Assists other students in any of these acts.

(2) Examples of academic misconduct include, but are not limited to: cheating on an examination; collaborating with others in work to be presented, contrary to the stated rules of the course; submitting a paper or assignment as ones own work when a part or all of the paper or assignment is the work of another; submitting a paper or assignment that contains ideas or research of others without appropriately identifying the sources of those ideas; getting unauthorized access to examinations or course materials; submitting, without the permission of the current instructor, work previously presented in another course; tampering with the laboratory experiment or computer program of another student; knowingly and intentionally assisting another student in any of the above, including assistance in an arrangement whereby any work, classroom performance, examination or other activity is submitted or performed by a person other than the student under whose name the work is submitted or performed.

III. Possible Disciplinary Sanctions:

(1) The following are the disciplinary sanctions that may be imposed by an instructor for academic misconduct:

(a) An oral or written notice of misconduct;
(b) An assignment to repeat the work, to be graded on its merits;
(c) A lower or failing grade on the particular assignment or test;
(d) A lower grade in the course;
(e) A failing grade in the course;

In addition, an instructor or the Academic Dean may recommend the following sanctions:

(f) A non-deletable failing grade in the course;
(g) Suspension from the University; (h) Expulsion from the university.

Sanctions f  h are imposed by the Office of the Provost.

(2) One or more of the disciplinary sanctions listed above may be imposed for an incident of academic misconduct.

IV. Definitions

As used herein:

(1) Office of the Provost means the Provost, Vice Provost or a designee.
(2) Days means academic calendar days and excludes Saturdays, Sundays, legal holidays and days upon which the university is closed.
(3) Academic Dean means the Academic Dean or designee for the college in which the subject course is taught.
(4) Instructor refers to the Instructor of Record.
(5) Minor Disciplinary Sanction means a disciplinary sanction, identified in paragraph III (1) (a)-(e) and imposed, for academic
misconduct, upon a student by an instructor.

(6) Major Disciplinary Sanction means a disciplinary sanction, identified in paragraph III (1) (f)-(h) and imposed, for academic misconduct, upon a student by the Office of the Provost or the Academic Integrity Appeals Board upon the recommendation of the instructor or the Academic Dean or imposed at the discretion of the Office of the Provost.

(7) Notice to the student, whenever required herein, shall be e-mailed to the students official student.uml.edu e-mail address or mailed to the student by regular first class United States mail at his or her current address as maintained by the university.

V. Imposition of Disciplinary Sanctions by the Instructor:

(1) Where an instructor concludes that a student enrolled in one of his or her courses has engaged in academic misconduct, the instructor may impose one or more of the following disciplinary sanctions, as listed under paragraph III, subsections (a) through (e):

(a) An oral or written notice of misconduct;
(b) An assignment to repeat the work, to be graded on its merits;
(c) A lower or failing grade on the particular assignment or test;
(d) A lower grade in the course;
(e) A failing grade in the course.

(2) When possible, prior to imposing a minor sanction, the instructor shall notify the student that the instructor believes an act of academic misconduct has occurred, that a sanction may be imposed, and that a Notification of Academic Dishonesty Form will be filed with the Office of the Provost.

(3) Upon the imposition of a minor sanction under this section, the instructor shall notify the Office of the Provost. Notification to the Office of the Provost shall occur within 10 days, using the Notification of Academic Dishonesty Form (http://www.uml.edu/docs/notificationofacademicdishonesty_tc_m18-3543.pdf), and shall include identification of the student, a description of the misconduct and a specification of the sanction imposed.

(4) Within 10 days following receipt of such notice, the Office of the Provost shall provide notice of the imposed discipline to the student, the instructor and to the Academic Dean. Notification to the student shall include a statement of the misconduct, specification of the sanction imposed, a statement indicating the students right to an appeal before the Academic Dean and a link to the policy and procedures set forth herein.

VI. Recommendation of Major Disciplinary Sanction by the Instructor:

(1) Where an instructor concludes that a student enrolled in one of his or her courses has engaged in academic misconduct in the course, the instructor for that course may recommend one or more of the following disciplinary sanctions:

(f) A non-deletable failing grade in the course;
(g) Suspension from the University;
(h) Expulsion from the university.

(2) When possible, prior to the recommendation of a major sanction, the instructor shall notify the student that the instructor believes an act of academic misconduct has occurred, that a major sanction is being recommended, and that a Notification of Academic Dishonesty Form will be filed with the Office of the Provost.

(3) Upon the recommendation of a major sanction under this section, the instructor shall notify the Office of the Provost using the Notification of Academic Dishonesty Form (http://www.uml.edu/docs/notificationofacademicdishonesty_tc_m18-3543.pdf). Notification to the Office of the Provost shall occur with 10 days and shall include identification of the student, a description of the misconduct and a specification of the sanction recommended.

(4) Within 10 days following receipt of such notice, the Office of the Provost shall provide notice of the recommended discipline to the student, the instructor, and the Academic Dean. Notification to the student shall include a statement of the misconduct, specification of the sanction recommended, a statement indicating the students right to an appeal before the Academic Dean and a copy of the policy and procedures set forth herein.

(5) A student who receives notice of a disciplinary sanction recommended under this section has the right to a hearing before the Academic Dean to contest the determination that academic misconduct occurred or the disciplinary sanction recommended or both. If the student desires such a hearing, he or she must file a written request with the Office of the Provost and the Academic Dean within 10 days of receipt of notice from the Office of the Provost.

(6) In the event that the student does not file a written request for an appeal within 10 days, the Office of the Provost shall review the matter with respect to the subject student and may, at his or her discretion, uphold the recommended sanction or impose a major sanction. In any event, the Office of the Provost shall, within a reasonable time, provide notice of the outcome to the student, the instructor and to the Academic Dean.
modify the sanction recommended. In any event, the Office of the Provost shall, within a reasonable time, provide notice of the outcome to the student, the instructor, and to the Academic Dean.

VII. Appeal to the Academic Dean: When an appeal to the Academic Dean is commenced in accordance with the provisions set forth in Paragraphs V(5) or VI(5), the Academic Dean shall proceed in accordance with this section to consider one or more of the disciplinary sanctions listed in paragraph IV, subsections (1) (a) through (h).

(1) Conference With Student: The Academic Dean shall offer to discuss the matter with the student. The purpose of this discussion is to permit the Academic Dean to review with the student the charges levied against him or her and to afford the student an opportunity to respond.

(2) Conference With Instructor: The Academic Dean shall attempt to discuss the matter with any involved instructor. This discussion may occur either before or after the conference with the student. It should include consultation with the instructor on the facts underlying the alleged academic misconduct and on the appropriateness of the imposed or recommended sanction.

(3) Determination that No Academic Misconduct Occurred: If, as a result of discussions under subsections (1) and (2), the Academic Dean determines that academic misconduct did not in fact occur or that the disciplinary sanction is not appropriate under the circumstances, the Academic Dean shall notify the instructor and the Office of the Provost. The Office of the Provost shall promptly thereafter notify the student and take appropriate action with respect to the student records.

(4) If, as a result of discussions under subsections (1) and (2), the Academic Dean determines that academic misconduct did occur and that one or more of the disciplinary sanctions listed under paragraph III, subsections (1) (a) through (h) is appropriate, the Academic Dean shall prepare and forward to the Office of the Provost, within 10 days, a written Finding of Misconduct which shall include identification of the student, a description of the alleged misconduct, a summary of evidence, findings of fact and a specification of the disciplinary sanction imposed.

VIII. Appeal to the Office of the Provost

The decision reached by the Academic Dean may be appealed to the Provost Office of the Provost if the student believes that he or she did not receive due process.

Grounds for Appeal of Due Process

An appeal to the Office of the Provost shall be limited to a review of supporting documents and the process and outcome of the Academic Dean or designee for one or more of the following grounds:

- Bias by the Instructor, Academic Dean, or designee substantially influenced the outcome of the process to the detriment of the student.
- New, relevant information has come to light that was not available at the time of the hearing by the Academic Dean.
- Unusual procedures were followed or the procedures outlined herein were not followed, to the detriment of the student.
- If the student desires such a hearing, he or she must file a written request with the Office of the Provost and the Academic Dean within 10 days of receipt of notice from the Office of the Provost. The request must be based upon the Grounds for Appeal listed above.

(2) When an appeal to the Office of the Provost is commenced in accordance with this paragraph, the Office of the Provost shall review the matter with respect to the subject student and may, at his or her discretion, uphold, vacate or modify the discipline imposed. In any event, the Office of the Provost shall, within a reasonable time, provide notice of the outcome to the student, the instructor, and to the Academic Dean.

(3) In the event that the student does not file a written request for an appeal within 10 days, the Office of the Provost shall review the matter with respect to the subject student and may, at his or her discretion, uphold or modify the discipline imposed. In any event, the Office of the Provost shall, within a reasonable time, provide notice of the outcome to the student, instructor and to the Academic Dean.

IX. Role of the Academic Integrity Appeals Board:

(1) The Academic Integrity Appeals Board is an ad hoc committee appointed by the Office of the Provost and consists of a minimum of three faculty members chosen by the Office of the Provost with no two members selected from the same College; the board shall not include a faculty member from within the department initiating charges of academic dishonesty. The Board is chaired by the Office of the Provost who shall vote only in the case of a tie. [Or One member shall serve as Chair at the direction of the Office of the Provost. The Chair shall vote only in the case of a tie.]

When an appeal is directed to the Academic Integrity Appeals Board by the Office of the Provost in accordance with the provisions set forth in Paragraphs VIII, the Academic Integrity Appeals Board shall schedule the hearing, within a reasonable time period, at a time that is mutually agreed upon by the student, Office of the Provost and members of the Academic Integrity Appeals Board.

(2) Reasonably in advance of the hearing, the Academic
Integrity Appeals Board shall obtain from the Academic Dean, in writing, a full explanation of the facts upon which the determination of misconduct was based and shall provide to the student a copy of the policy and procedures set forth herein.

(3) The hearing before the Academic Integrity Appeals Board shall be conducted in accordance with the following requirements:

(a) The Academic Integrity Appeals Board shall consider relevant evidence including documentary evidence and testimony of the instructor, student, Chair and/or Dean where appropriate.

(b) The student shall have the right to be heard and to present relevant evidence, including documentary evidence and the testimony of witnesses, in his or her own behalf.

(c) The Academic Integrity Appeals Board shall maintain a record of the hearing including any and all pleadings and documentary evidence presented.

(d) The Academic Integrity Appeals Board shall prepare written findings of fact and a written statement of its decision based upon the record of the hearing.

(e) The Academic Integrity Appeals Board may find academic misconduct and impose a sanction of suspension or expulsion only if the proof of such misconduct is clear and convincing. In other cases, a finding of misconduct must be based on a preponderance of the credible evidence.

(f) The Academic Integrity Appeals Board may impose a disciplinary sanction that differs from the recommendation of the Academic Dean.

(g) The instructor or Academic Dean may be witnesses at the hearing conducted by the Academic Integrity Appeals Board, but shall not have responsibility for conducting the hearing.

(4) Determination that No Academic Misconduct Occurred: If, after the hearing, the Academic Integrity Appeals Board determines that there is insufficient evidence that academic misconduct occurred or that no disciplinary sanction is appropriate under the circumstances, the Academic Integrity Appeals Board shall notify the instructor, the Academic Dean and the Office of the Provost. The Office of the Provost shall promptly thereafter notify the student and take appropriate action with respect to the student records.

(5) Process Following Determination by the Academic Integrity Appeals Board that Academic Misconduct Occurred:

(a) If, after the hearing, the Academic Integrity Appeals Board determines that academic misconduct did occur and that one or more of the disciplinary sanctions listed under paragraph III, subsections (1) (a) through (h) is appropriate, the Academic Integrity Appeals Board shall prepare and forward to the Office of the Provost, within 10 days, a written Finding of Misconduct which shall include identification of the student, a description of the misconduct and a specification of the disciplinary sanction to be imposed.

(b) Within 10 days following receipt of the written Finding of Misconduct from the Academic Integrity Appeals Board, the Office of the Provost shall provide written notice of the imposed discipline to the instructor, the Academic Dean and the student.

Academic Standing

- Warning Notice
- Probation
- Academic Dismissal and Reinstatement
- Graduate Fresh Start

GPA Minimum

No more than 6 course credits of grades below a B may be counted toward the master’s degree; no more than 9 credits of the same grades may be counted toward the doctorate. No graduate degree will be awarded to any student whose overall cumulative grade point average falls below 3.0.

Academic Standing

Graduate academic standing is run three times per year - Fall, Spring and Summer.

The consequences of the academic standing of warning or suspension will not apply for students completing degree requirements for that semester.

Warning Notice

Any graduate student whose semester grade point average (GPA) falls below 3.0 will automatically receive a warning notice which will also be sent to the graduate coordinator, and filed with the student's record in the Registrar's Office. The student will be strongly advised to meet with the graduate coordinator or his/her designee within 30 days of receipt of the warning notice and develop an academic plan to bring his or her GPA to a level above 3.0.

Probation

Any graduate student whose semester GPA falls below 3.0 for a second time, will automatically receive a letter of probation from the Vice Provost for Graduate Education. Copies of the
letter will be sent to the graduate coordinator, chairperson, college dean, and also placed on file with the student’s record in the Registrar’s Office. Within 30 days, the department graduate committee, chaired by the graduate coordinator or his/her designee, will meet with the student and decide whether to recommend loss of degree candidacy. Such a decision or other course of action will be fully documented in writing with copies sent to the chairperson, and college dean. A recommendation of loss of degree candidacy and dismissal are subject to the approval of the college dean.

Academic Dismissal and Reinstatement

Any student whose semester GPA falls below 3.0 for a third time, and whose cumulative GPA is below 3.0, will automatically be dismissed from his or her graduate program and the University. Reinstatement will be considered if the student provides a detailed justification and academic plan concerning how he or she will correct this academic deficiency. The plan must be attached to a Graduate Academic Petition and approved by the graduate coordinator, chairperson, the college dean, and the Vice Provost for Graduate Education or his/her designee. If any of the above individuals disapproves of the reinstatement, the dismissal will remain in effect and no subsequent appeals will be considered.

Independent of the warning/probation/dismissal system, the dean of the college where the student’s degree program resides may at any time examine the performance of any student not meeting the academic standard expected of graduate students within that college and recommend to the appropriate graduate committee a course of action including dismissal.

For the procedure for formal adjudication of any academic issues (non-misconduct) which may arise, please see University Appeals Process Regarding Academic (non-misconduct) Issues of Graduate Students.

Graduate Fresh Start

Master and Doctoral degree candidates and non-degree students who have been absent from the University for four years or longer may be readmitted under the program Graduate Fresh Start. If admitted into a degree granting program, under the terms of Graduate Fresh Start, a returning graduate student will be treated as if s/he were a new student. A maximum of two courses (six credits) at the 500 level or higher completed during earlier periods of enrollment with grades of “B” or better may, with the approval of the degree granting department, be transferred into the degree program. These courses must be transferred via an academic petition and will be accepted toward graduation but not included in the cumulative grade point average (GPA). Thesis and dissertation research credits are ineligible for transfer. Courses completed during earlier periods of enrollment with grades below "B" are not eligible for transfer. A student may be readmitted under the Graduate Fresh Start program only once at the graduate level.

Students who wish to be considered for the Graduate Fresh Start Program must follow the normal procedures for admission to the University and file a Graduate Fresh Start Contract (https://www.uml.edu/docs/GraduateFreshStart16_tcm18-229433.pdf). Academic Petitions for transfer credits must be approved by the appropriate graduate coordinator and/or department chair of the degree granting department, and must be filed with the University Registrar. In addition, the student must submit a personal statement which addresses personal and professional growth during the period of time in which the student was absent from the University which supports the student potential for academic success. If admitted, credits and GPA start at zero. Transfer courses may count towards the degree, but are not included in the GPA.

All courses taken and grades achieved during earlier periods of enrollment will appear on the transcript along with a notation that they are not included in the cumulative grade point average. Once this change is made to the academic record, the change can NOT be reversed.

Acceptance of Foreign or American Master’s Degree toward Doctoral Requirements

Students accepted into a doctoral program who hold a master’s degree in the same or a closely related discipline from a U.S. or foreign academic institution will have their transcripts and supporting documentation reviewed by the department graduate committee.

The committee may choose one of the following actions:

1. Approve all coursework and thesis for the master’s degree up to the total number of credits granted by the University of Massachusetts Lowell department for its master’s degree, and thereby require the student to complete only “beyond the master’s” course/thesis credits for the doctorate.
2. Accept the U.S. or foreign master’s degree, but because of deficiencies in the student’s master’s program, require a limited number of graduate courses to be added to the total credits required for doctoral degree completion “beyond the master’s”.
3. Require that a student with a U.S. or foreign master’s degree obtain a University of Massachusetts Lowell master’s degree before proceeding to the doctorate.

All coursework for U.S. or foreign master’s degrees considered for approval by the department must be at a grade level of B or
better. Official, documented verification of the degree awarded must also be provided.

Commencement

Conferring of Degrees

Academic Honors

Replacement Diploma

Commencement

Graduation exercises are held once a year at the end of the spring semester. Students who have completed degree requirements during the previous summer term or fall semester are permitted to attend commencement exercises, and their names are listed in the commencement booklet. Attending commencement exercises is not compulsory. An individual who wishes to receive a diploma by mail must notify his/her college dean and file a corrected address through student self service if he or she anticipates moving from a previously reported permanent address.

Conferring of Degrees

- In June for students completing degree requirements during the spring semester.
- In October for students completing degree requirements during the summer term.
- In February for students completing degree requirements during the fall semester.

Individuals who wish to submit verification of degree completion to employers or to graduate schools during the period between the end of their final grading period and the awarding of diplomas may obtain a letter of completion from the Registrars Office.

Academic Honors

Due to the many fields and diversity of study at UMass Lowell, academic honors for graduate students are discipline-based and vary within respective colleges. Honors for graduate students are not listed on transcripts.

Replacement Diploma

Replacement diplomas may be ordered through University Alumni Relations for an additional fee.

Course Credit

Maximum Semester Credit Limit

Graduate Credit for Undergraduate Courses

Undergraduate Credit for Graduate Courses

Maximum Semester Credit Limit

The usual course load for full-time graduate students is 9 credits/semester. Depending upon the program requirements and abilities of the student, individuals may carry more than 9 credits each semester. However, the absolute maximum number of total credits (combined undergraduate and graduate) for which a graduate student will be allowed to register is 18 credits/semester. The maximum number of thesis or dissertation credits for which a student may enroll in any semester is nine credits.

During the summer term students are classified as full-time when they are registered for a minimum of 9 credits which may combine courses/credits from the different sessions within the summer term. Students who enroll in only one of the accelerated summer session (summer I or summer II) may be considered by the institution as the equivalent to full-time for the specific time period of that session only when registered for a minimum of 6 credits. This is for enrollment purposes only. Please note: Financial aid, veterans benefits or other types of aid define 9 credits for full-time study.

Navitas Summer Pathway Program

The University of Massachusetts Lowell (UMass Lowell) offers a 10-week summer session to its Pre Undergraduate and Pre Masters international students. These students are admitted into a Bachelors or Masters program with the condition of a preparatory semester(s) which could encompass the summer session. The Pre Undergraduate and Pre Masters summer session consists of intensive academics of 18-22 clock hours per week in English, Mathematics and Cultural Support.

Graduate Credit for Undergraduate Courses

UMass Lowell courses at the 400 level are designed for seniors but under certain circumstances may be taken by graduate students for graduate credit. A maximum of 6 credits of 400 level courses may be used for credit toward the graduate degree with the permission of the degree granting department. Three hundred level courses and below are never counted toward a graduate degree. If a graduate student takes certain undergraduate courses to make up for background deficiencies or to satisfy language requirements, the course credit hours are not used as part of the graduate degree program but will appear on the graduate transcript.

Undergraduate Credit for Graduate Courses

A qualified junior or senior may take a course at the 500 level for undergraduate credit in accordance with the policy and
procedures of the department or college in which the course is
offered. The grade received in any such course is used in
calculating the undergraduate’s cumulative grade point
average. Counting of graduate credits for both the bachelors
and masters degrees is subject to departmental requirements.

At no time may grades computed in an undergraduate GPA be
used toward a graduate GPA.

Course Designations

- Course Numbering System
- Continuing Graduate Research
- Course Prefixes
- Audit

Maximum Semester Credit Limit

The usual course load for full-time graduate students is 9
credits/semester. Depending upon the program requirements
and abilities of the student, individuals may carry more than 9
credits each semester. However, the absolute maximum
number of total credits (combined undergraduate and
graduate) for which a graduate student will be allowed to
register is 18 credits/semester. The maximum number of thesis
or dissertation credits for which a student may enroll in any
given semester is nine credits.

Course Numbering System and Designation:

- 4000-4999 - Undergraduate courses usually designed for
  juniors or seniors; no more than six credits may be taken
  for graduate credit with the permission of the graduate
  coordinator.
- 5000-5999 - Courses for graduate credit, but which may
  be taken by advanced undergraduates with the advisor’s
  permission.
- 6000-6999 - Graduate courses which are open only to
  graduate students.
- 7000-7999 - Seminars, special topic courses, projects, or
  thesis research for advanced candidates in master’s and
doctoral degree programs.

Each course offering is designated by a four letter prefix and a
four-digit course number (e.g., BIOL.5290).

Continuing Graduate Research

Once a student has completed the required number of credits
for master’s or doctoral thesis/dissertation research with grades
of PR or S (see summary of degree credit requirements), he or
she will not be allowed to sign up for additional
thesis/dissertation research credits. Instead, if required for
Teaching/research assistantships or immigration/visa purposes,
the student may enroll in 3, 6, or 9 credits of Continuing
Graduate Research designated _ _763, 766, or 769 _ _ where
the first two blanks represent the departmental designation, 3,
6, and 9 indicate the respective number of credits, and the last
three blanks are the standard numbers which code to a
particular faculty member in the department.

The two digit college prefix identifies a college department
and/or special area. The three-digit course number identifies
the course level.

Course Prefixes

Each college department and/or special subject area has been
assigned an identifying two digit number within the numerical
ranges specified as follows:

- Education - EDUC
- Engineering - CHEN, CIVE, EECE, ETEC, ENVE &MECH,
  MTEC, ENGY, ENGN, PLAS
- Health - PUBH &AREO, HSCI, NURS, DPTH, NUTR, HSCI,
  MLSC, EXER
- Humanities/Social Sciences, Fine Arts - AMST, LGST,
  ENGL, HIST, CRIM, PHIL, POLI, PSYS, ASP, SOCI, ECON,
  WLF, LGWE, WLIT, WLAR, WLKH, WLCH, WLPO,
  WLAN, WLSI, WLSP, WLLA, ARHI, FAHS &ARTS, MUTH,
  MUAP_MUED, MUHI, MUPF, MUEN,MUBU, MUSR, AEST
- Management - ACCT, FINA, MKTG, POMS, MIST, ENTR,
  MGMT, BUSI
- Science and Math - BIOL, LIFE, CHEM, ATMO, ENVI,
  GEO, INFO, COMP, MATH, MSIT, PHYS, POLY, RADI
- Biomedical Engineering - BMBT
- Marine Science - im

Audit

A graduate student may, upon approval of the advisor and the
instructor, register for a course on an audit basis, but must pay
the full amount of tuition and fees. An audit student is not
required to take tests or the final examination. A change in
registration from audit to credit or credit to audit must be done
during the add/drop period. Under no circumstances can a course taken for audit be given credit at a later date.

**Equal and Fair Treatment**

Under federal and state laws, all students are protected from discrimination based on race, color, religion, national origin, disability, gender, (including sexual harassment), age, sexual orientation, marital or veteran status. If you feel that you have been discriminated against based upon any one of these areas, you must contact Equal Opportunity and Outreach (EOO). These protections also include retaliation for filing complaints of discrimination. Concerns regarding course offerings, instructor and student attitudes should also be directed to EOO staff at 978-934-3565.

Students are responsible for adhering to the policies of the University regarding equal and fair treatment.

**Graduate Grading Policies**

Grading System
Grade Exclusion
Grades for Projects, Theses/Dissertations and Seminars
Incompletes
Course Listing on the Graduate Transcript
Audited Courses
Grade Appeal Process

**Grading System**

The grading system uses grades:

A+ (4.0), A (4.0), A- (3.7)
B+ (3.3), B (3.0), B- (2.7)
C+ (2.3), C (2.0)
F (0.0)
FX (0.0) Failed due to Academic Misconduct (May not be replaced or deleted)

The following special grades are also used:

INC (Incomplete),
S (Satisfactory, B or better),
U (Unsatisfactory) for projects, theses/dissertations, and seminars only
AU (Audit)
W (Withdrawal from a course or from the University)
X (Withdrawal because of illness or personal emergency)
Y (University withdrawal for non-academic reasons)
Q (Never attended but did not withdraw. This grade requires a letter from the instructor to the University Registrar stating the student never attended the class.)
PR (In Progress for theses or dissertations)
NC (No Credit for theses or dissertations where no progress has been made).

A student registering for research will do so each semester up to the total number recommended. No graduate degree will be awarded to a student whose cumulative average for course work in his or her program is below 3.0. Some programs may require a higher grade point average for graduation. The cumulative grade point average is computed from all graduate level courses taken for a grade at the University of Massachusetts Lowell.

**Grade Exclusion**

A request may be submitted to omit a specific course (grade and credits) from the GPA for matriculated students. Such a request must be presented on an Academic Petition, provide detailed justification for the specific action, and certify that the action has been approved by a majority of the departmental graduate committee. Only one grade exclusion in total, including a grade for a repeated course, will be permitted for each degree sought by the student as recommended by the departmental graduate committee. However, the official transcript will list grades for all undergraduate and graduate courses taken at the University with the notation that the grade and credits are excluded from the GPA. Once a grade exclusion has been processed it may not be reversed. Additionally, grade substitutions are not permitted.

**Grades for Projects, Theses/Dissertations and Seminars**

- **Projects** (Enrollment Restricted to Matriculated Graduate Students):
  Only one of three grade designations will be allowed for projects:
  - S for projects completed at a satisfactory level
  - U for unsatisfactory completion of a project (no credit toward degree requirements)
  - INC Incomplete
- **Theses/Dissertations** (Enrollment Restricted to Matriculated Graduate Students):
  PR will be given for thesis/dissertation research if the student has made satisfactory progress during the semester.
  NC will be given if the student has made no progress during the semester on thesis/dissertation research.
  U Unsatisfactory (no credit toward degree requirements)

After successful defense of the thesis/dissertation, a grade of "S" (Satisfactory) will be given for all semesters of the thesis/dissertation research. Only the Registrar’s Office can...
issue this grade.

- **Seminars**
  
  - S - Satisfactory
  - U - Unsatisfactory (no credit toward degree requirements)
  - INC - Incomplete

Under no circumstances will letter grades (A, B+, etc.) be allowed for projects, theses/dissertations, or seminars.

**Incomplete**

If, because of unusual circumstances, a student is unable to meet all the requirements of the course by the end of a semester, the grade of Incomplete (INC) may be given. Responsibility for making arrangements with an instructor to complete all outstanding coursework rests entirely with the student, who must complete all outstanding coursework by the date listed on the Graduate Academic Calendar.

Under no circumstances will a student be allowed to graduate with incomplete(s) on his or her transcript. Prior to completion of the missing work, the incomplete will not be computed into the grade point average (GPA). If the student completes the missing work within the specified period, the instructor must evaluate the work and turn in a grade change form to the Registrar's Office before the deadline for instructors to submit final grades for incomplete courses.

However, if the student does not complete the missing work by the specified date and no grade change form is submitted by the instructor, the student's grade will automatically change to a grade of "F" and be computed into the GPA.

**Course Listing on the Graduate Transcript**

All graduate courses for which a student registers (including repeated courses) are listed on the transcript and are used to calculate the student's grade point average whether or not they are taken to fulfill degree requirements. In addition, undergraduate courses which a student takes to fulfill prerequisite requirements before or during matriculation in a graduate program, or courses taken for personal enrichment, will also be listed on the transcript.

**Audited Courses**

A graduate student may, upon approval of the advisor and the instructor, register for a course on an audit basis, but must pay the full amount of tuition and fees. An audit student is not required to take tests or the final examination. A change in registration from audit to credit or credit to audit must be done during the add/drop period. Under no circumstances can a course taken for audit be given credit at a later date.

**Graduate Clearance**

To apply for Graduation, graduate students must fill out a Declaration of Intent to Graduate (DIG) form and have it approved by their Graduate Coordinator and (if applicable), Thesis/Dissertation Advisor.

The Registrar’s Office will verify number of credits, final grades, GPA requirements and if applicable submission of thesis/dissertation prior to awarding the degree.

**Additional Requirements for Students Completing a Thesis or Dissertation**

All students who are completing a thesis or dissertation must submit one clean copy (NOT the original) of the signature page for the thesis or dissertation. The signature page must be signed and dated by the thesis/dissertation advisor and all committee members. Copies of the Thesis or Dissertation must be submitted to the Library for binding and microfilming by the deadline date. In addition, doctoral students are required to complete the "Survey of Earned Doctorates" online, you will be emailed the information when you submit your DIG form.

**Graduate Grade Appeal Process for Students**

The instructor of the class is the primary authority with respect to a student's proficiency and final grade in that course. A student who believes that his or her final grade reflects an erroneous, capricious, arbitrary, or prejudiced academic evaluation may appeal the grade. The academic judgment used in determining the merits of the grade to be awarded shall not be reviewable. This process does not apply to cases of academic dishonesty, which are adjudicated through the "academic dishonesty process."

1. The student may file an appeal of his or her complaint, in writing, to the instructor within 30 days after a final grade is posted to the students record. The instructor must respond within 14 days of receiving the appeal.
2. If the student remains dissatisfied by the decision of the instructor under step (1), he or she may, within 14 days after formal receipt of the instructor’s final decision, appeal, in writing, to the chairperson of the program (or the Dean of the College if the instructor is the
chairperson) in which the course or other exercise or activity is offered. The chairperson must respond within 14 days of receiving the appeal. The decision may be: (a) that the appeal be dismissed; (b) if there is demonstrable evidence of an erroneous, arbitrary, capricious, or prejudiced academic evaluation, then the chairperson will recommend appropriate remedies that a grade be changed or the student be allowed an opportunity to retake an examination or other exercise; or (c) that another appropriate remedy be administered.

3. If no satisfactory resolution is reached in step (2) then the student or the instructor may appeal, in writing, to the Dean of the College within 14 days after formal receipt of the chairperson’s final decision.

4. The Dean, after discussion with the appropriate parties, may resolve the grievance by agreement or render a decision within 21 days of receipt of the written appeal. The decision may be: (a) that the appeal be dismissed; (b) if the student provides demonstrable evidence of an erroneous, arbitrary, capricious, or prejudiced academic evaluation, then the Dean will recommend appropriate remedies that a grade be changed or the student be allowed an opportunity to retake an examination or other exercise; or (c) that another appropriate remedy be administered.

5. The decision of the Dean is final and not subject to additional appeal by either student or instructor. The appeals process ends at this step.

6. The Department chair or his/her designee is responsible for keeping a record of the appeal on file in accordance with University Records Retention Policy.

Registration and Enrollment Policies

- Continuous Registration
- Dropping Classes and Refund Policy
- Changes in Registration
- Change of Program

Continuous Registration

In order to maintain continuity of enrollment, a matriculated student must register each fall and spring until the program of study is complete and the degree has been earned. A graduate student who plans to receive his/her graduate degree in the summer term (awarded in August) must register during the previous summer session in order to maintain continuous matriculation.

If for any reason a student is not registered for a course (because of a leave of absence or because the thesis or dissertation has been successfully defended, but the final manuscript has not been submitted to the library), the student must register for CONT.6010 (Continued Matriculation) in order to maintain continuous registration. Since students are not allowed to register if they have outstanding financial obligations to the university, it will be necessary for them to clear their financial record in order to register for Continued Matriculation.

**Master’s students may only register for two semesters of Continued Matriculation. Doctoral candidates may register for up to three semesters.** Exceptions to the this rule may be granted with approval of the academic department (Graduate Coordinator/Department Chair) and college dean. Students completing a thesis or dissertation must also have the approval of their thesis/dissertation advisor. Exceptions must be requested via a Graduate Academic Petition. If an exception is not granted, the student will be withdrawn from the University and need to reapply. If a student reapplies and is readmitted, the rules regarding the Statute of Limitations restart.

Continued Matriculation does not entitle a student to any use of university facilities, services or resources, but only maintains an active record and provides for appropriate mailings. Students who are engaged in academic work necessary to complete their thesis or dissertation, participate in a required full time internship or curricular practical training, or otherwise engage in or make use of University facilities or other resources must register for a minimum of 1 credit. (Note: Specific internship/CPT requirements will vary by department and students may be required to register for 3, 6, or 9 credits depending upon their program of study.)

The rules regarding the Statute of Limitations for the completion of master’s and doctoral degrees still apply to students registered for Continued Matriculation.

All international students on F-1 or J-1 visas must register as full-time students (9 credits) each semester until their degree requirements are completed. Any variance from this policy must be approved by the International Student and Scholars Office.

A student who fails to maintain continuous matriculation loses the status of a degree candidate and must reapply to the Graduate Admissions Office.
Dropping Classes and Refund Policy

Graduate students may drop courses during the first ten days of classes and receive a refund. No refund will be given after these time periods. To formally withdraw from a course during this period, or thereafter, the student must drop the course through SiS (https://www.uml.edu/Enrollment/SiS/default.aspx) self service (https://www.uml.edu/Enrollment/isis/default.aspx). If the student fails to officially drop a course, he or she will remain enrolled and be required to pay for tuition and fees. In addition, if the student does not drop a course and does not attend classes, he or she will receive an "F" on the official transcript.

Changes in Registration

Courses may be added or dropped through self-service in SiS (https://www.uml.edu/Enrollment/SiS/default.aspx) (https://www.uml.edu/Enrollment/isis/default.aspx). Students who wish to add a course during the sixth through 10th day of classes will need a permission number from the instructor of the course. Permission numbers are not needed to drop a course. In addition, students may change from audit to credit or from credit to audit during this period. Courses dropped during the first 10 academic days will not appear on the student's permanent record. No new courses may be added and no course may be changed from audit to credit after the tenth academic day. Thereafter, a student wishing to drop courses must do so by the date indicated in the Graduate Academic Calendar (http://www.uml.edu/Registrar/Calendars/default.aspx).

No refund of tuition and fees is allowed after the tenth day of the semester. The grades for courses dropped after the tenth day will appear as W on the student's record.

Change of Program

A graduate student wishing to change departments or transfer to a doctoral program upon completion of his or her master's degree must follow the steps listed below:

1. No transfers will be considered until the student has been in the original department in which he or she was accepted for at least one semester.
2. All sections of a new application sheet must be completed.
3. If so desired, the student may request that all test scores, letters of recommendation, etc., in his or her original file be used as part of his or her new application package.
4. The student must specify on the application form when his or her master's degree will be completed and when he or she will actually begin doctoral studies (for students applying to a doctoral program).
5. A check made payable to University of Massachusetts Lowell to cover the application fee must be included, or payment must be made by credit card when applying online.

Right of Access to Student Records

Access
University Student Records
Release of Student Records
Release Exclusions
Additional Information

Access

The Family Educational Rights and Privacy Act of 1974 (FERPA) grants any student currently in attendance, or any former student, the right of access to inspect or review his or her educational files, records, or data. Students who wish to inspect their records must file a Right of Access form with the office or department in which the desired record is kept. Right of Access forms are available in the Office of Student Services or through student self service. Wherever practicable, within ten days of receipt of the Right of Access form, the office or department will notify the student as to the date, time, and location when the desired record will be available for inspection. If a student believes that circumstances effectively prevent inspecting and reviewing the records at the designated date, time and location, he or she may request alternative inspection arrangements or copies of the records instead, subject to a fee for copies. The Dean of Students or the Deans designee will consider the request.

University Student Records

The University maintains the following general records on students:


Permanent Academic Records - Registrar’s Office (https://www.uml.edu/Registrar/default.aspx) -
The file of each student must contain a record of all non-
University affiliated individuals or organizations requesting
access to information in the file, plus statements that specify
the legitimate educational purposes for which access was
requested.

Except as otherwise permitted under FERPA, information or
records concerning individual students may not be released to
any individual or agency without the students written
permission. Any request for such information received without
such written permission will not be honored and will be
returned with a request for a written release from the student.

Release of Student Records

FERPA allows release of a students education records without
the students written permission under certain circumstances,
including the following:

1. To personnel of the University, i.e., faculty, administrators,
or staff for legitimate educational purposes only.
2. To officials of other institutions in which the student seeks
admission or intends to enroll, provided that the student is
notified of the release.
3. To federal or state officials in connection with the audit
and evaluation of programs funded by federal or state
governments, with the enforcement of legal requirements
that relate to such programs, or in connection with the
students application for or receipt of financial aid.
4. To accrediting organizations in order to carry out their
accrediting functions.
5. To parents who claim the student as a dependent on their
IRS statement.
6. In connection with an emergency, to appropriate persons
if revealing such information is necessary to protect the
health or safety of the student or other persons.
7. In response pursuant to a validly issued subpoena, subject
to advance notification of the student unless such notice
is prohibited by court order.
8. As otherwise permitted under or consistent with FERPA.

The following data are considered informational in nature and
may be released without the permission of the student, at the
discretion of the University: students name, major,
acknowledgement of a student’s participation in officially
recognized activities and sports, weight and height of members
of athletic teams, date(s) of attendance; degrees, certificates,
awards received; the most recent previous educational agency
or institution attended by the student and appointment as a
Resident Assistant or Community Development Assistant. For
graduate students who are teaching credit courses, work
department, office address, and employments category are also
defined as directory information.

Release Exclusions

Any student who wishes to have some or all of his or her
directory information excluded from release by the University
without prior permission must complete the appropriate
selections available thru student self service
(www.uml.edu/enrollment/isis/
(https://www.uml.edu/Enrollment/SiS/default.aspx))

Additional Information

Any student who believes that his or her records are inaccurate
or misleading may request a hearing with the Dean of Students
to discuss the contents of such records and whether or not they
need to be changed. Additional information on procedures or
policies relating to University compliance with the Family
Rights and Privacy Act can be obtained from the Office of
Student Services or the Registrar’s Office.

Statute of Limitations (Time Limit for Degree
Completion)

A graduate degree, at either the master’s or doctoral level,
implies a significant mastery of a discipline within a specified time period. A well designed curriculum is not a mere collection of classes that add up to a set number of credits. It is, rather, a coherent selection of courses with an overall educational achievement that is greater than the sum of its parts. However, this coherence is lost if the program is completed over a long time span.

Master's degree requirements must be completed within a five-year period from the semester of admission. For those master's programs requiring 45 or more credits, the time limit is six years.

The doctoral degree must be completed within an eight-year period beginning with the semester of admission as fully matriculated or matriculated with conditions.

A student may obtain an extension of one year by filing an Academic Petition (https://www.uml.edu/docs/petition_grad_tcm18-87176.pdf) (http://www.uml.edu/docs/petition_grad_tcm18-3545.pdf (https://www.uml.edu/docs/petition_grad_tcm18-87176.pdf)) signed by his or her coordinator, department chair, and college dean, and which is then submitted to the Registrar's Office.

Time Extension Appeal Procedure

In exceptional cases, an additional extension may be granted by the Graduate Policy and Affairs Committee (GPAC). In this case, the student must submit an Academic Petition (https://www.uml.edu/docs/petition_grad_tcm18-87176.pdf) (http://www.uml.edu/docs/petition_grad_tcm18-3545.pdf (https://www.uml.edu/docs/petition_grad_tcm18-87176.pdf)), a letter of explanation accompanied by a detailed schedule for degree completion, and a letter from the student's coordinator or thesis advisor in support of the request.

Transfer Credit

The following are minimal guidelines for transfer of credit. Individual departments are free to impose more stringent requirements. Only courses completed elsewhere within five years prior to the date of admission to a graduate degree program at the University of Massachusetts Lowell may be considered by the faculty of the department for transfer in accordance with the following regulations.

1. A maximum total of 12 graduate credits earned with a grade of B or better taken at another accredited institution may be transferred to a master's degree program (see individual programs for further restrictions, if any). A maximum of 24 credits with a grade of B or better may be transferred to a doctoral program.

2. Grades of C or better for courses taken at UMass Lowell when the student held non-degree status may also be transferred (by Academic Petition) into a degree program. However, the 6 and 9 credits with grades below a B (graduation limit) for master's and doctoral degrees, respectively, (see Retention Policy) and calculation of the cumulative grade point average based on all graduate courses taken at the University (see Academic Grades) remain in effect.

Transcripts

In order to obtain a transcript, a student may print an unofficial transcript or order an official copy through self-service in SIS (https://www.uml.edu/Enrollment/Sis/default.aspx) (www.uml.edu/enrollment/sis/ (https://www.uml.edu/Enrollment/Sis/default.aspx)). If SIS is not available, a transcript may be ordered by filling out a Transcript Request Form (https://www.uml.edu/docs/transcriptrequest_tcm18-3516.pdf) (www.uml.edu/docs/transcriptrequest_tcm18-3516.pdf) and submitting it to the University of Massachusetts Lowell Registrar’s Office at 883 Broadway Street, Lowell, MA 01854.

Course Listing on the Graduate Transcript

All graduate courses for which a student registers (including repeated courses) are listed on the transcript and are used to calculate the student's grade point average whether or not they are taken to fulfill degree requirements. In addition, undergraduate courses which a student takes to fulfill prerequisite requirements before or during matriculation in a graduate program, or courses taken for personal enrichment, will also be listed on the transcript.
University Appeals Process Regarding Academic (Non-Grade Appeal and Non-Misconduct) Issues

The underlying purpose of the University’s appeals procedure is to guarantee due process and to protect the rights of both students and faculty in graduate programs.

The following procedure provides a mechanism for formal adjudication of any academic issues (non-misconduct and not related to grade appeal) which may arise. (For information regarding the process for grade appeals, see the Graduate Grade Appeal Process.)

Responsibility for initiation of each of the steps belongs to the appellant.

Step 1. If an informal discussion between the student and the instructor or individual with whom the student has a conflict does not resolve the issue, the resolution of an academic appeal of a student should begin within the department. The first step in the resolution of a problem or disagreement should be a discussion between the instructor, the student, and his/her faculty advisor or the coordinator of the program.

Step 2. If the matter cannot be resolved after such a discussion, a formal appeal, in writing and containing the pertinent facts, should be presented by the student to the chairperson/head of the department within two months of the occurrence that precipitated the appeal. Any appeal made outside this time period shall not be considered by any University body. The chairperson of the department will appoint committee composed of faculty members in the department. Within seven working days, this committee shall convene and discuss the appeal with the student and the instructor, coordinator, or individual with whom the student has a conflict. The student may be accompanied by his or her advisor or a faculty representative during the discussion of the appeal. The committee, by a majority vote after deliberations with only members of the committee present, shall render a decision within five working days and notify the appropriate parties in writing with the rationale for the decision included in the notification.

Step 3. If the decision of the departmental committee is not satisfactory to all parties, the appeal may be forwarded to the College Dean within two weeks of the decision of the departmental committee. The Dean will appoint a college committee composed of area coordinators of all graduate programs within the college or a suitable committee of faculty. The committee will be chaired by the college dean, or his/her designee. Within seven working days, the committee shall convene and discuss the appeal with the student. At this level the student may request to be present at the committee meetings, that discussions or proceedings be tape recorded, and that a transcript be prepared from the tape. The request for a recording must be made at the time the appeal is made to the college committee. The college committee shall render a decision by majority vote after deliberations with only members of the college committee present within five working days and notify the appropriate parties in writing with the rationale for the decision included in the notification.

Step 4. If the decision of the college committee is not satisfactory to all parties, the appeal may be forwarded to the Graduate Policy and Affairs Committee (GPAC) within ten working days after the decision of the college committee. The committee shall convene within 10 working days after the GPAC chairperson has received a written request for a hearing from the appellant, and discuss the appeal with the student and faculty advisor or representative. A request for recording and preparing a transcript of the discussions with the student present may be made at the time of appeal. The committee shall render a written decision within five working days and notify the appropriate parties. The decision of the Graduate Policy and Affairs Committee shall be final, and the information accumulated during the appeal procedure shall be forwarded to the Provost to be kept on file. If any decision involving the awarding of a degree is made and the official deadline for graduation exercises has passed during the appeal, the degree date will reflect the initiation of the appeal.
The above time periods define working days as days when classes are in session for the fall and spring semesters. Efforts will be made to honor the same time periods during intercession and June - August although some flexibility must be accepted by the appellant because of potential difficulties in assembling committee members during these periods.

The GPAC chairperson may modify the Step 4 hearing time framework at his/her discretion to coincide with regularly scheduled GPAC meetings. In either of the above cases, the appellant must be notified in writing by the hearing officer (along with an explanation) of any modification of the hearing time schedule. The chairperson may recommend that final voting/discussion of Step 4 cases be done in Executive Session with only committee members present.

**Out-of-State Students Taking Online Courses**

Out-of-State students taking online classes are urged to follow the [Online and Continuing Education student complaint process](https://continuinged.uml.edu/general/student_complaint_process.cfm); if no resolution is reached, out-of-state students taking online classes may file a complaint about University of Massachusetts with the appropriate body in their state of residence. Please see [Student Complaint Contact Information by State](https://www.uml.edu/docs/Student%20Complaint%20Contact%20Information_tcm18-282006.pdf).

**University Disciplinary Procedures for Graduate Students**

**Academic Dishonesty - Academic Integrity Policy**

**Administrative Dismissal from the University**

Administrative dismissal may be invoked when a student fails to comply, after due notice, with an administrative regulation of the University. Examples of some conditions which justify administrative dismissal are listed in the Undergraduate Catalog at [www.uml.edu/catalog/undergraduate/policies/administrative_dismissal.aspx](https://www.uml.edu/catalog/undergraduate/policies/administrative_dismissal.aspx) and apply to all students, undergraduate and graduate.

**Non-Academic Misconduct**

Improper conduct or behavior of graduate students is subject to the University of Massachusetts Lowell Student [Conduct Code and Judicial Process](https://www.uml.edu/docs/Student%20Conduct%20Code%20and%20Resident%20Student%20Handbook_tcm18-74786.pdf). Copies of this document may be obtained from the Dean of Students Office.

**Withdrawal Policies**

**Withdrawal from a Course**

**Withdrawal from the University**

**Withdrawal from a Course**

A student finding it necessary to withdraw from a course must do so within the time specified in the [graduate academic calendar](https://www.uml.edu/Registrar/Calendars/default.aspx). The student’s permanent record will indicate a grade of W for the course(s) from which he or she has withdrawn unless the withdrawal has taken place within the first 10 class days of the semester during which time no record will be kept. (See [Dropping Classes and Refund Policy](https://www.uml.edu/Registrar/Calendars/default.aspx) in this Catalog for information on dropping a course.)

**Withdrawal from the University**

A student who wishes to withdraw from the University must submit his/her request in writing to the Registrar’s Office. This procedure ensures that the student’s academic and financial obligations are cleared before leaving the University. If a student officially withdraws from the University by the withdrawal date indicated in the graduate academic calendar, the permanent record will indicate a grade of W. If the student fails to follow the official withdrawal procedure and does not withdraw in good standing, the student will not be permitted readmission to a graduate program at the University except under extenuating circumstances.

All previous application materials will remain on file for a two year period. At any time during this period, a student who has officially withdrawn may request readmission by completing and submitting only the cover page of the graduate application and paying the application fee. After two years, a student must file a new, complete application and submit the appropriate fee to the [Graduate Admissions Office](https://www.uml.edu/Grad/default.aspx).
Francis College of Engineering

The education of engineers in state-of-the-art areas of advanced technology and the UMass Lowell’s commitment to national and regional economic development are the major premises upon which the graduate programs in the College of Engineering are based. These programs are intended to produce engineers whose education not only develops expertise in the design, development and production of products, but also an understanding of the management involved in the creation of new products, companies and service organizations. Thus, the graduate programs in engineering are intended to educate engineers capable of keeping abreast with the rapidly changing technology that characterizes the high technology economy of the Northeast and for research careers in academia, industry and government. These graduate programs lead to degrees of Master of Science in Engineering, Master of Science, Doctor of Philosophy, and Doctor of Engineering. The College is led by Joseph Hartman (https://www.uml.edu/Engineering/faculty/Hartman-Joseph.aspx), Ph.D., Dean of the Francis College of Engineering (http://www.uml.edu/Engineering/default.aspx). The graduate programs for the College are overseen by James A. Sherwood, Associate Dean of Graduate Studies.

You will need Adobe Acrobat Reader (https://get.adobe.com/reader/) to view any pdf files. It can be downloaded for free from the Adobe website (https://get.adobe.com/reader/).

On this page you will find:

- Graduate Programs Offered
- Common Admission Requirements
- Common Doctoral Degree Requirements
- Dissertation Proposal
- Nontechnical/Management Courses for Doctor of Engineering
- Other Doctoral Programs
- Links to department catalog section
- Engineering College-Wide Courses (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Faculty in the College of Engineering (https://www.uml.edu/docs/ENGG%20Faculty%20List_tcm18-90421.pdf) (pdf)

### Graduate Programs Offered

The Master of Science in Engineering (M.S. Eng.) degree awarded in the following fields:

- Chemical Engineering
- Civil Engineering - Options: Environmental, Geotechnical, GeoEnvironmental, Structural, Transportation
- Computer Engineering
- Co-op Option in Engineering (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Electrical Engineering
- Energy Engineering - Options: Nuclear, Solar
- Mechanical Engineering
- Plastics Engineering

The Master of Science (M.S.) degree awarded in the following fields:

- Engineering Management
- Environmental Studies

The Doctor of Philosophy (Ph.D.) degree awarded through the College of Engineering in the following options:

- Chemical Engineering
- Civil and Environmental Engineering
- Computer Engineering
- Electrical Engineering
- Energy Engineering
- Mechanical Engineering
- Plastics Engineering

The Doctor of Engineering (D.Eng.) degree awarded through the College of Engineering in the following options:

- Chemical Engineering
- Civil and Environmental Engineering
- Computer Engineering
- Electrical Engineering
- Energy Engineering
- Mechanical Engineering
- Plastics Engineering

The intent of the Doctor of Engineering/Doctor of Philosophy (D.Eng./Ph.D.) programs is to prepare engineers for leadership and research positions in industry, academia and government. The doctoral programs include advanced graduate course work in engineering and allied subjects and research culminating in a doctoral dissertation. The Ph.D. degree is oriented more
towards academic research, while the D.Eng. degree is oriented more toward industry.

A total of 63 credit hours of graduate level courses are required for both the Ph.D. and D.Eng. degrees. These credits are composed of the following components:

- The Ph.D. degree must involve a traditional research-based dissertation, plus: A minimum of 30 approved credit hours of graduate-level engineering including associated science and math courses. A minimum of 21 credit hours of doctoral dissertation. The balance of the remaining 12 credits can be a mix of graduate-level engineering including associated science and math course and dissertation credits at the discretion of the department, faculty advisor and dissertation committee.

- The D.Eng. degree must involve a dissertation, which can be either a traditional research-based dissertation or an industry-based project, plus: 33 approved credit hours of graduate-level engineering including associated science and math courses. 21 credit hours of doctoral dissertation. 9 credit hours of approved management-type courses.

In addition to this 63 semester hours of approved graduate courses and dissertation:

- The student must have a minimum grade point average of 3.25 to graduate.
- The student is required to take and pass the doctoral qualifying examination.

Dissertations which are industrial in orientation should use the D.Eng. degree, based upon discussion with the supervising faculty advisor. Students may elect either degree designation with the consent of the faculty advisor, subject to the requirements of each degree.

Options are offered in the following areas:

- Computer Engineering
- Electrical Engineering
- Mechanical Engineering
- Plastics Engineering
- Civil and Environmental Engineering
- Chemical Engineering
- Energy Engineering (jointly administered by Mechanical Engineering and Chemical Engineering)

Rules and requirements vary slightly with the administering department.

Common Admission Requirements

Admission to the program will be based on review by Graduate Admissions and by the Admissions Committee of each administering Department. Applicants are required to submit the following items to Graduate Admissions:

- Graduate Record Examination (GRE) scores
- TOEFL (Test of English as a Foreign Language) exam scores are required for international students
- Three letters of recommendation.
- Statement of Purpose
- Application fee
- Application form
- Official transcripts.

Doctoral programs in the College of Engineering may also require a BS or MS in Engineering or a closely related field. Depending on the option selected, students may be required to make up prerequisites which they lack in comparison to the equivalent Engineering curriculum at the University of Massachusetts Lowell.

Transfer Credits

1. A student with a masters degree in Engineering or a closely related field may apply to have coursework for the master's degree up to a total of 24 credits.

2. A student with graduate-level work completed at a credited US or Canadian university may apply for transfer of up to 24 semester credits in acceptable graduate engineering courses (with grade of B or better) towards the doctoral program, upon approval by the Department Graduate Coordinator.

3. In cases where a student has an M.B.A., or has completed the Business Administration Minor for Engineering students, in addition to a B.S. in engineering or a closely related field, portions of the management component of the Doctor of Engineering program may be waived upon
review by the administering department.

Note: Students may be required to make up prerequisites which they lack in comparison to the equivalent Engineering curriculum at the University of Massachusetts Lowell.

Common Doctoral Degree Requirements

In addition to 63 semester hours of approved graduate credits and thesis:

1. The student must have a minimum grade point average of 3.25 to graduate.
2. Students are required to take and pass a doctoral qualifying examination before they are officially classified as a doctoral candidate.

Doctoral Qualifying Examination

1. The doctoral qualifying examination is administered on a declared schedule, usually twice each year. The timing and format of the doctoral qualifying examination may vary by department.
2. The student is permitted two attempts at passing the doctoral qualifying examination.
3. If this first attempt at the doctoral qualifying examination is unsatisfactory, a second and final attempt at passing the exam must occur at the next offering of the qualifying exam. Failure to schedule or to participate in the qualifying exam process as outlined will be considered a failed attempt.
4. Students failing the doctoral exam twice will automatically be dismissed from the doctoral program.
5. Students who do not take the examination at the prescribed time may lose all their financial support, if any, and may be dismissed from the doctoral program.
6. The decision of each administering Department regarding whether a student has passed the qualifying exam is final.

Doctoral Dissertation Proposal

Each student is required to submit and defend a dissertation proposal before a Department Doctoral Committee. This committee shall be comprised of the departmental faculty advisor and at least two other faculty members. This committee may or may be the same as the dissertation research committee for the student. Upon approval by this Department Doctoral Committee, the doctoral graduate coordinator for the department will notify the Vice Provost for Graduate Education and the Associate Dean for Graduate Studies in the College of Engineering that the student is now formally a candidate for the Doctor of Engineering/Doctor of Philosophy degree. Admission to candidacy status does not guarantee awarding of the doctoral degree.

Dissertation

After a student has chosen an area of research and a research advisor, a Dissertation Committee is selected by the student and his or her research advisor in accordance with the policy of the department. The Dissertation Committee shall consist of at least three members, one of whom is the research supervisor and at least two of whom shall be from the student’s major department. An outside expert from industry or another university may be a member of the committee, but that individual must possess academic credentials which would qualify him or her to serve as a member of the University of Massachusetts Lowell faculty. The responsibilities of the Dissertation Committee shall be to:

1. Approve the research topic;
2. Supervise the progress of the dissertation;
3. Read, evaluate, and approve or disapprove of the written dissertation;
4. Hear, evaluate and approve or disapprove of the oral defense of the dissertation;
5. Report the completion of all dissertation requirements to the department and the Registrar’s Office.


Nonteachnical/Management Courses for Doctor of Engineering

D.Eng. students are required to take a minimum of 9 credits of graduate nontechnical/management courses from a list of approved courses offered within the College of Engineering or College of Management.

Approved nontechnical/management graduate courses from the College of Engineering (3 credits each):

- 22.576 Engineering Project Management
- 26.507 Plastics Industry Organization
- 26.514 Statistics for Six Sigma
- 26.515 Lean Plastics Manufacturing
- 26.537 Business Law
Approved management graduate courses from the College of Management (3 credits each):

Other Doctoral Programs
The Doctor of Philosophy in Physics (Ph.D.) degree awarded through the College of Arts and Sciences in the following fields:
- Applied Mechanics
- Energy Engineering
- Radiological Sciences

The Doctor of Philosophy in Chemistry (Ph.D.) degree awarded through the College of Arts and Sciences in the following fields:
- Biochemistry
- Environmental Studies
- Polymer Science/Plastics Eng. Option

The Doctor of Science (Sc.D.) degree awarded through the College of Health Sciences in the following field:
- Work Environment - Options: Occupational Ergonomics, Industrial Hygiene, Epidemiology, Work Environment Policy

Links to Department Sections in This Graduate Academic Catalog:
- Chemical Engineering
- Civil & Environmental Engineering
- Electrical & Computer Engineering
- Energy Engineering
- Mechanical Engineering
- Plastics Engineering

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**Engineering Management**

**Master of Science in Engineering Management**

- Program Overview
- Admissions Requirements
- Accelerated Bachelors to MSEM Masters
- Graduate Program Curriculum Outline

**Co-op Option in Engineering**

The Department of Engineering Management participates in the Graduate Master’s Co-op Option in Engineering. For detailed information about the Co-op Program and curriculum requirements, please see the Graduate Catalog Engineering Co-op page (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).

**Program Overview**

The Master of Science in Engineering Management (MSEM) is designed for technical professionals who have opted for the management track in technical and engineering services enterprises. The program is 31 credits in length. Some courses will be offered both on campus and online and the MSEM is open to both full-time and part-time students.

Students have the choice of three concentrations: (a) design and manufacturing, (b) engineering services/infrastructure management and (c) operations and supply management. The three concentrations encompass the non-research and development (non R &D) part of technical enterprises that are needed for new technical projects and product realizations.

Besides preparing engineering or business bachelor degree undergrads for careers in engineering management, this program also serves non-engineering or business undergraduates who wish to pursue a technical management career. These candidates may be required to complete prerequisite courses that provide an introduction to basic engineering economy concepts needed for courses in the curriculum, at the discretion of the MSEM program coordinator. After successful completion of these prerequisite courses, students with non-engineering or business undergraduate degrees can pursue the remaining MSEM curriculum in the same way as students with engineering undergraduate degrees.

**Admissions Requirements**

General Admission Requirements

The following are general admission requirements.

Admission to the program will be based on review by Graduate Admissions and by the Admission Committee of the MSEM Department. Applicants are required to submit the results from
the Graduate Record Examination (GRE) to the Graduate School. In addition, international students must obtain the results of the Test of English as a Foreign Language (TOEFL) examination. Depending on the option selected, students may be required to make up prerequisites which they lack in comparison to the equivalent Engineering curriculum at the University of Massachusetts Lowell. In cases where a student has an M.B.A. or has completed the Business Administration Minor for Engineering students, in addition to a B.S. in engineering or its equivalent, certain requirements the MSEM program may be waived upon review by the MSEM Admissions Department. However, all MSEM students are expected to fully complete the 31 credit program requirements.

**Specific Admission Requirement for MSEM**

1. BS in any engineering or science discipline, or a BS in Industrial Management or Operations Research
2. Graduate Admissions Application
3. Application fee
4. GPA of 3.0 or better in the respective undergraduate program
5. GRE scores minimum to be determined by the MSEM admission committee
6. Three letters of recommendation
7. Statement of Purpose
8. TOEFL =>79 or IELTS =>6.5 for international students.

Students with industrial or management experience and a bachelor’s degree in another area can be admitted on a case-by-case basis, e.g. BA in English or History. In such cases, a resume is requested to assist in the decision process.

In some cases, an applicant may be required to satisfactory complete up to three undergraduate engineering/science courses to ensure that the student has the necessary background knowledge to succeed in the MSEM program.

**Accelerated Bachelors to MSEM Masters**

The College of Engineering will offer a combined BSE/MSEM program in Engineering Management for UMass Lowell undergraduate students based on a BS in any engineering or science discipline. The admission requirements and benefits of the accelerated MSEM are as specified by the University. Applications from UMass Lowell undergraduates may be submitted in the junior year and must include the following:

1. UMass Lowell Undergraduate Degree: Official Transcripts. (A minimum overall GPA of 3.0 at the time of conferral of the undergraduate degree is required. Students who do not meet this requirement at the end of their undergraduate studies will not qualify for the Bachelors to Master’s benefits; however, they may reapply to the program via the regular application process.)
2. The GRE can be waived for UMass Lowell undergraduates with a GPA of 3.0 and above an upon receipt of a recommendation by an UMass Lowell faculty member.
3. Successful completion of all other university admissions requirements, including three letters of recommendation.
4. Statement of Purpose.

**Graduate Program Curriculum Outline**

The core courses are a blend of engineering and business fundamentals, while the three concentrations allow students to narrow their course selection into well thought out collection of courses into each concentration, while leveraging the expertise of the faculty in these topics.

Note: Students may choose to do either a professional-practice capstone (6 credits) or take additional courses (6 credits minimum) in an Engineering Management concentration. For the non-capstone option, students must submit a plan of study to the MSEM graduate coordinator and obtain his/her approval during the first year of the program. Any change to the submitted plan requires the approval of the MSEM graduate coordinator.

**Required (Core) Courses**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MECH.5760</td>
<td>Engineering Project Management</td>
<td>3</td>
</tr>
<tr>
<td>POMS.6220 or CHEN.5480</td>
<td>Decision Analytics or Engineering Process Analytics</td>
<td>3</td>
</tr>
<tr>
<td>ACCT.5010</td>
<td>Financial Accounting (prereq: FINA.5010)</td>
<td>2</td>
</tr>
<tr>
<td>FINA.5010</td>
<td>Business Financial Analysis</td>
<td>2</td>
</tr>
<tr>
<td>MKTG.5010</td>
<td>Marketing Fundamentals</td>
<td>2</td>
</tr>
<tr>
<td>POMS.5010</td>
<td>Operations Fundamentals</td>
<td>2</td>
</tr>
<tr>
<td>MGMT.5010</td>
<td>Organizational Behavior</td>
<td>2</td>
</tr>
<tr>
<td><strong>Sub-Total # Core Credits Required</strong></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

**One of the three Concentration Course Choices (Total Min. credits required = 9) (attach list as needed)**

**a. Design and Manufacturing Concentration**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIVE.5210 or</td>
<td>Reliability Analysis in Engineering or</td>
<td>3</td>
</tr>
</tbody>
</table>
b. Engineering Services/Infrastructure Management Concentration

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIVE.5110</td>
<td>Inspection an Monitoring of Civil Infrastructure</td>
<td>3</td>
</tr>
<tr>
<td>CIVE.5400</td>
<td>Urban transportation planning</td>
<td>3</td>
</tr>
<tr>
<td>CIVE.5440</td>
<td>Transportation Economics and Project Evaluation</td>
<td>3</td>
</tr>
<tr>
<td>CIVE.5210</td>
<td>Reliability Analysis</td>
<td>3</td>
</tr>
<tr>
<td>CIVE.5760</td>
<td>GIS Application in Civil and Environmental Engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

c. Operations and Supply Management Concentration

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLAS.5150</td>
<td>Lean Plastics Manufacturing</td>
<td>3</td>
</tr>
<tr>
<td>PLAS.6060</td>
<td>Plastics Manufacturing Systems Engineering</td>
<td>3</td>
</tr>
<tr>
<td>PUBH.5510</td>
<td>Work Environment Policy and Practice</td>
<td>3</td>
</tr>
<tr>
<td>MGMT.6100</td>
<td>Managerial Leadership</td>
<td>3</td>
</tr>
<tr>
<td>MGMT.6010</td>
<td>Managing Organizational Change</td>
<td>3</td>
</tr>
<tr>
<td>MGMT.6150</td>
<td>International Business</td>
<td>3</td>
</tr>
<tr>
<td>POMS.6010</td>
<td>Operations Management</td>
<td>3</td>
</tr>
<tr>
<td>POMS.6020</td>
<td>Global Supply Chain Management</td>
<td>3</td>
</tr>
<tr>
<td>POMS.6120</td>
<td>Statistics for Predictive Analysis</td>
<td>3</td>
</tr>
<tr>
<td>POMS.6240</td>
<td>Analytical Decision Making Tools</td>
<td>3</td>
</tr>
</tbody>
</table>

Sub Total # Concentration Credits Required: 9

Professional Capstone Practice or Non-Capstone Option (Total credits required = 6)*

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
</table>

Curriculum Summary

Total number of courses required for the degree: 12
Total credit hours required for degree: 31

Prerequisite or Other Additional Requirements for concentration b. Engineering Services / Infrastructure Management:

- CIVE.4750 Construction Management (3 credits)
- CIVE.4700 Engineering Economics (3 credits)

*For the non-capstone option, students must submit a plan of study to the MSEM graduate coordinator and obtain his/her approval during the first year of the program. Any change to the submitted plan requires the approval of the MSEM graduate coordinator.
Biomedical Engineering & Biotechnology Program

The Boston, Dartmouth, Lowell and Worcester campuses of the University of Massachusetts offer joint Master of Science in Biomedical Engineering and Biotechnology.

Admission Requirements

- Admission Requirement
- Transfer of Credits/Advanced Standing
- Academic Program
- General Program Requirements
- Core Course Requirements
- Specialization Course Requirements
- Capstone Requirement
- Earning the Master of Science Degree
- Professional Science Master’s Option
- Combined Bachelors to Master’s Degree Program

Co-op Option in Engineering

The Department of Biomedical Engineering & Biotechnology Program participates in the Graduate Master’s Co-op Option in Engineering. For detailed information about the Co-op Program and curriculum requirements, please see the Graduate Catalog Engineering Co-op page (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).

Admission Requirements

Applicants from many different science/engineering undergraduate programs are invited to apply. Because the degree brings together biomedical engineering with biotechnology, it is designed equally for students with life sciences or engineering/physical science backgrounds. One’s specific background will be of less interest in determining qualification for entrance than will be one’s personal and career goals, demonstrated ability an research potential and commitment to an interdisciplinary, team-work approach.

Applicants will be accepted from individuals holding appropriate bachelor’s degrees or master’s degrees (or the US baccalaureate equivalents from a foreign institution). Applicants should have a background in life science, physical science or engineering. All applicants must have taken a full year (two semester or three quarter sequence) of calculus and the successful applicants will normally have had undergraduate coursework in statistics/experimental design and in life science/biomedical science.

Applicants are encouraged to contact participating faculty to explore how they might fit into a specific specialization option before submitting their application and to report on the results of those contacts in their Statement of Purpose (see below). A personal interview with the applicant by the campus Advising/Admissions/Curriculum Committee (AACC) may be recommended but is not required.

Applicants submit the following and are expected to meet the standards indicated:

1. Generally students with an overall undergraduate grade point average of 3.0 or higher will considered for admission. Applicants must present official undergraduate and graduate transcripts from all schools attended.

2. Applicants accepted into the program should present a minimum Graduate Record Exam (GRE) combined verbal and quantitative score of 300 (1100 for tests taken prior to August 1, 2011). The AACC will also pay particular attention to the applicant’s score on the GRE analytical writing section of the general examination because of the emphasis placed on strong writing skills in this program. Only official GRE scores form Educational Testing Service will be considered acceptable.

3. Applicants must have a minimum of two semesters of calculus and have strong quantitative skills.

4. International applicants should present a minimum Test Of English as a Foreign Language (TOEFL) score of 79 (internet version), 213 (computer version) or 550 (paper version). Only official TOEFL scores from Educational Testing Service will be considered acceptable.

5. Three Letters of recommendation, from individuals familiar with the applicants academic ability and potential to conduct original research at the doctoral level, will be required.

6. Applicants will also be required to submit a Statement of Purpose (personal essay). This statement is an important element in the application packet. It has two related topics:

7. Indication of an applicants qualifications an motivation for the program. Applicants should indicate their qualifications for and motivation to undertake this program as well as their personal and career goals. Specifically, the statement should indicate the applicant’s background, research credentials and career plans as they relate to the multidisciplinary nature of the doctorate and
Students who join the program with an earned master’s degree may receive Advanced Standing in the doctoral program. The number of credits required to complete the Ph.D. will be determined by the home campus AACC, but at a minimum 9 course (core or specialization) credits, the capstone project course (3 credits), doctoral seminar (taken twice, 1 credit each) and 30 dissertation research credits will be required. The capstone project may be waived for students who have completed a master’s thesis or research project at one of the UMass campuses. These students will be required to complete a minimum of 12 course (core or specialization) credits. Students with Advanced Standing will be required to pass the Qualifying Examination before progressing to the dissertation stage.

Doctoral students who enter the program with advanced standing will not earn the MS. To earn the MS, a student must complete or transfer in credit to meet the core (16 credits), specialization (12 credits) and capstone project course (3 credits) requirements.

### Academic Program

The curriculum is organized around common experiences, including common core courses, a capstone project and intercampus graduate research presentations. The program makes use of distance learning/on-line/faculty exchange for delivery of courses and seminars and the campuses are close enough to permit commuting between them. The program encourages a multidisciplinary team approach during the Instrumentation and Laboratory Experience & the capstone project. Industry representation occurs in the introductory core course, in the capstone project and from an outside advisory group. In addition, each student pursues a sequence of courses and then completes a capstone project in a specialization option.

### Biomedical Engineering Specialization Options

- **Biomaterials**: Tissue Engineering, Polymer/Plastics, Fibers/Textiles, Nanotechnology
- **Biomedical Information Systems**: Bioinformatics, Cheminformatics, Genomics, Proteomics
- **Biomedical Instrumentation**: Sensors, Signal Processing, Clinical Sciences
- **Biomechanics**: Joint/Muscle Mechanics
- **Integrative Physiology**: Cardiovascular and Pulmonary Modeling
- **Medical Imaging**: Optics, NMR, MRI, Acoustics, Cell Imaging
- **Medical Physics**: Radiation Therapy, Nuclear Medicine, Diagnostic Imaging, Nuclear Instrumentation

### Biotechnology Specialization Options

- **Diagnostic Imaging, Nuclear Instrumentation, Medical Physics**: Radiation Therapy, Nuclear Medicine, Diagnostic Imaging, Nuclear Instrumentation
- **Medical Imaging**: Optics, NMR, MRI, Acoustics, Cell Imaging
- **Medical Physics**: Radiation Therapy, Nuclear Medicine, Diagnostic Imaging, Nuclear Instrumentation

### Transfer of Credits/Advanced Standing

For students who have previously completed graduate course work, the admission committees on each campus may approve the transfer of graduate credits for courses from an accredited United States college or university that received a grade of B (not B-) or better if those courses were not already used in the degree requirements of another earned degree. The graduate school at each campus will govern the maximum number of credits that may be transferred into the program. The transfer credit may replace core or specialization course requirements.

The project/directed studies, seminar and dissertation research credits will not be accepted for transfer from institutions outside of the UMass system.

Students may also have core courses waived without transfer of course credit. Students would still be responsible for the full credits required for each degree (31 credits for the MS and 63 credits for the Ph.D.), but would not have to take the waived course.

- Individuals are invited to submit a personal resume.

Individual circumstances can be taken into account and extraordinary qualifications in some areas can be used to outweigh weaknesses in others.

Along with an admissions decision comes consideration of the appropriate program of courses for the applicant. The interdisciplinary nature of our program gives special importance to the advising relationship in forming a specific academic program to meet each student’s specific goals. Applicants may be offered admission with a number of courses identified as conditional requirements that they will need to take to fill in for gaps in preparation or knowledge. Each admitted student is assigned to a faculty advisor, who is identified in the letter of admission. Acceptance into the program is subject to the availability of appropriate advisors.

### Indication of how an applicant will fit into the program.

Applicants should indicate their specific areas of interest within Biomedical Engineering and Biotechnology, so that a fit between their interests and qualifications and the specific specialization options that the program offers can be determined. If the applicant has a specific interest in working with one or more of the program’s faculty, they should describe that specific interest and identify those faculty member(s). The Statement of Purpose should also exemplify the applicant’s writing skills.

- We invite applicants also to submit a personal resume.

- Applicants should indicate their specific areas of interest within Biomedical Engineering and Biotechnology, so that a fit between their interests and qualifications and the specific specialization options that the program offers can be determined. If the applicant has a specific interest in working with one or more of the program’s faculty, they should describe that specific interest and identify those faculty member(s). The Statement of Purpose should also exemplify the applicant’s writing skills.

- Students may also have core courses waived without transfer of course credit. Students would still be responsible for the full credits required for each degree (31 credits for the MS and 63 credits for the Ph.D.), but would not have to take the waived course.
Agricultural and Marine Biotechnology: Therapeutics, Pharmacology, Nutritional Biochemistry, Food Science Technology

Bioprocessing/Applied Microbiology: Bioremediation, Fermentation, Biocatalysis, Applied Genetic Engineering, Biopharmaceutical Sciences

Molecular Biotechnology: Clinical Sciences, Biochemical Applications, Diagnostics, Therapeutics

**General Program Requirements**

The program of courses includes a core requirement, specialization requirement and capstone requirement. As students advance, they will have to meet requirements in addition to satisfactory completion of courses, lab experience and capstone project.

The Master of Science requires completion or transfer of at least 31 total credits. Students must meet the specific requirements of their "home campus" for such matters as grade averages, documentation of completion of requirements and registration for program continuation if needed. No courses receiving a grade below C (2.0) can receive credit. Grades earned below C are still calculated in the student's grade point average.

Students are limited in the number of Directed or Independent Study courses credits that they can apply toward their program. No more than 6 credits of coursework below the level of dissertation registrations may be in the form of Directed or Independent Study. All courses must be conducted at the graduate level.

Students must pursue and complete a program of study approved by their assigned advisor. The interdisciplinary nature of this program makes close contact between each student and his or her advisor important.

**Core Course Requirements (16 credits)**

The core courses provide a common foundation for all students, either from life science or physical science/engineering backgrounds. Proposed core courses must be approved by the IACC.

1. Introduction to Biomedical Engineering & Biotechnology (3 credits) This course should be taken in a students first semester in the program if possible. Team-taught introductory course that emphasizes a multidisciplinary approach to current topics in the range of academic disciplines and gives students their first exposure to faculty research areas. The course, as much as possible, will involve faculty from all participating campuses. We will also invite outside industry speakers to present topics of contemporary importance and offer joint lectures from guest speakers. Approved UMass Lowell course: IB 500: Introduction to Biomedical Engineering & Biotechnology (3 credits)

2. Laboratory Experience (3 credits) This course is designed to be a practical, hands-on lab rotation course and give students exposure to cutting-edge research methodology in a number of different areas, with a balance between biomedical engineering and biotechnology areas. A team approach will be encouraged as students employ various laboratory techniques to carry out short-term projects. Students will either rotate through a number of different experimental procedures within a single investigator's laboratory or rotate through multiple faculty laboratories, learning a particular type of methodology for with the laboratory may be noted and uses frequently. The course may also provide laboratory experiences/demonstrations at sister campuses and industrial sites where faculty members have affiliations. Approved UMass Lowell course BMBT-5500 BMEBT Laboratory Experience (3 credits), Students must satisfactorily complete at least one lab-based course. This could be BMBT-5500 or a lab-based course within their specialization.

3. Advanced Mathematics (3 credits) The core mathematics requirement offers two options: Advanced Numerical Methods, for those from a physical science, engineering or mathematics background, or Applied Mathematics for Life Scientists. Advanced Numerical Methods uses differential equations and statistics to examine engineering problems with biomedical examples/applications. Applied Mathematics for Life Scientists provides an intense treatment of the subject matter designed to achieve applied math literacy for students with life science and related backgrounds. An on-line version of this course will be available to all campuses. Approved UMass Lowell courses: CHEN.5390 Math Method for
Engineers (Recommended for students with a Biomedical Engineering specialization) PLAS.5480 Numerical Methods in Plastics Processing
MATH.5300 Applied Mathematics
IMATH.5310 Applied Mathematics
IMATH.5550 Applied Math for Life Sciences

Biotechnology specialization) RADI.5820 Numerical Methods in Radiological Sciences and Protection

Quantitative Physiology (3 credits) This course presents physiology at the organ system level with a quantitative approach. It helps integrate the curriculum for individuals with life science an engineering undergraduate backgrounds, permitting engineers and physical scientists a appreciation of how organisms function from the organ/system perspective and gives life scientists a more rigorous quantitative approach to physiology than is usual in undergraduate courses. Approved UMass Lowell course: BMBT-5750 Quantitative Physiology (3 credits)

Bioethics (1 credits) Current ethical issues in biomedical research will be included, with a review of legal/regulatory (e.g. FDA) considerations in the development of biological products and bringing them to market. This course is offered in seminar format with multi-campus participation and biotechnology industry guest speakers. Equivalent courses on the campuses may be substituted, although these might have additional credits. An on-line version of this course will be available to all campuses. Approved UMass Lowell course: BMBT-5200 Ethical Issues in Biomedical Research (1 credit)

Advanced Cell and Molecular Biology (3 credits) Rigorous treatment of topics in advanced cell and molecular biology, illustrating applied research through examples and presenting biochemistry concepts at the cell/molecular level. Approved UMass Lowell course: BIOL-6660 Special Topics: Molecular and Cellular Biology (3 credits)

Specialization Course Requirements (12 credits) Specialization courses will help the student attain depth in focused areas. Each specialization option represents an area in biotechnology or biomedical engineering, within which are found a selection of appropriate graduate courses. Faculty involved in each specialization will see to an appropriate combination of depth and breath in the student’s selection of specialization courses. They may announce some structure to the course selection allowed within the area. With the approval of their advisor, students will select 12 credits of course work (minimum) from within one or the specializations. Any graduate course approved by the advisor may be used to satisfy this requirement. Many specialization options will require more than 12 credits of additional course work. Capstone Requirements (3 credits) As students transition from coursework to some real time experience, they undertake a capstone project course. This is designed to be a culminating experience in which the student synthesizes course knowledge and experimental skills into a brief but detailed experimental study, which also involves cross-field interdisciplinary cooperation. Although in some cases this project may be done individually under the supervision of one faculty member, it is expected that students will join in a team-based, collaborative effort involving students from a number of different disciplines, post-doctoral fellow and industry representatives; with intercampus participation. Approved UMass Lowell course: BMBT-6000 Capstone Project (3 credits)

Annually in May, a Biomedical Engineering and Biotechnology Research Symposium will be held, rotating each year to a different campus, at which the students from all four campuses will present their projects in a poster session and/or orally. Participation in this non-credit activity is required.

Earning the Master of Science Degree Following successful presentation of the capstone project and with a minimum of 31 credits completed or transferred in required an approved courses, the student will be awarded the Master of Science degree as a credential along the way toward the doctorate. Students must have at least a cumulative B
average to receive the Master of Science degree and advance to the Qualifying Examination. (Students not working up to that level are subject to review for dismissal from the program. Specific standards are set for graduate students on each “home campus” for continuation in graduate programs.) Abstracts

International. **Professional Science Master's Option**

The Professional Science Master’s (PSM) option (http://www.uml.edu/Catalog/Graduate/UMass-system/Biomedical-engineering-biotech/Professional-Science-Masters.aspx) is a two-year program designed to enhance core science curricula with business fundamentals, communications, ethics and project management. Students put their skills and knowledge into practice during a required internship. (Students who are employed full-time may be able to substitute a project for the required internship.) The program provides its graduates with the following knowledge, skills and abilities:

- Competency in cutting-edge technical/laboratory/computer skills related to a wide range of instrumentation/procedures;
- The application of research in solving current biomedical/health problems especially in relationship to new discoveries in nanoscience and technology;
- The ability to function as interdisciplinary collaborators with strong critical thinking, inquiry-based analytical skills;
- The ability to work on integrated problems in multidisciplinary research teams;
- The development of written and oral presentation skills which will allow them to adapt highly scientific material to a variety of audiences;
- The development of problem solving skills using a multidisciplinary approach;
- Appreciation of the challenges of conducting/publishing research associated with contemporary biomedical ethical issues;
- Grantsmanship skills that will allow them to collaborate with researcher to obtain extramural private/federal research funding;
- Knowledge about intellectual property/patents/regulatory issues;
- The understanding of how theory/concepts are related to applied research.

The understanding of how applied research is conducted in an industrial setting; The understanding of how industry applies experimental research to equipment design/manufacturing/product development; As well as the skills listed above, the Ph.D. program (http://www.uml.edu/Catalog/Graduate/UMass-system/Biomedical-engineering-biotech/Doctoral-Program.aspx) aims to provide its doctoral recipients with the following additional knowledge, skills and abilities:

- The ability to formulate/test multiple, original scientific hypotheses related to their dissertation research based on careful observations and a comprehensive review of past and current literature in their field;
- The ability to design/carry out detailed experiments or develop theoretical models/numerical simulations;
- The application of their research in solving current biomedical/health problems especially in relationship to new discoveries in nanoscience and technology;
- The ability to function as independent researchers with strong critical thinking, inquiry-based analytical skills;
- The ability to critically interpret their research results, synthesizing findings from other investigators/previous studies, that will serve as the basis for developing new hypotheses;
- Written/Oral presentation skills resulting in publication of their findings and presentation of results at professional research conferences; and
- Grantsmanship skills that will allow them to obtain pre-doctoral and post-doctoral extramural private/federal research funding.

**Combined Bachelor's and Master's Degree Program**

The program participates in the University’s effort to encourage outstanding graduate students to begin study toward an advanced degree while still undergraduates. Arrangements are possible for joint programs, that combine a bachelor’s degree in one of the other departments in the University with a master’s degree in the Biomedical Engineering and Biotechnology program. Such arrangements are made for eligible students after discussions with graduate coordinators in both departments (see eligibility...
Master of Science in Biomedical Engineering and Biotechnology

Master of Science in Biomedical Engineering and Biotechnology, Professional Science Master’s (PSM) Option

- Program Description
- Admissions Requirements
- Curriculum
- Professional Internship

Program Description

The intercampus Biomedical Engineering and Biotechnology (BMEBT) program offers a 34-credit Master of Science Degree in Biomedical Engineering and Biotechnology, Professional Science Masters (PSM) option. This non-thesis program prepares students for a professional career and may be completed on either a full-time or part-time basis. In lieu of a research component, the PSM option requires PLUS courses in business, a communications course, and a professional internship in a specialization area of Biomedical Engineering or Biotechnology.

Individuals interested in the program include graduates of BS programs in biology, chemical engineering, chemistry, clinical laboratory science, computer science, electrical engineering, mathematics, mechanical engineering, physics, plastics engineering and polymer science. Other interested clientele include professionals that are currently employed in the pharmaceutical, biotechnology or medical device industries as well as medical and research labs who are interested in expanding and updating their knowledge in biomedical engineering/biotechnology while concurrently obtaining communication and business skills required for greater job opportunities. The combination of science and business training provided by this program meets the workforce needs of the Massachusetts economy, where healthcare, as well as biomedical and medical device companies, are leading industries.

Admission Requirements

1. Have earned an appropriate Baccalaureate degree from an accredited university or college with a recommended GPA of 3.0 or better.
2. Have successfully completed prerequisite technical courses: Applicants must have completed the equivalent of two semesters of calculus. Successful applicants will normally have also had undergraduate coursework in statistics/experimental design and in life science/biomedical science.
3. Have earned the following minimums: Graduate Record Examination (GRE) combined verbal and quantitative score of 295 (1000 for tests taken prior to August 1, 2011) and TOEFL score of 79 (internet based) for international applicants.

Curriculum*

The Master of Science in Biomedical Engineering and Biotechnology is a 34 credit hour program. Twenty-four credit hours of STEM courses, 9 credits of PLUS courses and a 1 credit internship and seminar are required.

STEM Required Courses (12 credits):
- BMBT.5000 Introduction to Biomedical Engineering & Biotechnology (3 credits)
- BMBT.5750 Quantitative Physiology (3 credits)
- BIOL.6660 Special Topics: Molecular and Cellular Biology (3 credits)

And one of the following 3 credit courses
- ENGY.5090 System Dynamics
- ENGY.5390 Math Methods for Engineers*
- PLAS.5480 Numerical Methods in Plastics Processing
- MATH.5300 Applied Mathematics I
- MATH.5310 Applied Mathematics II
- MATH.5550 Applied Math for Life Sciences (Online)+
- RADI.5820 Numerical Methods in Radiological Sciences and Protection

* Recommended for students with a Biomedical Engineering specialization.
+ Recommended for students with a Biotechnology specialization.

Additional STEM required courses may be chosen with advisor approval.
approval.

**STEM Electives (minimum 12 credits)**

STEM electives are chosen with advisor approval from the available science and engineering courses offered at the participating campuses. Electives are chosen from within a defined specialization option. Available options are listed below:

**Biomedical Engineering Specialization Options**

- Biomaterials: Tissue Engineering, Polymers/Plastics, Fibers/Textiles, Nanotechnology
- Biomedical Information Systems: Bioinformatics, Cheminformatics, Genomics, Proteomics
- Biomedical Instrumentation: Sensors, Signal Processing, Clinical Sciences
- Biomechanics: Joint/Muscle Mechanics
- Integrative Physiology: Cardiovascular and Pulmonary Modeling
- Medical Imaging: Optics, NMR, MRI, Acoustics, Cell Imaging
- Medical Physics: Radiation Therapy, Nuclear Medicine, Diagnostic Imaging, Nuclear Instrumentation

**Biotechnology Specialization Options**

- Agricultural and Marine Biotechnology: Therapeutics, Pharmacology, Nutritional Biochemistry, Food Science Technology
- Bioprocessing/Applied Microbiology: Bioremediation, Fermentation, Biocatalysis, Applied Genetic Engineering, Biopharmaceutical Sciences
- Molecular Biotechnology: Clinical Sciences, Biochemical Applications, Diagnostics, Therapeutics

**PLUS courses (Business and Communication 9 credits)**

**PLUS Required Courses (4 credits)**

- BIOL.6040 Professional Communication in Science and Technology (3 credits) OR MGMT.6540 Advanced Professional Communication (3 credits)
- BMBT.5200 Bioethics (1 credit)

**PLUS Elective Courses (minimum 5 credits)**

- ?ACCT.5010 Financial Accounting (2 credits)
- FINA.6400 Financing Innovation and Technology Ventures (3 credits)
- ?MKMT.5010 Marketing Fundamentals (2 credits)
- ?MKMT.6300 Market Research for Entrepreneurs (3 credits)
- ?POMS.5010 Operations Fundamentals (2 credits)
- ?ENTR.6500 Innovation and Emerging Technologies (3 credits)
- ?MGMT.5010 Organizational Behavior (2 credits)
- ?MGMT.6010 Managing Organizational Design and Change (3 credits)
- ?MGMT.6300 New Product Development (3 credits)
- ?MGMT.6510 Organizational Behavior (3 credits)
- ?MGMT.6520 Human Resources Management (3 credits)
- MGMT.6910 Strategy Formation and Implementation (3 credits)

Additional PLUS electives may be chosen with advisor approval.

**Professional Internship in Biomedical Engineering or Biotechnology (1 credit)**

A Professional Internship is required for students in the PSM option and is expected to be a minimum of 350 hours and have 3–6 month duration. The internship is designed to provide students with an opportunity to obtain real-world experience in business, government agencies, non-profit organizations or research laboratories. Internships or research project experiences will typically take place in clinical, pharmaceutical, diagnostic, biotechnological or medical device companies or institutions. Research experience can also be obtained at the University or other research centers.

Internships have to be approved in advance by the Advising/Admissions/Curriculum Committee (AACC) on each campus, including approval of a qualified supervisor for off-campus internships. The AACC will provide oversight of all internships. A written report, signed by the internship supervisor, must be submitted by the student upon completion of the internship. An oral presentation by the intern at a BMEBT seminar also is required. For students already employed in a BMEBT industry, the professional internship will be tailored to meet the needs of both employee and employer. A new project experience will be required that adds to the students current set of skills.

To be eligible for the Professional Internship, students will be
required to have:

1. completed a minimum of 12 credits of STEM courses,
2. completed a minimum of 6 credits of PLUS courses,
3. attained an overall minimum GPA of 3.0 and
4. have AACC permission.

All students will be required to submit a final written report and give oral presentation on their work at a seminar. All post-internship students will participate in this seminar. All Professional Internships require supervision by program faculty.

Professional Science Masters curriculum includes the following courses as part of the internship requirement:

- **PSM 500 Professional Science Masters Internship (0 credits)**
  Professional Science Masters students who are preparing to participate in an internship enroll in this Professional Development Seminar prior to the semester of their work period. This seminar will provide them with resources and skills to manage an internship search; secure a position; and work successfully in a professional environment.

- **PSM 501 Professional Science Masters Reflective Seminar (1 credit)**
  Reflective seminar concurrent with the internship enables Professional Science Masters (PSM) students to share and learn from the experiences of colleagues in other settings. Students evaluate and compare individual internship experiences, explore career opportunities and gain further knowledge about functioning in a professional environment. The seminar may be conducted online, on campus, or in a blended mode and may include writing and oral presentation of experience.

**Total (34 credits)**

* Note: Courses listed are available at UMass Lowell. Other STEM and PLUS courses are available at the other campuses involved in the BMEBT program and may be used towards the degree with the approval of the graduate coordinator.

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**Biomedical Engineering & Biotechnology Doctoral Program**

The Boston, Dartmouth, Lowell and Worcester campuses of the University of Massachusetts offer a joint Ph.D. degree program in Biomedical Engineering and Biotechnology. Students in the Ph.D. program may elect to receive the MS degree along the way to the doctorate.

- **Admission Requirements**
- **Academic Advisor**
- **Transfer of Credits/Advanced Standing**
- **Academic Program**
- **General Program Requirements**
- **Core Course Requirements**
- **Specialization Course Requirements**
- **Capstone Requirement**
- **Earning the MS Degree**
- **Selection of the Doctoral Dissertation Committee**
- **Qualifying Examination**
- **Doctoral Credit Requirements**
- **Dissertation Defense**
- **Professional Science Master’s Option**
- **Combined Bachelors to Masters Degree Program**

**Admission Requirements**

Applicants from many different science/engineering undergraduate programs are invited to apply. Because the degree brings together biomedical engineering with biotechnology, it is designed equally for students with life sciences or engineering/physical science backgrounds. Ones specific background will be of less interest in determining qualification for entrance than will be ones personal and career goals, demonstrated academic ability and research potential, and commitment to an interdisciplinary, team-work approach.

Applications will be accepted from individuals holding appropriate bachelors degrees or masters degrees (or the US baccalaureate equivalents from a foreign institution). Applicants should have a background in life science, physical science, or engineering. All applicants must have taken a full year (two semester or three quarter sequence) of calculus, and the successful applicants will normally have had undergraduate coursework in statistics/experimental design and in life science/biomedical science.

Applicants are encouraged to contact participating faculty to explore how they might fit into a specific specialization option before submitting their application and to report on the results of those contacts in their Statement of Purpose (see below). A personal interview with the applicant by the campus Advising/Admissions/Curriculum Committee (AACC) may be
recommended but is not required.

Applicants submit the following and are expected to meet the standards indicated:

- Generally students with an overall undergraduate grade point average of 3.0 or higher will be considered for admission. Applicants must present official undergraduate and graduate transcripts from all schools attended.

- Applicants accepted into the program should present a minimum Graduate Record Exam (GRE) combined verbal and quantitative score of 300 (1100 for tests taken prior to August 1, 2011). The AACC will also pay particular attention to the applicants score on the GRE analytical writing section of the general examination because of the emphasis placed on strong writing skills in this program. Only official GRE scores from the Educational Testing Service will be considered acceptable.

- Applicants must have a minimum of two semesters of calculus and have strong quantitative skills.

- International applicants should present a minimum Test of English as a Foreign Language (TOEFL) score of 79 (internet version), 213 (computer version) or 550 (paper version). Only official TOEFL scores from the Educational Testing Service will be considered acceptable.

- Three letters of recommendation, from individuals familiar with the applicants academic ability and potential to conduct original research at the doctoral level, will be required.

- Applicants will also be required to submit a Statement of Purpose (personal essay). This statement is an important element in the application packet. It has two related roles:

  1. Indication of an applicants qualifications and motivation for the program. Applicants should indicate their qualifications for and motivation to undertake this program as well as their personal and career goals. Specifically, the statement should indicate the applicants background, research credentials, and career plans as they relate to the multidisciplinary nature of the doctorate, and discuss your research experience (academic, industrial) and include any publications and grants/patents, and

  2. Indication of how an applicant will fit into the program. Applicants should indicate their specific areas of interest within Biomedical Engineering and Biotechnology, so that a fit between their interests and qualifications and the specific specialization options that the program offers can be determined. If the applicant has a specific interest in working with one or more of the program’s faculty, they should describe that specific interest and identify those faculty member(s). The Statement of Purpose should also exemplify the applicants writing skills.

- We invite applicants also to submit a personal rsum.

Individual circumstances can be taken into account, and extraordinary qualifications in some areas can be used to outweigh weaknesses in others.

Along with an admissions decision comes consideration of the appropriate program of courses for the applicant. The interdisciplinary nature of our program gives special importance to the advising relationship in forming a specific academic program to meet each students specific goals. Applicants may be offered admission with a number of courses identified as conditional requirements that they will need to take to fill in for gaps in preparation or knowledge. Each admitted student is assigned to a faculty advisor, who is identified in the letter of admission. Acceptance into the program is subject to the availability of appropriate advisors.

Academic Advisor

Campus AACC’s are responsible for overseeing the advising components of the program, which are initiated while each student is still an applicant. Students will be assigned a faculty advisor when they are accepted into the program. The initial faculty advisor will either be a member of the AACC or a program faculty determined based on the applicants Statement of Purpose. After the student’s first year in the program, the student may want to change to a new advisor that fits the student’s research interest and is likely to become the chair of the student’s dissertation committee.

Transfer of Credits/Advanced Standing

For students who have previously completed graduate course work, the admissions committees on each campus may approve the transfer of graduate credits for courses from an accredited US college or university that received a grade of B (not B-) or better if those courses were not already used in the degree requirements of another earned degree. The graduate school at each campus will govern the maximum number of credits that
may be transferred into the program. The transfer credit may replace core or specialization course requirements. The project/directed studies, seminar and dissertation research credits will not be accepted for transfer from institutions outside of the UMass system.

Students may also have core courses waived without transfer of course credit. Students would still be responsible for the full credits required of each degree (31 credits for the MS and 63 credits for the PhD), but would not have to take the waived course.

Students who join the program with an earned masters degree may receive "Advanced Standing" in the doctoral program. The number of credits required to complete the PhD will be determined by the home campus AACC, but at a minimum 9 course (core or specialization) credits, the capstone project course (3 credits), doctoral seminar (taken twice, 1 credit each) and 30 dissertation research credits will be required. The capstone project may be waived for students who have completed a masters thesis or research project at one of the UMass campuses. These students will be required to complete a minimum of 12 course (core or specialization) credits. Students with Advanced Standing will be required to pass the Qualifying Examination before progressing to the dissertation stage. Doctoral students who enter the program with advanced standing will not earn the MS. To earn the MS, a student must complete or transfer in credit to meet the core (16 credits), specialization (12 credits), and capstone project course (3 credits) requirements.

Academic Program

The curriculum is organized around common experiences, including common core courses, a capstone project, and intercampus graduate research presentations. The program makes some use of distance learning/on-line/faculty exchange for delivery of courses and seminars, and the campuses are close enough to permit commuting between them. The program encourages a multidisciplinary team approach during the Instrumentation and Laboratory Experience, the capstone project, and in the selection of the dissertation committee. Industry representation occurs in the introductory core course, in the capstone project, in the doctoral seminar series, and from an outside advisory group. In addition, each student pursues a sequence of courses and then completes a focused research project leading to a doctoral dissertation in a specialization option.

Biomedical Engineering Specialization Options

- Biomedical Instrumentation: Sensors, Signal Processing, Clinical Sciences
- Biomechanics: Joint/Muscle Mechanics
- Integrative Physiology: Cardiovascular and Pulmonary Modeling
- Medical Imaging: Optics, NMR, MRI, Acoustics, Cell Imaging
- Medical Physics: Radiation Therapy, Nuclear Medicine, Diagnostic Imaging, Nuclear Instrumentation

Biotechnology Specialization Options

- Agricultural and Marine Biotechnology: Therapeutics, Pharmacology, Nutritional Biochemistry, Food Science Technology
- Bioprocessing/Applied Microbiology: Bioremediation, Fermentation, Biocatalysis, Applied Genetic Engineering, Biopharmaceutical Sciences
- Molecular Biotechnology: Clinical Sciences, Biochemical Applications, Diagnostics, Therapeutics

General Program Requirements

The program of courses includes a core requirement, specialization requirement, and capstone requirement. As students advance, they will have to meet requirements in addition to satisfactory completion of courses, including participation in seminars and symposiums, passing a qualifying examination, defending a dissertation proposal, completing a dissertation, and a dissertation defense.

The PhD requires completion or transfer of at least 63 total credits (or a minimum of 44 credits for students with advanced standing due to an existing MS degree). Students must meet the specific requirements of their "home campus" for such matters as grade averages, documentation of completion of requirements, registration for program continuation if needed, and submitting the final dissertation to the library. No course receiving a grade below C (2.0) can receive credit. Grades earned below C are still calculated in the students grade point average.

Students are limited in the number of Directed or Independent Study course credits that they can apply toward their program. No more than 6 credits of coursework below the level of dissertation registrations may be in the form of Directed or Independent Study. All courses must be conducted at the graduate level.

Students must pursue and complete a program of study
approved by their assigned advisor. The interdisciplinary nature of this program makes close contact between each student and his or her advisor important.

Core Course Requirements

The core courses provide a common foundation for all students, either from life science or physical science/engineering backgrounds. Proposed core courses must be approved by the IACC.

1. Introduction to Biomedical Engineering & Biotechnology (3 credits)

This course should be taken in a student's first semester in the program if possible. Team-taught introductory course that emphasizes a multidisciplinary approach to current topics in the range of academic disciplines and gives students their first exposure to faculty research areas. The course, as much as possible, will involve faculty from all participating campuses. We will also invite outside industry speakers to present topics of contemporary importance and offer joint lectures from guest speakers.

Approved UMass Lowell course: BMBT.5000, Introduction to Biomedical Engineering & Biotechnology (3 credits)

2. Instrumentation and Laboratory Experience (3 credits)

This course is designed to be a practical, hands-on lab rotation course and give students exposure to cutting-edge research methodology in a number of different areas, with a balance between biomedical engineering and biotechnology areas. A team approach will be encouraged as students employ various laboratory techniques to carry out short-term projects. Students will either rotate through a number of different experimental procedures within a single investigator's laboratory or rotate through multiple faculty laboratories, learning a particular type of methodology for which the laboratory may be noted and used frequently. The course may also provide laboratory experiences/demonstrations at sister campuses and industrial sites where faculty members have affiliations.

Approved UMass Lowell course: BMBT.5500 BMES Instrumentation and Laboratory Experience (3 credits)

3. Advanced Mathematics (3 credits)

The core mathematics requirement offers two options:

1. Advanced Numerical Methods, for those from a physical science, engineering or mathematics background or

Advanced Numerical Methods uses differential equations and statistics to examine engineering problems with biomedical examples/applications. Applied Mathematics for Life Scientists provides an intense treatment of the subject matter designed to achieve applied math literacy for students with life science and related backgrounds. An on-line version of this course will be available to all campuses.

Approved UMass Lowell courses:

- ENGY.5090 System Dynamics (3 credits)
- ENGY.5390 Math Methods for Engineers (3 credits)*
- ENGY.5480 Numerical Methods in Plastics Processing (3 credits)
- MATH.5300 Applied Mathematics I (3 credits)
- MATH.5310 Applied Mathematics II (3 credits)
- MATH.5550 Applied Math for Life Sciences (3 credits, online) +
- RADI.5820 Numerical Methods in Radiological Sciences & Protection (3 credits)

* Recommended for students with a Biomedical Engineering specialization.
+ Recommended for students with a Biotechnology specialization.

4. Quantitative Physiology (3 credits)

This course presents physiology at the organ system level with a quantitative approach. It helps integrate the curriculum for individuals with life science and engineering undergraduate backgrounds, permitting engineers and physical scientists an appreciation of how organisms function from the organ/system perspective and gives life scientists a more rigorous quantitative approach to physiology than is usual in undergraduate courses.

Approved UML course: BMBT.5750 Quantitative Physiology (3 credits)

5. Bioethics (1 credit)

Current ethical issues in biomedical research will be included, with a review of legal/regulatory (e.g., FDA) considerations in the development of biological products and bringing them to market. This course is offered in seminar format with multi-campus participation and biotechnology industry guest speakers. Equivalent courses on the campuses may be substituted, although these might have additional credits. An on-line version of this course will be available to all campuses.

Approved UMass Lowell course: BMBT.5200 Ethical Issues in Biomedical Research (3 credits)

Advanced Cell and Molecular Biology (3 credits)
Rigorous treatment of topics in advanced cell and molecular biology, illustrating applied research through examples and presenting biochemistry concepts at the cell/molecular level.

Approved UMass Lowell course: BIOL.6660 Special Topics: Molecular and Cellular Biology (1 credit)

6. Advanced Cell and Molecular Biology (3 credits)

Rigorous treatment of topics in advanced cell and molecular biology, illustrating applied research through examples and presenting biochemistry concepts at the cell/molecular level.

Approved UMass Lowell course: BIOL.6660 Special Topics: Molecular and Cellular Biology (3 credits)

Specialization Course Requirements

Specialization courses will help the student attain depth in focused areas. Each specialization option represents an area in biotechnology or biomedical engineering, within which are found a selection of appropriate graduate courses.

Faculty involved in each specialization will see to an appropriate combination of depth and breadth in the students selection of specialization courses. They may announce some structure to the course selections allowed within the area. With the approval of their advisor, students will select 12 credits of course work (minimum) from within one of the specializations. Any graduate course approved by the advisor may be used to satisfy this requirement. Many specialization options will require more than 12 credits of additional course work.

Capstone Requirement

As students transition from coursework to dissertation research, they undertake a capstone project course. This is designed to be a culminating experience in which the student synthesizes course knowledge and experimental skills into a brief but detailed experimental study, which also involves cross-field interdisciplinary cooperation. Although in some cases this project may be done individually under the supervision of one faculty member, it is expected that students will join in a team-based, collaborative effort involving students from a number of different disciplines, post-doctoral fellows, and industry representatives; and with intercampus participation.

Approved UMass Lowell course: BMBT.6000 Capstone Project (3 credits)

Annually in May, a Biomedical Engineering and Biotechnology Research Symposium will be held, rotating each year to a different campus, at which the students from all four campuses will present their projects in a poster session and/or orally. Participation in this non-credit activity is required.

Earning the MS Degree

Following successful presentation of the capstone project and with a minimum of 31 credits completed or transferred in required and approved courses, the student will be awarded the Master of Science degree as a credential along the way toward the doctorate. Students must have at least a cumulative B average to receive the MS degree and advance to the Qualifying Examination. (Students not working up to that level are subject to review for dismissal from the program. Specific standards are set for graduate students on each “home campus” for continuation in graduate programs.)

Selection of the Doctoral Dissertation Committee

As they move through this stage of their program, students will select their Doctoral Dissertation Committee, with one person as the major advisor. A committee must have at least three members (in some cases individual campus requirements may result in a higher minimum). The advisor and at least one other dissertation committee member must be chosen from the approved faculty of the Biomedical Engineering and Biotechnology program. Having one member of a dissertation committee be an outside industry scientist or engineer is encouraged.

Two models are provided for the dissertation committee, the intercampus and the intracampus committee structures:

The intercampus structure, which is strongly recommended, has one faculty member from a campus other than the candidates home campus. It is expected that all three members will not represent the same academic departmental affiliation.

The intracampus committee structure has faculty just from the home campus. It is expected that all three members will not be from the same academic department.

Each students committee is approved by the campus AACC, which will also approve any changes to a previously-approved committee.

Qualifying (Written) Examination

Students must pass a written qualifying examination that will cover questions on course work as well as experimental procedures the student has utilized. All material in the student’s curriculum is subject to examination. The examination must be taken within one year after completion of the MS Biomedical Engineering and Biotechnology requirements, or within two years after entering the program for a student with advanced standing.

Doctoral students, in consultation with their advisor, will identify two topic areas in which to be examined. At least one of the topics must be primarily engineering/technological in nature (for example, solid mechanics), and another primarily biological/medical in nature (for example, pathophysiology of musculoskeletal disorders). Proposals for the qualifying examination must be submitted to the AACC with approval of
Doctoral students will register for a minimum of 30 credits of doctoral research with their faculty advisor (dissertation chair). They will use these credits during preparation and defense of the dissertation proposal, carrying out their dissertation research and preparation and defense of the doctoral dissertation.

Approved UMass Lowell course: BMBT.7590 Dissertation Research (1-9 credits)

3. Dissertation Proposal (Oral Preliminary Examination)

Students must present for approval a written dissertation proposal and then defend it in an oral presentation to his or her dissertation committee. The dissertation proposal will follow the format established for NIH proposals, including the page limits, and will perform an extensive review of the literature on the student's chosen topic, present original hypotheses, design experiments to test the hypotheses, document the appropriate methodology that will be used, project anticipated results, and indicate how such results might be interpreted. The proposal must show application to current biomedical/biotechnological problems. After successfully defending the dissertation proposal, the student attains the designation "doctoral candidate". Failure to pass the defense of the dissertation proposal (oral examination) results in dismissal from the Ph.D. program.

Dissertation Defense

The doctoral candidate will defend his/her written dissertation before the doctoral dissertation committee, the University, and the outside community. The specific format of the defense is usually decided by the committee chair, but a typical format consists of the Ph.D. candidate first presenting an overview of the thesis research, then answering specific questions asked by the committee members. Questions may test anything from knowledge of the existing literature, to scrutinization of the material and methods or experimental design, to the assumptions in the research, to the interpretation of the results, to recommendations for future work. If the candidate has worked closely with his or her advisor, and committee, it is likely that there will be no surprises at this final stage of the process. It is common, however, for the committee to ask that certain minor revisions be made to the written dissertation before final submission. Successful defense of the dissertation and submission of the finished work to the library will result in the awarding of the Ph.D. in Biomedical Engineering and Biotechnology. Dissertations must be filed with Dissertation Abstracts International.

Combined Bachelor's and Master's Degree Program

The program participates in the University's effort to encourage outstanding graduate students to begin study toward an advanced degree while still undergraduates. Arrangements are possible for joint programs that combine a bachelor's
degree in one of the other departments in the University with a master's degree in the Biomedical Engineering and Biotechnology program. Such arrangements are made for eligible students after discussions with graduate coordinators in both departments (see eligibility requirements).

Graduate Certificate Programs in Biomedical Engineering and Biotechnology

There are six graduate certificates offered by UMass Lowell departments that are associated with the intercampus Biomedical Engineering and Biotechnology Program. With the approval of the degree granting department, graduate certificate course credit may be applied to master's and doctoral degree programs.

- Biomedical Engineering
- Biotechnology and Bioprocessing
- Disability Outcomes
- Environmental Biotechnology
- Medical Plastics Design and Manufacturing
- Molecular and Cellular Biotechnology

Download Graduate Certificate Application Form (pdf) (https://www.uml.edu/docs/Graduate%20Certificate%20App%20Only%20082016_tcm18-3292.pdf)
BMBT.5000 Introduction to Biomedical Engineering & Biotechnology (Formerly IB 500) - Credits: 3

Team-taught introductory course that emphasizes a multidisciplinary approach to current topics in the range of academic disciplines and gives students their first exposure to faculty research areas. The course, as much as possible, will involve faculty from within Biomedical Engineering and Biotechnology. The course, as much as possible, involves faculty from all participating campuses. Speakers from industry are also invited to present topics of contemporary importance.

BMBT.5120 Medical Image Processing (Formerly IB 512) - Credits: 3

This course will focus on post-acquisition manipulation and analysis used clinically and in research. Techniques for processing N-dimensional images acquired using several different medical image modalities will be studied including basic image visualization, filtering, segmentation and registration. The emphasis will be on engineering methods &techniques rather than a rigorous mathematical investigation of algorithms and theory. Programming will not be required, but homework and projects will require use of an open-source software tool, ImageJ, to perform image processing tasks. [NOTE: Many students in prior semesters have expressed a preference for using MATLAB from Mathworks for image processing. All assignments can be completed using either ImageJ OR MATLAB].

BMBT.5130 Biomedical Analytics & Informatics (Formerly IB 513) - Credits: 3

The focus of this course will be on the analysis of large biomedical data sets using the R Programming Language, an open-source programming language with several development platforms freely available for Windows, Mac, and Linux. The central topics will cover basic data analytics methods applying the widely used data analysis tool, R. This course will not focus on any specific biotechnology area. Many of the analytical skills obtained can be applied across a number of biomedical applications. The syllabus also covers an overview of major biomedical "Big Data" areas. Students may implement their final course project using a dataset in any biomedical application area of their choosing, i.e. genomics, medical imaging, health policy informatics, and personal health monitoring. There is no programming pre-requisite for this course. Students must have the willingness and capacity to learn how to apply R Programming.

BMBT.5160 Basic Principles of Nuclear Magnetic Resonance Imaging (Formerly IB 516) - Credits: 3

The goal of this course is to provide the student with a general understanding of the physical principles of magnetic resonance imaging (MRI) and the instrumentation used to create a magnetic resonance image. This goal will be sought without deep exploration of any particular physical science or mathematical discipline. Background knowledge in freshman-level science and mathematics courses is assumed. The topics to be covered in this course include: 1) theoretical and experimental aspects of MRI and their application to problems in medicine and biology, 2) physical principles underlying the generation and detection of the nuclear magnetic resonance signal, 3) MRI instrumentation, and 4) Nuclear magnetic resonance relaxation parameters and how they affect contrast in a magnetic resonance image.

BMBT.5170 Embedded System Design in Medical Systems (Formerly IB 517) - Credits: 3

This course covers the design principles of embedded systems including both the hardware and software aspects. We will introduce the design methodology and cost effectiveness of embedded systems. We will discuss the microprocessor, memory and storage subsystems. The interfacing between the computer system and medical instruments will be reviewed. Firmware, operating systems, programming tools will be considered. The course will have a lab component that includes hands-on exercises of embedded Linux (or RTEMS) in an online virtual laboratory environment.

BMBT.5200 Ethical Iss. Biomedical (Formerly IB 520) - Credits: 1

BMBT.5250 Introduction to Translational Science (Formerly IB 525) - Credits: 3

Introduction to Translational Science will introduce students to the elements of translational research and is targeted toward individuals who have no prior experience with clinical or translational research. This course will focus on the principles and practices of translational medicine as they apply to the development of a new drug (small molecules and/or biologics), device, or diagnostic. The course will cover the following topics: Defining translational research, pre-clinical development of novel targets and leads, clinical development, the regulatory process, the design of the first-in-human clinical trial, protecting human subjects and managing clinical data.

BMBT.5300 Ergonomics and Work - Credits: 3

An overview of the scientific basis for design of the workplace to optimize physical and mental interaction of workers with machines, tools, and work methods. Topics include work measurement, anthropometry, biomechanics, work physiology, cumulative trauma disorder and information presentation and processing.
BMBT.5310 Occupation Biomechanics - Credits: 3
The anatomical and physiological basis of human motor capabilities. Quantitative models are developed to explain muscle strength performance, motion control, physical fatigue, and acute and chronic musculoskeletal trauma, particularly static link models of lifting and other manual activities. Application to the evaluation and design of various tasks and occupations.

BMBT.5320 Occupational Biomechanics Laboratory - Credits: 3
A laboratory presentation of the biomechanical basis for understanding and predicting human motor capabilities using bioinstrumentation. Computerized data acquisition, electromyography and load cells for strength measurement are examples of the equipment used in this lab. Particular emphasis is placed on the evaluation of occupational activities.

BMBT.5400 Occupational Safety Engineering - Credits: 3
The purpose of this course is to introduce students to the principles of safety hazards in the work environment. This course is primarily designed to emphasized the safety aspects to the hazards at work. It begins with the historical development of occupational safety and health and progressively examines the fundamentals of recognition, measurement, evaluation, and control of occupational safety hazards.

BMBT.5500 BMBT Laboratory Experience (Formerly IB 550) - Credits: 3
BMBT.5750 Quantitative Physiology (Formerly IB 575) - Credits: 3
This course presents physiology at the organ system level with a quantitative approach. It helps integrate the curriculum for individuals with life science and engineering undergraduate backgrounds, permitting engineers and physical scientists an appreciation of how organisms function from the organ/system perspective and gives life scientists a more rigorous quantitative approach to physiology than is usual in undergraduate courses.

BMBT.6000 Capstone Project (Formerly IB 600) - Credits: 3
BMBT.6010 Sem: Biomedical Engineering & Biotechnology (Formerly IB 601) - Credits: 3
The goal of the seminar is to have students develop effective writing and speaking skills required for preparation of research papers and professional presentations. The course emphasizes the importance of clear, concise writing style and delivery of presentations to both scientists and the lay public. Outside readings are designed to critically evaluate contemporary issues related to: disclosure and conflict of interest, publishing ethics, the balance of research, security, and publishing censorship, electronic science collaborations, and the social implications of science. Preparation of research grant proposals, the curriculum vitae, and poster presentations, and the submission of manuscripts for publication are also reviewed.

BMBT.6050 1-Credit Continued Capstone Project (Formerly IB 605) - Credits: 1
1-Credit Continued Capstone Project course is for students who need an extra semester to complete their capstone. Part of reduced course load program for international students.

BMBT.6320 Advanced Biomechanics - Credits: 3
A course in advanced biomechanical modeling methods, covering three dimensional static models, optimization methods and dynamic models. Special emphasis will be placed on biomechanical models of the hand. Time will also be dedicated to reviewing current developments in the scientific literature.

BMBT.6380 Methods of Work Analysis - Credits: 3
Criteria for selection of an approach to ergonomic job analysis depend on the combination of exposures (Micro- and Macro-level ergonomic stressors) observed to be present as well as the analytical goal. Many ergonomic analysis techniques are based on traditional industrial engineering approaches (time-motion study and work sampling), applied to the identification and evaluation of potential risks to workers' health. A variety of methods, both observational and instrumental, will be discussed; laboratory sessions will permit hands-on application of several of these for critical evaluation.

BMBT.7100 Directed Study (Formerly BMBT 710) - Credits: 1-3
BMBT.7110 Directed Studies (Formerly IB 711) - Credits: 1
BMBT.7120 Directed Studies (Formerly IB 712) - Credits: 2-3
BMBT.7200 Independent Study (Formerly IB 720) - Credits: 3
BMBT.7210 Independent Study (Formerly IB 721) - Credits: 1
BMBT.7220 Independent Study (Formerly IB 722) - Credits: 1-3
Credits: 2
BMBT.7560 Doctoral Dissertation (Formerly IB 756) -
Credits: 6
BMBT.7590 Dissertation Research (Formerly IB 759) - Credits: 1-9
BMBT.7700 CPT - Co-op Training (Formerly IB 770) -
Credits: 1
Course required to perform CPT
BMBT.7710 CPT- Co-op Training (Formerly IB 771) -
Credits: 0-1
Course required to perform CPT
BMBT.7800 Thesis Review (Formerly IB 780) -
Credits: 1
Thesis Review
Chemical Engineering

Department of Chemical Engineering

The Department of Chemical Engineering at UMass Lowell offers a wide variety of advanced degree programs.

- Doctor of Engineering (D.Eng.)
- Chemical Engineering Option
- Energy Engineering Option
- Doctor of Philosophy (Ph.D.)
- Chemical Engineering Option
- Energy Engineering Option
- Doctorate in Philosophy in Physics (Ph.D.)
- Energy Engineering Option (see Physics Dept.)
- Master of Science in Chemical Engineering (M.S.E.)
- Chemical Engineering
- Energy Engineering (Nuclear Option)
- Graduate Certificates
- Biotechnology and Bioprocessing
- Materials Science and Engineering
- Modeling, Simulation, and Control of Systems and Processes
- Combined BS/MS Engineering Program

The departmental programs encompass both traditional areas of chemical and nuclear engineering and modern frontier areas such as advanced engineered materials, biotechnology, and computer aided process design and controls. The department encourages cooperative university-wide efforts, especially in areas such as bioengineering, materials and recycling.

Master's Program

Master of Science in Chemical Engineering Degree Program

The UMass Lowell program in Chemical Engineering is designed to provide the opportunity for graduate students to study the fundamentals and applications of chemical engineering principles, and to carry out independent research.

Admission Requirements

The Department will consider students for enrollment in the Chemical Engineering program who have a BS degree in engineering or science. Those students who do not have an undergraduate degree in Chemical Engineering are required to take complete CHEN.4030 Chemical Reaction Eng., CHEN.5100 Advanced Separation Processes, CHEN.5200 Advanced Thermodynamics, CHEN.5280 Advanced transport Phenomena, and CHEN.5390 Mathematical Methods for Engineers for a total of 15 credits which, if successfully completed, may be used toward the masters or doctoral degree. These students are expected to prepare adequately for these courses through self-study but CHEN.6510/2 can also be utilized. It is highly recommended that such students complete four years of mathematics through differential equations, one year of organic chemistry and one semester of physical chemistry, prior to enrolling in the graduate program.

All applicants must submit all required application materials and fees as specified by the Graduate Admissions Office.

Advisors and Advisory Committee

The Graduate Coordinator will be the academic advisor for each student, to help remedy deficiencies in prerequisites, select electives if most value and plan the overall study program. For those completing a thesis, the thesis advisor will chair the advisory committee, which will guide the student in his or her research and supervise the completion of thesis requirements.

Plan of Study

Each student shall file an approved plan of study with the Department Chairperson and Graduate Coordinator. This form will contain a listing of the courses, which will make up his or her program. Any changes must have the approval of the Department Graduate Coordinator.

Credit Requirements

The Master of Science degree in Chemical Engineering requires the successful completion of 30 credit hours. Students may elect one of two options:

1. 24 credit hours of course work, plus at least 6 credit hours in preparation of an acceptable thesis, or
2. 30 credit hours of course work for the non-thesis option. Students who have received a teaching or research assistantship will be required to submit an acceptable thesis. A thesis must be defended in an oral examination conducted by the student’s thesis committee.

All students must enroll in at least two semesters of graduate seminar (CHEN.601/602) during the period of study. (These are zero credit seminars.)

Core Requirements

The core requirements will consist of one course in advanced
mathematics, one course in thermal/fluid processes and one course in solid mechanics. A minimum of four total courses must be taken from the following core areas.

**Advanced Mathematics**

- CHEN/ENGY.5090 System Dynamics
- CHEN/ENGY.5390 Mathematical Methods for Engineers

**Thermal/Fluid Processes**

- CHEN.5100 Advanced Separation Processes
- CHEN.5200 Advanced Thermodynamics
- CHEN.5280 Advanced Transport Phenomena

**Solid Mechanics**

- CHEN.5060 Colloidal, Interfacial & Nanomaterials Science and Engineering
- CHEN.5080 Material Science and Engineering (Not for those who graduated from UMass Lowell)
- CHEN.5230 Nanodevices and Electronic Materials
- CHEN.5250 Design and Packaging of Materials
- CHEN.5350 Cell and Microbe Cultivation

**Thesis**

Each student who chooses to complete a thesis will be required to complete six credits of thesis and must defend the thesis when completed according to University regulations. The research work for the thesis shall be conducted under the supervision of a department faculty advisor and a committee of two others for the thesis. The student must prepare and submit an acceptable proposal for the thesis prior to beginning the work.

During the period the student is enrolled in graduate thesis, he or she may be required to submit to the faculty of the department a brief monthly report, showing progress in his or her thesis or project and approval by his or her advisor.

**Elective Requirements**

The remainder of the course requirements are to be made up of elective courses. See the elective course listing under the Doctoral Program.

**Doctoral Programs**

**Doctoral Programs in Chemical Engineering**

- Doctor of Engineering (D.Eng.) and Doctor of Philosophy

**D.Eng. and Ph.D. - Chemical Engineering Option or Energy Engineering Option (Nuclear Engineering Concentration)**

**Objectives**

The Doctor of Engineering/Doctor of Philosophy degree is designed to prepare engineers for leadership positions in industry, academia and government. The program includes advanced graduate course work in engineering and allied subjects.

**Admission Requirements**

The applicant is required to have at least a B.S. degree in engineering or science. A student may apply to transfer up to 24 credit hours of applicable graduate course work toward the doctoral degree. In cases where a student has an M.B.A., in addition to the B.S. degree or its equivalent, the management portion of the Doctor of Engineering program may be waived. Students who do not have adequate preparation in chemical engineering may be required to take additional courses to make up deficiencies.

**Degree Requirements**

A total of 63 credit hours of graduate level courses are required for the doctoral degree. The general degree requirements follow:

1. Forty two (42) approved credit hours of graduate level engineering courses including the core requirements.
2. A two course sequence in advanced mathematics (with approval of the graduate coordinator).
3. For the D. Eng degree, nine (9) credit hours of approved management/non-technical courses is substituted for nine credit hours of engineering courses.
4. Twenty-one (21) credit hours for the dissertation.
5. Students must enroll in at least two semesters of graduate seminar.
6. The student is required to be in full time residence at the University for at least one year.
7. The student must have a minimum grade point average of
3.25 in order to graduate. Exceptions may be made for students whose Masters Degree is in a discipline other than engineering. Students may register for no more than six credit hours of research in preparing a formal dissertation proposal. This proposal and the students ability to perform research must be orally defended before the students doctoral committee and other interested parties. This constitutes their candidacy examination. Upon passing this examination and completing all course requirements, the student becomes a candidate for the doctoral degree and may register for additional research credit with the advisors approval.

Core Requirements

The core requirements will consist of two courses in advanced mathematics, two courses in thermal/fluid processes and one course in solid mechanics. The specific courses follow:

Advanced Mathematics:
- CHEN/ENGY.5090 Systems Dynamics
- CHEN/ENGY.5390 Mathematical Methods for Engineers

Thermal/Fluid Processes (select two of the following):
- CHEN.5100 Advanced Separation Processes
- CHEN.5200 Advanced Thermodynamics
- CHEN.5280 Advanced Transport Phenomena

Solid Mechanics (select one of the following):
- CHEN.5060 Colloidal, Interfacial and Nanomaterials Science and Engineering
- CHEN.5080 Material Science and Engineering
- CHEN.5230 Nanodevices and Electronic Materials
- CHEN.5250 Design and packaging of Materials
- CHEN.5290 Advances in Nanotechnology and Green Chemistry
- CHEN.5330 Macromolecular Science and Engineering
- CHEN.5350 Cell and Microbe Cultivation
- CHEN.5410 Nanostructural Characterization by SEM, TEM and AFM
- MECH.5xxx (Any Dept of Mechanical Engineering graduate level materials course approved by the student’s advisor)
- PLAS.5xxx (Any Dept of plastics Engineering graduate level materials course approved by the student’s advisor)

Elective Requirements

A total of 27 credits of elective courses must be taken. For the Chemical Engineering Option, the courses will be from either the processing, materials or biotechnology/bioprocessing area. For the Nuclear Concentration in the Energy Option, the courses will be from the nuclear area. The specific courses in those areas follow:

Processing (in addition to the core courses):
- CHEN.5060 Colloidal, Interfacial and Nanomaterials Science and Engineering

Materials (in addition to the core courses):
- CHEN.5180 Microprocessor Control
- CHEN.5220 Computer-Aided Chemical process Design
- CHEN.5300 Advanced Control Strategies
- CHEN.5330 Macromolecular Science and Engineering
- CHEN.5350 Cell and Microbe Cultivation
- CHEN.5450 Isolation and purification

Biotechnology/Bioprocessing (in addition to the core courses):
- CHEN.5350 Cell and Microbe Cultivation
- CHEN.5380 Advanced Separations in Biotechnology
- CHEN.5450 Isolation and purification
- CHEN.5550 Biopharmaceutical Regulatory Compliance
- CHEN.5860 Bioprocessing projects Laboratory
- BIOL.5190 Biochemistry I
- BIOL.5760 Cell Culture
- BIOL.5xxx (Any Dept of Chemistry graduate level materials course approved by the student’s advisor)

Nuclear (in addition to the core courses):
Qualifying Examination

1. The student is permitted two attempts at passing the qualifying examination which is administered on a declared schedule. Students who fail the qualifying examination the first time must retake the exam at its next scheduled offering. Students failing the doctoral exam twice will automatically be dismissed from the doctoral program. Those who do not take the examination at the prescribed time may lose all their financial support, if any, and may be dismissed from the doctoral program.

2. The qualifying exam will be a closed book examination and will be administered during two specified days. Supplementary material will be provided to the student at the time of the exam. The first day will focus on basic science and engineering concepts and will be similar to the Fundamentals of Engineering (FE) Exam. The student is encouraged to use the FE Exam study guide or take an FE Review Course to prepare for the first day exam. The topics which could be covered are: Chemistry; Fluid Mechanics; Material Science/Structure of Matter; Mathematics; Thermodynamics; Chemical Reaction Engineering; Chemical Thermodynamics; Heat Transfer; Mass Transfer; Material/Energy Balances; and Process Control. The second day will focus on the core areas of Advanced Mathematics and Thermal/Fluid Processes as well as a specialty area selected by the student. For the Chemical Engineering Option the specialty areas are Chemical Processing, Materials and Biotechnology/Bioprocessing.

Dissertation

The research work for the dissertation shall be conducted under the supervision of a departmental faculty advisor and a committee of two others. The student must defend and submit an acceptable proposal for the dissertation prior to beginning the research work.

Graduate Certificates

Graduate Certificates in Chemical Engineering

UMass Lowell offers the following graduate certificates in chemical engineering:

- Biotechnology and Bioprocessing
- Materials Sciences & Engineering
- Modeling, Simulation, and Control of Systems and Processes

Graduate Certificate Application Form (https://www.uml.edu/docs/Graduate%20Certificate%20App %20Only%200082016_tcm18-3292.pdf) (pdf)

You will need Adobe Acrobat Reader (https://get.adobe.com/reader/) to view any pdf files. It can be downloaded for free from the Adobe website (https://get.adobe.com/reader/).

Biotechnology and Bioprocessing

Biological Sciences Department & Chemical and Nuclear Engineering Department

Contact:
Carl Lawton, Ph.D.
978-934-3158
carl_lawton@uml.edu (mailto:carl_lawton@uml.edu)

The certificate is intended for students who hold a baccalaureate degree in science, engineering, health, or related disciplines. The courses emphasize biological and engineering
principles, process concepts and the application of these to process design and improvement. Courses deliberately cross disciplinary boundaries and emphasize teamwork in a multidisciplinary environment as well as a result-oriented, document-driven approach to efficient project completion.

Required Courses:

- BIOL.5350 -or- CHEN.5350 Principles of Cell and Microbe Cultivation
- BIOL.5450 -or- CHEN.5450 Isolation and Purification of Biotech Products
- BIOL.5550 -or- CHEN.5550 Biopharmaceutical Regulatory Compliance
- Plus One Approved 3 credit Elective

Gainful Employment Disclosure Information


Materials Sciences & Engineering

Department of Chemical and Nuclear Engineering

Contact:
Zhlyong Gu, Ph.D.
978-934-3540
zhlyong_gu@uml.edu

This 12 credit certificate provides an advanced course of study in materials science and engineering that will broaden and enhance the capabilities and education of experienced professionals and technologists at the graduate level.

Required Course:

- CHEN.5080 Introduction to Materials Sciences (3 credits)

Elective Courses (choose three):

- CHEN.5060 Colloidal, Interfacial & Nanomaterials Science & Engineering (3 credits)
- CHEN.5230 Nanodevices and Electronic Materials (3 credits)
- CHEN.5240 Self Assembly & Nanotechnology (3 credits)
- CHEN.5290 Recent Advances in Nanotechnology and Green Chemistry (3 credits)
- CHEN.5330 Macromolecular Colloidal Science and Engineering (3 credits)
- ENGY.5370 Nanomaterials Characterization I (3 credits)
- ENGY.5410 Nanomaterials Characterization II (3 credits)

Gainful Employment Disclosure Information


Modeling, Simulation, and Control of Systems and Processes

Department of Chemical and Nuclear Engineering

Contact:
Alfred Donatelli, Ph.D.
978-934-3156
alfred_donatelli@uml.edu

The sequence of courses provides advanced training in the modeling and analysis of complex systems with some special focus on thermo-fluid processes and general control system design and analysis. The courses are mathematically intensive and many require the use of modern computer analysis tools (Matlab, Simulink, Aspen, etc.). The graduate certificate program is appropriate for students and professionals interested in gaining skills in mathematical modeling and simulation techniques, and for those individuals interested in updating their knowledge and experience with modern control methods.

This is a 12 credit certificate.

Choose Four Courses:

- ENGY.5090 System Dynamics (3 credits)
- CHEN.5220 Computer-Aided Chemical Process Design (3 credits)
- CHEN.5280 Advanced Transport Phenomena (3 credits)
- CHEN.5300 Advanced Control Strategies (3 credits)
- CHEN.5390 Math Methods for Engineers (3 credits)
- CHEN.5480 Engineering Process Analytics
- A Technical Elective with the Approval of the Coordinator (3 credits)

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-
CHEN.5010 Paper Industry Processes (Formerly 10.501) - Credits: 3
Processes of fiber separation from raw materials, fiber purification and mechanical processing of fiber and sheet formation. Chemical engineering theory is applied to the analysis of these operations.

CHEN.5020 Principles of Chemical Engineering (Formerly 10.502) - Credits: 3
Introduction to the field of chemical engineering and solution of problems involving units and dimensions, mass balances, flow sheets and gas relationships.

CHEN.5060 Colloidal, Interfacial and Nanomaterials Science and Engineering (Formerly 10.506) - Credits: 3
Unifying principle and the three main classes of colloids (dispersions, macromolecular solutions and micelles) are considered. Topics covered include surface tension, work and energy, effect of surface curvature, zeta potential, surface activity and diverse applications of interest to chemical engineers.

CHEN.5080 Material Science and Engineering (Formerly 10.508) - Credits: 3
An advanced overview of solid materials that are likely to be considered for engineering applications in, or be produced by the chemical process industries. They will be discussed from the viewpoints of their unit cell structures, appropriate phase diagrams, their chemical and physical attributes, and the association of these to end use applications. Discussion of metals, ceramics, polymers, and composites. For Non-UML graduates.

CHEN.5100 Advanced Separation Processes (Formerly 10.510) - Credits: 3
This course emphasizes separation processes requiring a rate analysis for adequate understanding, which includes most of the newer separation methods of industrial importance such as membrane, sorption and chromatographic separations. Unifying fundamental relations and concepts are emphasized. Graphical and numerical design procedures are covered.

CHEN.5120 Industrial Chemistry (Formerly 10.512) - Credits: 3
Survey of the major sources and uses of chemicals, industrial chemical processes, fundamental raw materials, and career paths available in the chemical industry. More intensive treatment of selected industrial processes with emphasis of green/sustainable chemical processes.

CHEN.5180 Microprocessor Control (Formerly 10.518) - Credits: 3
Single board computers and single chip controllers and how they are used in chemical process control. Programming methods for using minicomputers as process controllers; interfacing requirements and communications. Laboratory projects include both software and hardware.

CHEN.5200 Advanced Thermodynamics (Formerly 10.520) - Credits: 3
Classical and statistical thermodynamics are applied to develop procedures for obtaining estimates of equilibrium properties required for chemical process design. An introduction to surface energy as an important parameter in the processing of colloids, especially in the nanometer size range, will also be undertaken.

CHEN.5220 Chemical Process Design (Formerly 10.522) - Credits: 3
Process synthesis, definition, and characterization. Introduction to modular process simulation packages such as ASPEN PLUS, Recycle and tear stream analysis. Stream convergence, Unit operations models, Flow sheet manipulation. Data records and physical property estimation techniques.

CHEN.5230 Nanodevices and Electronics Materials Processing (Formerly 10.523) - Credits: 3
Materials processing methods in electronics and related industries; crystal contamination control, growth, diffusion, etching, epitaxy, ion implantation, lithography, and other topics.

CHEN.5240 Self Assembly and Nanotechnology (Formerly 10.524) - Credits: 3
This course will describe two of the most fast-growing area/fields with both fundamental importance and practical relevance: self-assembly and nanotechnology. The first half of the course will discuss the theories and applications of self-assembly phenomena. The second half will focus on nanomaterials and nanotechnology.

CHEN.5260 Advanced Kinetics and Reactor Design (Formerly 10.526) - Credits: 3
The course will cover advanced chemical reaction kinetics, rate laws and reactor design with an emphasis on heterogeneous and catalytic reaction systems involving interphase and mass transfer effects.

CHEN.5280 Advanced Transport Phenomena (Formerly 10.528) - Credits: 3

An advanced study of the mechanisms of the transport processes. Transport equations are developed from both microscopic and macroscopic viewpoints. Analogies and similarities between the transport processes are discussed. Considerable emphasis is placed upon solutions to problems.

CHEN.5290 Recent Advances in Nanotechnology and Green Chemistry (Formerly 10.529) - Credits: 3

This course is designed to expose students to a variety of concepts in chemistry and challenge them to think critically about experiments used to interrogate these concepts. Organic polymer chemistry with an emphasis on electronically conducting polymers will be the main area of focus. Students would first be introduced to scientific subject matter outside their realm of familiarity and be expected to identify new concepts and links to existing experimental paradigms. The course is divided into 3 parts: (i) introduction to nanothehnology and green chemistry with a focus on nanoscale electronic polymers, (ii) green chemistry and the overlap area with nanotechnology, and (iii) green engineering.

CHEN.5300 Advanced Control Strategies (Formerly 10.530) - Credits: 3

An introduction to computer control and to some of the common control strategies applied to the design of complex chemical process control systems.

CHEN.5320 Principles of Chemical Engineering II (Formerly 10.532) - Credits: 3

Continuation of Principles of Chemical Engineering including real gas relationships, humidity, energy balances, and combined mass-energy balance systems. Introduction to the first law of thermodynamics. Note: Non-majors only.

CHEN.5330 Macromolecular Colloidal Science and Engineering (Formerly 10.533) - Credits: 3

This course treats both synthetic and natural macromolecules (i.e., polymers, and biopolymers), Interrelating synthesis commercial manufacture, molecular, macroscopic and application properties as well as the colloidal nature of their solutions. Pertinent fundamental principles are reviewed.

CHEN.5340 Industrial Bioprocessing - Credits: 3

Students will learn principles and concepts of industrial bioprocessing. The course covers key concepts and practices of upstream, downstream and analytical bioprocessing technologies. In addition, recent FDA initiatives of Process Analytical Technology (PAT), Quality by Design, and Emerging Technologies will be covered. The course consists of 14 modules. Each module will cover subject matter provided by industry experts.

CHEN.5350 Cell and Microbe Cultivation (Formerly 10.535) - Credits: 3

This course presents the principles of biochemical engineering with an emphasis on the unit operation of cell cultivation for production of commercially important products, especially biopharmaceuticals. The bioreactor is viewed as a device for controlling the environment of recombinant and traditional cultures. Major topics include media design, kinetics of growth and production, expression systems, bioreactor types, cell physiology, and bioprocess economics.

CHEN.5370 Nanomaterials Characterization I (Formerly 10.537) - Credits: 3

This lecture course will provide an in-depth introduction to the principles, instrumentation and applications of most common nanomaterial characterization techniques. Nanomaterial imaging, physical, chemical, and optical property analyses are the main focus of this class. Topics covered will include: electron microscopy (SEM/TEM), scanned prove microscopy (AFM), elemental analysis (EDX/XPS), crystal structure analysis (XRD/SAED), thermal analysis (DSC/TGA), laser based characterization (LSCM/DLS/Raman), chromatographic methods (GC), infrared spectroscopy, UV/Vis spectroscopy and contact angle goniometry. The analytical and quantitative applications of these techniques for investigating different types of nanomaterials will also be described. Lab demonstrations will be included in lectures.

CHEN.5380 Advanced Separations in Biotechnology (Formerly 10.538) - Credits: 3

This course provides in depth analysis of the two methods used most often in Bioseparations, filtration and chromatography. For both techniques, basic concepts are reviewed. Membrane, depth, sterile and tangential flow filtration, as well as ion exchange, hydrophobic interaction, and hydroxypetite chromatography are considered. The emphasis for both methods is on specific applications, scale-up, validation and cleaning.

CHEN.5390 Mathematical Methods for Engineers
Ordinary and partial differential equations, linear algebra, matrix/vector calculus, numerical methods, introduction to optimization methods, and other topics as time permits. Both analytical and numerical techniques are integrated to give good analytical skills coupled with practical problem solving tools. Extensive computer work with the MATLAB package is required. (Same as 24.539).

**CHEN.5400 Nanomaterials Characterization I**  
(Formerly 10.540) - Credits: 3

This lecture course will provide an in-depth introduction to the principles, instrumentation and applications of most common nanomaterial characterization techniques. Nanomaterial imaging, physical, chemical, and optical property analyses are the main focus of this class. Topics covered will include: electron microscopy (SEM/TEM), scanned probe microscopy (AFM), elemental analysis (EDX/XPS), crystal structure analysis (XRD/SAED), thermal analysis (DSC/TGA), laser based characterization (LSCM/DLS/Raman), chromatographic methods (GC), infrared spectroscopy, UV/Vis spectroscopy and contact angle goniometry. The analytical and quantitative applications of these techniques for investigating different types of nanomaterials will also be described. Lab demonstrations will be included in lectures.

**CHEN.5410 Nanomaterials Characterization II**  
(Formerly 10.541) - Credits: 3

This hands-on laboratory course will cover the practical aspects of light, electron and scanned probe microscopy techniques discussed in Nanomaterials Characterization I (10.540). A variety of nanomaterials sample systems will be characterized using laser scanning confocal microscopy (LSCM), scanning electron microscopy (SEM), transmission electron microscopy (TEM) and atomic force microscopy (AFM). The laboratory experiments will provide practical experience in sample preparation techniques, optimization of instrumental conditions for imaging and spectroscopy, and data analysis and interpretation. Students will work on individual term projects involving real-world samples that are of interest to them, and use the techniques they learned in the course to characterize their samples.

**CHEN.5440 Formulation of Biotherapeutics**  
(Formerly 10.544) - Credits: 3

Biotherapeutics, particularly antibodies, are currently the fastest growing pharmaceuticals. Ideally, biotherapeutics are formulated in aqueous solutions and are often a great challenge due physical and chemical stability issues. This course addresses the latest trends and challenges in biologics formulation with a focus on the important role of preformulation in understanding the biological molecule itself for greater “formulatability” and “developability”. The course will feature interactive discussions on early formulation screening, thorough biophysical and analytical characterization, improving the feedback loop in the early formulation-development interface, overcoming aggregation and other heterogeneity challenges, and improving overall product profile. In addition, the course will also cover an optimization of the formulation process through rational iterative approach and in-depth case studies. As a whole, this course focuses on providing you with additional tools and knowledge to help streamline solutions to formulation and stability issues for biologics.

**CHEN.5450 Isolation and Purification**  
(Formerly 81.545) - Credits: 3

Efficient isolation and purification of biological products, especially proteins, from complex natural mixtures.

**CHEN.5460 Biomaterials Science and Engineering**  
(Formerly 10.550) - Credits: 3

The goal of this course is to provide an understanding for design, synthesis, fabrication, and characterization of biomaterials for medical applications. The course will also cover biomimetic engineering strategies to generate materials that can be used for improving human health such as drug delivery, tissue engineering, and regenerative medicine. Example topics include biocompatibility, protein adsorption, degradation, swelling, mechanical properties, biomaterial-tissue interactions, vaccines, micro/nano technologies, instructive biomaterials for stem cells, medical devices and implants, performance of implants, and modulation of cell behavior and function through biomaterial strategies.

**CHEN.5480 Engineering Process Analytics**  
(Formerly 10.548) - Credits: 3

This course covers multivariate statistical data analysis and experimental design. Students will learn how to extract information by analyzing various engineering datasets, and how to generate information-rich datasets via minimum experiments. Software for data analysis and experimental design will be utilized during tutorial and practice.

**CHEN.5500 Biomedical Applications of Nanotechnology**  
(Formerly 10.550) - Credits: 3

The course will aim to give students an introduction to the applications of nanotechnology in biomedicine. The course will cover the basics of nanomaterials including synthesis and characterization, use of nanotheranostics platforms for drug delivery and imaging, nanomaterials for tissue engineering;
nanobiodevices and nanotoxicology. The course is designed for
graduate students in the Chemical Engineering and the
Biomedical Engineering/Biotechnology programs as well as
seniors in Chemical Engineering.

CHEN.5520 Directed Study: Chemical Engineering
(Formerly 10.552) - Credits: 3

CHEN.5550 Biopharmaceutical Regulatory Compliance (Formerly 10.555) - Credits: 3

This course examines the regulatory framework in which "drugs", biologics" and "cellular therapies" are evaluated in
the United States, including the laws, regulations and the state
of industrial practice.

CHEN.5560 Materials for Aerospace and Energy Applications (Formerly 10.556) - Credits: 3

Material requirements for emerging applications in aerospace and energy sectors will be discussed. Mechanical, thermal and
electrical and barrier properties of filled polymers and polymer nanocomposites will be studied. The effect of resin structure,
filler additives, reactive diluents on the resulting properties will
be reviewed. Scale-up issues will be studied using basic
principles of chemical engineering.

CHEN.5860 Biotechnology Processing Projects Laboratory (Formerly 10.586) - Credits: 3

Development of manufacturing processes for the products of biotechnology are followed through a series of process unit
operations. Following the synthesis, purification and formulation of a specific enzyme throughout the course,
students examine interactions between process steps and evaluate the impact of each on the total production process. As
a final project, students assume the role of project team leader,
developing a commercial-scale production process for the
enzyme.

CHEN.5930 Cooperative Education (Formerly 10.593) - Credits: 0

CHEN.6010 Seminar (Formerly 10.601) - Credits: 0
Required for all graduate students.

CHEN.6020 Graduate Seminar (Formerly 10.602) - Credits: 0
Required for all graduate students.

CHEN.6500 Nanoscale Transport Phenomena for Manufacturing Nanodevices (Formerly 10.650) - Credits: 3

An interdisciplinary course taught by faculty from the Chemical, Mechanical and Plastics Engineering Departments, who have special knowledge in nanoscale fluid mechanics and heat transfer. The course on nanoscale transport phenomena constitutes a bridge between existing fluid and heat transfer courses in multiple disciplines and emerging nanoscale science and engineering concepts to reflect the forefront of nanomanufacturing. The course is designed to incorporate recent advances in manufacturing polymer-based nanodevices. Key issues of the implementation and maintenance costs for fabrication will be addressed. Hands-on laboratory experiments will be performed to complement the lectures with the ultimate goal of designing and building a complete nanodevice at the end of the course. The course will prepare graduates for employment focused on designing and manufacturing nano/microfluidic systems, lab-on-a-chip devices, electronics devices, medical devices, and other emerging technologies.

CHEN.7200 Special Projects in Chemical Engineering (Formerly 10.720) - Credits: 3

Special projects undertaken by a student to expand his/her knowledge in specific fields related to his/her master's project.

CHEN.7330 Graduate Project - Chemical Engineering (Formerly 10.733) - Credits: 3

Advanced research project required of students electing non-
thesis option performed under the supervision of a senior faculty member in the Chemical Engineering Program. The project must be approved by an examining committee and the Department Chairperson.

CHEN.7360 Graduate Project - Chemical Engineering (Formerly 10.736) - Credits: 6

CHEN.7410 Thesis Review (Formerly 10.741) - Credits: 1

CHEN.7430 Master's Thesis - Chemical Engineering (Formerly 10.743) - Credits: 3

Advanced research work required of students electing thesis option performed under the supervision of a senior faculty member in the Chemical Engineering Program. The thesis must be approved by an examining committee and the Department Chairperson.

CHEN.7460 Master's Thesis - Chemical Engineering
CHEN.7500 Doctoral Dissertation Review (Formerly 10.750) - Credits: 1

Doctoral Dissertation Review

CHEN.7530 Doctoral Dissertation/Chemical Engineering (Formerly 10.753) - Credits: 1-3

Advanced research work required of students performed under the supervision of a senior faculty member in the Chemical Engineering Program. The dissertation topic must be approved by the doctoral committee.

CHEN.7560 Doctoral Dissertation/Chemical Engineering (Formerly 10.756) - Credits: 6

CHEN.7590 Doctoral Dissertation/Chemical Engineering (Formerly 10.759) - Credits: 9

CHEN.7610 Continued Grad Research (Formerly 10.761) - Credits: 1

Continued Grad Research

ENGY.5040 Energy Engineering Workshop (Formerly 24.504) - Credits: 3

A group/individual design project. The design effort will integrate many aspects of the student’s engineering background, including design concepts, technical analyses, economic and safety considerations, etc. A formal report and oral presentation are required.

ENGY.5050 Reactor Physics (Formerly 24.505) - Credits: 3

Advanced treatment of several topics in reactor physics, including cross sections and processing methods, development of transport theory, reduction to diffusion theory, and analyses of analytical and numerical solutions of the resultant balance equations.

ENGY.5070 Reactor Engineering and Safety (Formerly 24.507) - Credits: 3

Modeling and analysis of reactor thermal-hydraulics and safety systems. Topics include nuclear heat generation and transport, single and two-phase flow, boiling crisis, and safety analysis.

ENGY.5090 Dynamic Systems Analysis (Formerly 24.509) - Credits: 3

Mathematical foundation using the state-variable approach. Topics include matrix methods, Laplace and Fourier transforms, transfer functions, frequency response and stability analyses, and distributed/lumped parameter systems. Applications to mechanical and thermo-fluid systems. Modeling and simulation of systems using Matlab are emphasized. A comprehensive project, including formal written and oral reports, is required.

ENGY.5100 Nuclear Fuel Cycle (Formerly 24.510) - Credits: 3

This course will explore the various stages of the nuclear fuel cycle. The nuclear fuel cycle is broadly classified into three stages; front end, service stage, and back end. The course will introduce students to the various sub stages within the three broad stages of the nuclear fuel cycle. The course will explore the technology that is currently being used in these stages, then compare difference in approaches. Further modifications to the fuel cycle management will be discussed to make nuclear energy more sustainable. The course will provide an overview of front end fuel cycle including: mining, milling, enriching, fabrication; back end of the fuel cycle including: waste and recycling (or not); and in core fuel management, burnup calculations; and approaches to balance the cost of electricity production using nuclear reactors. The students will be introduced to nuclear burnup code such as ORIGEN. At the conclusion of the course students will be tasked to design and evaluate an aspect of the nuclear cycle that has been discussed in the class including but not limited to: enrichment plant, in-core fuel management, spent fuel management.

ENGY.5140 Chemical and Nuclear Waste (Formerly 24.514) - Credits: 3

History of nuclear waste disposal; engineering design of disposal systems. Present status of waste and the character and quantities of future wastes. Review of disposal concepts on a generic basis. The national plan for waste disposal.

ENGY.5160 Radiation Shielding and Protection (Formerly 24.516) - Credits: 3

This course will explore the fundamental principles of the interaction of nuclear and atomic radiation with matter and the transport of radiation through materials. The students will learn characterization of radiation fields and sources, and transport radiation through material. The course will discuss radiation exposure, dose, dose equivalent in context of radiation shielding and protection. Consequently, the students will compile each of these topics to learn how to design and analyze radiation shielding and protection. The students will learn how to use both the SOURCES and ORIGEN (or
equivalent) code systems for calculating radiation sources and the MCNP (or equivalent) code system for the transport of radiation. At the conclusion of the course the students are expected to develop a shielding design for a given constraints typically encountered in the nuclear field.

ENGY.5180 Energy Technology, Economics and Policy - Credits: 3

Survey course where students integrate the knowledge form previous undergraduate courses to explore and interpret energy technologies, economics and policies. This course is an elective course for engineering students and requires a good basic understanding of technical concepts related to the measurement and calculation of energy conversion and engineering economics.

ENGY.5190 Reactor Operator Training (Formerly 24.519) - Credits: 3

Training, including in-reactor experience and topical lectures, as given to Reactor Operator Trainees who will undergo Federal testing for a Reactor Operator License.

ENGY.5200 Reactor Operator Training (Formerly 24.520) - Credits: 3

Continuation of 24.519. Upon completion of this course, the student will be given a simulated Reactor Operator examination, including a written test, an oral test about reactor systems, and a controls manipulation test.

ENGY.5310 Selected Topics in Engineering (Formerly 24.531) - Credits: 3

Special problems in nuclear science and engineering assigned to the individual student, with emphasis on modern research methods and preparation of results for publication.

ENGY.5320 Selected Topics: Energy Science (Formerly 24.532) - Credits: 3

Special problems in nuclear science and engineering assigned to the individual student, with emphasis on modern research methods and preparation of results for publication.

ENGY.5340 Fundamentals of Nuclear Security and Safeguards (Formerly 24.534) - Credits: 3

This course will include technical and policy matters related to nuclear security and safeguards. The students will explore in interplay between technical and social science disciplines. Students will be introduced to fundamental nuclear physics and engineering, material science, risk assessment, computational techniques, modeling and simulation, information technology, measurement techniques, and detector development. These technical disciplines will be combined with social science fields such as political science, international relations, international law, energy policies, and regional studies.

ENGY.5360 Reactor Experiments (Formerly 24.536) - Credits: 3

A laboratory-based course using the U Mass Lowell Research Reactor (UMLRR) to illustrate, validate, and expand upon a mix of topics from reactor core physics, reactor operations, and balance-of-plant/energy removal considerations in nuclear systems. Typical experiments may include an approach to critical demo, reactivity measurements, generation of blade worth curves, analysis of various reactor kinetics and dynamic scenarios (including temperature and xenon effects), measurement of axial flux profiles and temperature/void coefficients, analysis of loss of flow and other pump transients, etc. Matlab will be used for data analysis and for reactor simulation. Other analysis tools such as VENTURE, MCNP, or PARET using existing models of the UMLRR may also be used. Comprehensive analysis reports that compare/contrast experimental and simulation data will be required. Oral presentations summarizing the results from the experiments will also be required.

ENGY.6010 Graduate Research Seminar (Formerly 24.601) - Credits: 0

ENGY.6510 Selected Topics in Energy Engineering (Formerly 24.651) - Credits: 3

ENGY.7050 Supervised Tchg - Nuclear Engineering (Formerly 24.705) - Credits: 0

ENGY.7330 Graduate Project - Energy Engineering (Formerly 24.733) - Credits: 3

ENGY.7390 Graduate Project - Energy Engineering (Formerly 24.739) - Credits: 9

ENGY.7410 Thesis Review (Formerly 24.741) - Credits: 1

ENGY.7430 Master's Thesis - Nuclear Engineering (Formerly 24.743) - Credits: 3

ENGY.7460 Master's Thesis - Energy Engineering (Formerly 24.746) - Credits: 6

ENGY.7490 Master's Thesis - Energy Engineering (Formerly 24.749) - Credits: 9

ENGY.7530 Doctoral Dissertation/Energy
Engineering (Formerly 24.753) - Credits: 3
Advanced research work required of students performed under the supervision of a senior faculty member in the Nuclear Engineering Program. The dissertation topic must be approved by the doctoral committee.

ENGY.7560 Doctoral Dissertation/Energy Engineering (Formerly 24.756) - Credits: 6
ENGY.7590 Doctoral Dissertation/Energy (Formerly 24.759) - Credits: 9
Advanced research work required of students performed under the supervision of a senior faculty member in the Energy Engineering Program. The dissertation topic must be approved by the doctoral committee.

ENGY.7660 Continued Graduate Research (Formerly 24.766) - Credits: 6
ENGY.7690 Continued Graduate Research (Formerly 24.769) - Credits: 9
Business Administration Minor for Civil & Environmental Engineering

The Business Administration Minor for Civil & Environmental Engineering is a program delivered by the College of Management. It consists of a focused set of 5 courses plus two courses already in the Civil and Environmental Engineering (CEE) core program, of which two may be used as CEE senior year Professional electives. The net additional course work (over and above the 128 credits needed for the CEE degree) is three courses (some of which may be taken during the summer).

This Minor provides management training which is very desirable in industry, and allows an easy transition into a later MBA program.

For students in Civil & Environmental Engineering, the following courses are required in the Business Administration Minor:

- 49.201 Economics I (already in CEE core)
- 60.201 Accounting/Financial *
- 61.301 Business Finance *
- 62.201 Marketing Principles
- 66.301 Organizational Behavior * (may be used as a CEE Professional Elective)
- 14.372 Civil Engineering Systems (already in CEE core)
- 14.475 Construction Management (CEE Professional Elective)

Courses marked with an asterisk * are available during the summer or on-line.

To enroll in this Minor, students need to file a Declaration of Minor form with the College of Management before registering for 300 level courses, and indicate their intention to pursue this Minor with their CEE Faculty Advisor. Immediately after registering for the final courses which complete the minor, the student should file an academic petition, indicating approval by the College of Management, with the Office of Enrollment Services.

This Minor differs from the "regular" Minor in Business Administration offered by the College of Management in that 14.372 Civil Engineering Systems is used in lieu of one of the CoM electives, and 14.475 Construction Management is used in lieu of an MIS course.

Civil & Environmental Engineering

Department of Civil and Environmental Engineering

The UMass Lowell Department of Civil and Environmental Engineering offers a wide variety of graduate programs. Program options include environmental engineering, geoenvironmental engineering, geotechnical engineering, structural engineering, transportation engineering, and environmental studies.

- Doctor of Engineering (D.Eng.) Civil and Environmental Engineering Option
- Doctor of Philosophy (Ph.D.) Civil and Environmental Engineering Option
- Doctor of Philosophy in Chemistry (Ph.D.) Environmental Studies Option
- Master of Science in Civil and Environmental Engineering
- Master of Science in Environmental Studies Environmental Engineering Science Concentration
- Master of Science in Environmental Studies Atmospheric Sciences Concentration

Graduate Certificate Programs

- Environmental Biotechnology
- Sustainable Infrastructure for Developing Nations
- Bachelor’s-Master’s Engineering Program

Graduate study in Civil and Environmental Engineering is an intensive program of instruction at an advanced technical level. The program permits students to design, in consultation with their advisor, a plan of study that meets individual goals and career objectives.

Co-op Option in Engineering

- The Department of Civil & Environmental Engineering participates in the Graduate Master’s Co-op Option in Engineering. For detailed information about the Co-op Program and curriculum requirements, please see the Graduate Catalog Engineering Co-op Option page (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).

Masters Program

Civil & Environmental Engineering Master’s Programs

The UMass Lowell Department of Civil & Environmental
Engineering offers master’s degree programs in Civil &Environmental Engineering and in Environmental Studies. Options within the Master of Science in Civil and Environmental Engineering include: Environmental Engineering, Geotechnical Engineering, Geoenvironmental, Structural Engineering, and Transportation Engineering. There are two concentrations within the Master of Science in Environmental Engineering - one in Atmospheric Sciences, and another in Environmental Engineering Sciences.

- Master of Science in Civil &Environmental Engineering Environmental Engineering OptionGeotechnical Engineering OptionGeoenvironmental OptionStructural Engineering OptionTransportation Engineering Option
- Master of Science in Environmental Studies Atmospheric Sciences ConcentrationEnvironmental Engineering Sciences Concentration
- Co-op Option in Engineering The Department of Civil &Environmental Engineering participates in the Graduate Master’s Co-op Option in Engineering. For detailed information about the Co-op Program and curriculum requirements, please see the Graduate Catalog Engineering Co-op page (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).

**Master of Science in Civil &Environmental Engineering**

**Program Description and General Requirements**

Graduate study in Civil and Environmental Engineering is an intensive program of instruction at an advanced technical level. The program permits students to design, in consultation with their advisor, a plan of study that meets individual goals and career objectives.

Program options include environmental engineering, geoenvironmental engineering, geotechnical engineering, structural engineering and transportation engineering.

Admission to a particular engineering option is open to applicants with undergraduate degrees in engineering, mathematics or science. The degree requires successful completion of 30 credit hours of course work, or 24 credit hours of instruction and a publishable thesis, or 27 hours of course work and preparation of a project report.

Courses are scheduled in the late afternoon and evening to provide study opportunities for students with full-time employment. Successful completion of undergraduate prerequisite courses is required prior to registering for graduate courses. However, undergraduate prerequisites and selected graduate courses, that do not have prerequisites, may be taken during the first year of study, but only with the written permission of the students advisor. Required undergraduate prerequisite courses are listed in descriptions of the core graduate courses shown below.

Applicants who satisfy graduate admission requirements will be assigned to a faculty member who will serve as their academic advisor. Students receiving a teaching or research assistantship will normally be required to submit a publishable thesis. Those admitted to graduate study as non-degree students may apply for matriculated status. However, no more than 12 credits of work completed while in non-degree student status or transferred from another department or college will be used toward a degree. Matriculated status is preferred before initial registration and is mandatory prior to registration for second semester courses. Faculty will review a petitioner’s performance in all courses attempted.

Visit the Civil & Environmental Engineering Department (https://www.uml.edu/Engineering/Civil-Environmental/default.aspx) website for more information.

**Master of Science in Civil Engineering (Environmental Engineering Option)**

The program offers an opportunity to pursue a broad range of interests in the fields of environmental and water resources engineering. The course of study is designed to meet an individual student’s interests and career goals. Programs consist of civil engineering courses in water and wastewater treatment, environmental chemistry, hydrology, hydraulics, air pollution control, environmental law and policy and may include courses from allied disciplines such as biological and health sciences, environmental studies, chemistry and work environment. The program of study consists of four core courses and elective courses. Undergraduate core course prerequisites must be completed before beginning graduate course work.

**Prerequisite Undergraduate Courses for MS Environmental Engineering Option**

In order to obtain the MS Degree in Civil and Environmental Engineering, Environmental Engineering Option, a student is required to have completed undergraduate courses in the areas of chemistry, physics, mathematics and engineering. At a minimum, the following courses are required. University of Massachusetts Lowell (UML) course numbers are provided for reference purposes. Course work that is equivalent to the UML courses specified are acceptable. However, an official determination of prerequisite course equivalency will be conducted by UML faculty that teach the specified undergraduate course, or by the Department of Civil and Environmental Engineering Graduate Coordinator, only after the student has applied and been accepted into the graduate
program. This list represents the minimum prerequisite course requirements. Additional undergraduate course work may be required to remedy academic deficiencies. Students will be notified of deficiencies in an acceptance letter. All deficiencies must be eliminated before a student can be classified as “fully matriculated”.

The undergraduate prerequisite courses are as follows:

- CHEM.1210 Chemistry I
- CHEM.1230L Chemistry I Lab
- CHEM.1220 Chemistry II
- CHEM.1240L Chemistry II Lab
- MATH.1310 Calculus I
- MATH.1320 Calculus II
- MATH.2310 Calculus III
- PHYS.1410 Physics I
- PHYS.1410L Physics I Lab
- MATH.2340 Differential Equations
- CIVE.2030 Statics
- CIVE.2050 Dynamics
- CIVE.3010 Fluid Mechanics
- CIVE.3620 Environmental Engineering

Core Courses (5 total)

- CIVE.5610 Physical and Chemical Treatment Processes
- CIVE.5620 Physical and Chemical Hydrogeology
- CIVE.5670 Environmental Aquatic Chemistry
- CIVE.5680 Environmental Fate and Transport
- CIVE.5780 Biological Wastewater Treatment

Elective Courses (up to 5 total)

Individual student programs consist of a complement of elective courses usually taken from the following list:

- CIVE.5270 Geotechnical and Environmental Site Characterization
- CIVE.5290 Engineering with Geosynthetics
- CIVE.5640 Hydraulics and Hydrology
- CIVE.5660 Environmental Applications & Implications of Nanomaterials
- CIV.5720 Marine and Coastal Processes
- CIVE.5730 Solid Waste Engineering
- CIVE.5750 Groundwater Modeling
- CIVE.5760 GIS Applications in Civil & Environmental Engineering
- CIVE.5950 Hazardous Waste Site Remediation
- ENVS.5010 Wetlands Ecology
- ENVS.5020 Freshwater Ecology
- ENVS.5100 Water Resources Management
- ATMO.5230 Air Pollution Control
- ATMO.5710 Air Pollution Phenomenology
- ENVI.5200 Methods in Environmental Impact Assessment and Analysis
- ENVS.5810 Understanding the Massachusetts Contingency Plan
- GEOL.5100 Glacial and Pleistocene Geology
- GEOL.5240 Regional Hydrogeology
- CHEM.5140 Advanced Analytical Chemistry

Additional advanced courses may be taken as electives after consultation with a faculty advisor and approval from the department.

Master of Science in Civil Engineering (Geotechnical Engineering Option)

The master’s degree program in geotechnical engineering encompasses soil mechanics theory and applications in the fields of foundation and soil engineering. Course work emphasizes the engineering behavior of soil, soil property determination, and the use of advanced soil mechanics theory and soil-structure interaction in the solution of soil and foundation engineering problems. Elementary courses in soil mechanics, statics, strength of materials and fluid mechanics are required as prerequisites for graduate core courses. Students receiving a teaching or research assistantship are required to submit a publishable thesis. The program of study consists of five required courses: CIVE.5310 Advanced Soil Mechanics and any four core courses and four elective courses, selected with the consent of a students faculty advisor. Additional advanced courses may be taken as electives after consultation with a faculty advisor and approval from the Department. Program and course details are included in the
graduate course list and the graduate catalog.

Core Courses (5 total)

- CIVE.5310 Advanced Soil Mechanics
- CIVE.5270 Geotechnical and Environmental Site Characterization
- CIVE.5280 Drilled Deep Foundations
- CIVE.5300 Driven Deep Foundations
- CIVE.5320 Theoretical and Numerical Soil Mechanics
- CIVE.5330 Advanced Foundation Engineering
- CIVE.5340 Soil Dynamics and Earthquake Engineering
- CIVE.5360 Soil Engineering
- CIVE.5370 Experimental Soil Mechanics

Elective Courses (up to 5 total)

- CIVE.5040 Advanced Strength of Materials
- CIVE.5210 Reliability Analysis in Engineering
- CIVE.5290 Engineering with Geosynthetics
- CIVE.5380 Soil Behavior
- CIVE.5390 Ground Improvement
- CIVE.5500 Behavior of Structures
- CIVE.5560 Finite Element Analysis
- CIVE.5620 Physical and Chemical Hydrogeology
- CIVE.5760 GIS Applications in Civil & Environmental Engineering
- GEOL.5560 Applied Geophysics

Master of Science in Civil Engineering (Geoenvironmental Option)

The solution of environmental problems related to soil and/or groundwater often requires knowledge of both Geotechnical and Environmental Engineering. The Geoenvironmental program provides fundamental training in soil mechanics, groundwater hydrology, environmental chemistry, and soil engineering. Course work is offered in each area as well as in courses that combine disciplines generally required in the solution of complex site problems, such as, landfill design, remediation of hazardous waste sites, dewatering and soil improvement.

Core Courses (5 total)

- CIVE.5310 Advanced Soil Mechanics

Select 2 Courses from the following:

- CIVE.5270 Geotechnical Environmental Site Characterization
- CIVE.5290 Engineering with Geosynthetics
- CIVE.5360 Soil Engineering

Elective Courses (up to 5 total)

- CIVE.5040 Advanced Strength of Materials
- CIVE.5210 Reliability Analysis in Engineering
- CIVE.5280 Drilled Deep Foundations
- CIVE.5300 Driven Deep Foundations
- CIVE.5330 Advanced Foundation Engineering
- CIVE.5340 Soil Dynamics and Earthquake Engineering
- CIVE.5360 Soil Engineering
- CIVE.5370 Experimental Soil Mechanics

GRADUATE – ALL COLLEGES

GRADUATE – ALL COLLEGES

Academic Catalog 2017 - 2018 / Civil & Environmental Engineering - General Information
Additional advanced courses may be taken as electives after consultation with a faculty advisor and approval from the Department.

Master of Science in Civil Engineering (Structural Engineering Option)

The structural option within Civil and Environmental Engineering offers instruction and research in advanced concepts and techniques to develop innovative solutions for critical and challenging problems in Structural Engineering. A student seeking an MS Engineering in Structural Engineering must have at least one core course from each group (A, B, and C) to meet the core course requirements. Student study programs in structural engineering are developed with a faculty advisor to meet the needs of the individual. Students should also meet the prerequisite requirement in each graduate-level course by receiving an approval from the instructor.

Group A (Design):
- CIVE.5080 Practice of Structural Engineering
- CIVE.5510 Design of Steel Structures
- CIVE.5520 Computer-based Design of Concrete Buildings

Group B (Analysis):
- CIVE.5030 Computer-Based Analysis of Structures
- CIVE.5500 Behavior of Structures
- CIVE.5560 Finite Element of Analysis (or equivalent)

Group C (Dynamics and Stability):
- CIVE.5120 Structural Stability
- CIVE.5340 Soil Dynamics and Earthquake Engineering
- CIVE.5570 Structural Dynamics

Elective Courses (up to 7 total)
- CIVE.5040 Advanced Strength of Materials
- CIVE.5050 Concrete Materials
- CIVE.5110 Inspection and Monitoring of Civil Infrastructure
- CIVE.5210 Reliability Analysis in Engineering
- CIVE.5300 Deep Foundations
- CIVE.5310 Advanced Soil Mechanics
- CIVE.5330 Advanced Foundation Engineering
- CIVE.5360 Soil Engineering
- CIVE.5390 Ground Improvement
- CIVE.5410 Traffic Engineering
- CIVE.5530 Wood Structures
- CIVE.5540 Pre-stressed Concrete Design
- CIVE.5550 Seismic Design of Structures
- CIVE.5580 Bridge Design
- CIVE.5590 Masonry Design
- CIVE.5760 GIS Application in Civil and Environmental Engineering
- CIVE.5810 Engineering Systems Analysis
- CIVE.5830 Stochastic Concepts

Notes:
1. Courses listed in Group A, B or C above may be taken as electives after meeting core requirements.
2. Additional geotechnical and geoenvironmental courses and appropriate advanced courses from the Departments of Mathematics and Mechanical Engineering may be taken as electives after consultation with a faculty advisor and with the approval of the Department.
3. With the approval of the Department, a student may substitute one of the core requirements with another advanced Mathematics or Engineering course.

Master of Science in Civil Engineering (Transportation Engineering Option)

The program in Transportation Engineering offers courses in planning, design and operation of multi-modal transportation facilities. It emphasizes the interdisciplinary nature of the subject, supplementing engineering concepts with techniques from management, economics, operations research and environmental studies. It is designed to provide students with advanced technical knowledge for addressing transportation problems in a variety of practical situations. Specialization in a
specific area can be achieved through thesis and project work. Graduate study plans are designed based upon student interest, professional needs and undergraduate preparation. Students are expected to have completed or show proficiency in the following courses in partial fulfillment of degree requirements:

Core Courses Requirements (Select at least 3 courses)

- CIVE.5400 Urban Transportation Planning
- CIVE.5410 Traffic Engineering
- CIVE.5420 Transportation Network Analysis
- CIVE.5480 Traffic Management and Control
- CIVE.5490 Traffic Flow Theory
- CIVE.5830 Stochastic Concepts

Elective Courses (up to 7 total)

Following is a list of elective courses that are periodically being offered by the Department. Other than the listed courses, students may take graduate courses from other appropriate disciplines such as engineering, management and pure and applied science as electives after consultation with a faculty advisor and with the approval of the Department.

- CIVE.5210 Reliability Analysis in Engineering
- CIVE.5405 Advanced Highway Geometric Design
- CIVE.5430 Traffic Principles for Intelligent Transportation Systems
- CIVE.5440 Transportation Planning Practice
- CIVE.5450 Public Transit Planning and Design
- CIVE.5460 Pavement Design
- CIVE.5470 Airport Planning and Design
- CIVE.5760 GIS Applications in Civil and Environmental Engineering
- CIVE.5810 Engineering Systems Analysis
- CIVE.5850 Transportation Safety

1 - Any course listed above may be taken as an elective after core course requirements have been satisfied.

Master of Science in Environmental Studies
Environmental Engineering Sciences Concentration

This interdisciplinary program offers a Master of Science in Environmental Studies with a thesis or a non-thesis track. Enrollment in the program is open to individuals with a baccalaureate degree in technology, biology or a physical science. Others may be admitted with the approval of the Graduate Coordinator. Such students may make up course prerequisite deficiencies while in the program, although those credits will not count toward the total required for the masters degree. Frequently, students entering the program are required to take a number of undergraduate courses to develop analytical skills and to prepare for advanced level course work. Undergraduate courses may include calculus, statistics, chemistry, computer programming or courses designed to develop problem-solving skills. Course requirements are determined by discussion with the Program Coordinator. The thesis track requires completion of an approved program of study involving a minimum of 24 credits of core courses and electives, and 6 credits of thesis, consisting of laboratory research or scholarly investigation, for a total of 30 credits. Students may only register for thesis research with the prior approval of a thesis advisor. The thesis work is to be guided by a principal advisor who is a member of the University of Massachusetts Lowell faculty and by two additional committee members, at least one of whom must be a member of the faculty. Committee selection and the thesis topic are subject to the approval of the graduate coordinator. The non-thesis track requires completion of an approved program of study involving 30 credits of core courses and electives. All individual programs of study must include the core courses listed below:

Prerequisite Undergraduate Courses for M.S. Environmental Studies Option

In order to obtain the M.S. Degree in Environmental Studies, a student is required to have completed undergraduate courses in the areas of chemistry, physics, and mathematics. At a minimum, the following courses are required. University of Massachusetts Lowell (UML) course numbers are provided for reference purposes. Course work that is equivalent to the UML courses specified are acceptable. However, an official determination of prerequisite course equivalency will be conducted by UML faculty that teach the specified undergraduate course, or by the Environmental Studies Graduate Coordinator, only after the student has applied and been accepted into the graduate program. This list represents the minimum prerequisite course requirements. Additional undergraduate course work may be required to remedy academic deficiencies. Students will be notified of deficiencies in an acceptance letter. All deficiencies must be eliminated before a student can be classified as "fully matriculated".

The undergraduate prerequisite courses are as follows:

- CHEM.1210 Chemistry I
- CHEM.1230L Chemistry I Lab
- CHEM.1220 Chemistry II
Core Courses

- ENVE.5100 Water Resources Management
- CIVE.5730 Solid Waste Engineering
- ENVE.5230 Air Pollution Control or
- ENVE.5710 Air Pollution Phenomenology

Elective Courses

- CIVE.5090 Environmental/Engineering Geology
- CIVE.5610 Physical and Chemical Treatment Processes
- CIVE.5620 Physical and Chemical Hydrogeology
- CIVE.5670 Environmental Aquatic Chemistry
- CIVE.5680 Environmental Fate and Transport
- CIVE.5700 Small and Alternative Wastewater Treatment
- CIVE.5720 Marine and Coastal Processes
- CIVE.5740 Air Quality Modeling
- CIVE.5750 Groundwater Modeling
- CIVE.5950 Hazardous Waste Site Remediation
- ENVE.5010 Wetlands Ecology
- ENVE.5020 Limnology
- ENVE.5030 Environmental Toxicology and Risk Assessment
- ENVE.5050 Glacial Geology
- ENVE.5060 Regional Hydrogeology
- ENVE.5270 Environmental Laws
- ENVE.5710 Air Pollution Phenomenology
- ENVE.5720 Energy and the Environment
- ENVE.5750 Physical Chemistry for Environmental Studies
- ENVE.5760 Boundary layer Meteorology
- ENVE.5770 Remote Sensing of the Atmosphere
- ENVE.5780 Advanced Synoptic Meteorology
- ENVE.5790/ATMO.5150 Atmospheric Structure and Dynamics
- ATMO.5010 Boundary Layer Meteorology
- ENVI.5750/CHEM.5750 Physical Chemistry for Environmental Studies
- Chose one of the following courses:
  - PUBH.527/ENVE.5270 Environmental Law and Policy
  - ECON.615 Environmental and Natural Resources Economics

ATMOSPHERIC Sciences Concentration

Enrollment in this program is open to individuals with a bachelor’s degree in sciences, mathematics and engineering. Others may be admitted with the approval of the Graduate Program Coordinator. Such students may make up course prerequisite deficiencies while in the program, although these credits will not count toward the total required for the masters degree. Frequently, students entering the program are required to take a number of undergraduate courses to develop the analytical skills, and to prepare for the advanced level courses.

The M.Sc. program requires the completion of 30 credits, 9 in core courses, and 15 in elective courses listed below. Six credits may be achieved by completing a Master’s Thesis. The thesis involves original laboratory or theoretical work, usually publishable in accredited and peer reviewed technical journals. With the Graduate Program Coordinators approval, the thesis work may be performed at home or at the students employment facilities. The thesis advisory committee will consist of a Principal Advisor who is the member of the EEAS faculty, and two members chosen from EEAS or associated UMass Lowell faculty. One member may be from outside the University, with the approval of the Graduate Coordinator. Students may elect to take additional courses instead of writing a thesis.

Most of the courses are offered in the evening, usually from 6 to 9 p.m., once per week. This enables working students to complete the course requirements while the student is employed. A maximum of 5 years is allowed for completion of the masters degree, including the thesis.

Core Courses

- ATMO.5010 Boundary Layer Meteorology
- ENVI.5750/CHEM.5750 Physical Chemistry for Environmental Studies
- Chose one of the following courses:
  - PUBH.527/ENVE.5270 Environmental Law and Policy
  - ECON.615 Environmental and Natural Resources Economics

Elective Courses

- ATMO.5020 Advanced Synoptic Meteorology
Doctoral Programs

The UMass Lowell Department of Civil & Environmental Engineering offers three doctoral programs.

- **Doctor of Engineering (D.Eng.)**
  Civil and Environmental Engineering Option

- **Doctor of Philosophy (Ph.D.)**
  Civil and Environmental Engineering Option

- **Doctor of Philosophy (Ph.D.) in Chemistry**
  Environmental Studies Option

D.Eng. and Ph.D. - Civil & Environmental Engineering Option

Objectives

The objective of the Doctor of Engineering/Doctor of Philosophy degree in Civil and Environmental Engineering is to develop decision-making, research-oriented engineers with the ability to produce new engineering knowledge and analyze complex, cross-disciplinary issues. Successful applicants are expected to perform advanced research in one or more areas of concentration within the Department of Civil and Environmental Engineering and successfully complete both core courses and electives that may be drawn from a variety of disciplines. Beyond the core courses, the program can be tailored to the needs of each student through a formal arrangement between the student and his or her research advisor.

Areas of Concentration

The areas of concentration within the Doctor of Engineering/Doctor of Philosophy in Civil and Environmental Engineering are:

- Environmental Engineering
- Geoenvironmental Engineering
- Geotechnical Engineering
- Transportation Engineering
- Structural Engineering

Program Curriculum

In addition to the general degree requirements described earlier, students are required to take the Core Courses in one of the program concentration areas listed below.

- **Core for Environmental Engineering Concentration**
  - CIVE.5610 Physical and Chemical Treatment Processes
  - CIVE.5620 Physical and Chemical Hydrogeology
  - CIVE.5670 Environmental Aquatic Chemistry
  - CIVE.5680 Environmental Fate and Transport
  - CIVE.5780 Biological Wastewater Treatment
  - CIVE.5950 Hazardous Waste Site Remediation

- **Core for Geoenvironmental Engineering Concentration**
  - CIVE.5310 Advanced Soil Mechanics
  - CIVE.5360 Soil Engineering
  - CIVE.5620 Physical and Chemical Hydrogeology
  - CIVE.5670 Environmental Aquatic Chemistry
  - CIVE.5950 Hazardous Waste Site Remediation

  and at least one of the following:

  - CIVE.5290 Engineering with Geosynthetics
  - CIVE.5380 Soil Behavior
  - CIVE.5270 Geotechnical and Environmental Site Characterization
  - CIVE.5310 Advanced Soil Mechanics

  (and any four of the following:)

  - CIVE.5270 Geotechnical and Environmental Site Characterization
  - CIVE.5290 Engineering with Geosynthetics
  - CIVE.5300 Deep Foundations
  - CIVE.5320 Theoretical Soil Mechanics
Admissions Requirements

Admission to applicants who have at least one degree in engineering from an accredited university and department requires high academic standing in all prior course work. Admission may be also offered to applicants who hold a Bachelor’s and/or Master’s degree in non-engineering fields. In such cases, the applicant must successfully complete all requirements for a Master of Science in Civil and Environmental Engineering prior to being considered a candidate for the Doctor of Engineering/Doctor of Philosophy degree.

Plan of Study

Within about one academic year of initiation of doctoral study, each student must work with his/her research advisor to develop a Plan of Study that complies with doctoral program and University policies. Courses substitutions in the Plan of Study must be reviewed by the Departmental Graduate Committee. Formal requests for substitutions are made by the student’s Research Advisor. The student’s Research Advisor is the supervisor of the student’s research activities. The Advisor will work with the student to develop Dissertation research focus and request the service of appropriately qualified persons in the student’s Dissertation Committee. The Dissertation Committee will comprise a minimum of 4 persons of which at least 2 will be full time, regular faculty members of the Department of Civil and Environmental Engineering. The function of the Dissertation Committee is to ensure that the final edition of the student’s dissertation meets the high technical standards expected in doctoral work and that the student successfully defends his/her findings prior to the award of the Doctor of Engineering degree. Dissertation Committee members are not necessarily co-investigators of the student’s research topic.

Qualifying Examination

Upon the completion of a maximum of 45 credit hours of graduate work that count towards the doctoral degree, the student will apply to the Dissertation Committee to take a Qualifying Examination. In addition, students who were admitted as non-engineering degree holders into the Doctor of Engineering/Doctor of Philosophy program must satisfy all requirements for the award of the M.S. degree in Civil and Environmental Engineering before they are allowed to take the Qualifying Examination. The Qualifying Examination may be written and oral. The Dissertation Committee members will submit their grades to the Doctoral Program Coordinator who will tally them and report the overall grade on a pass/fail basis, to the student and his/her advisor. Students who successfully complete the Qualifying Examination will be designated as Candidates for the Doctor of Engineering/Doctor of Philosophy degree. For each doctoral student, a maximum of two Qualifying Examinations will be allowed. A doctoral student who fails the Qualifying Examination two times will not be allowed to continue in the doctoral program. Shortly after passing the Qualifying Examination, the Doctoral degree candidate will be expected to develop a thesis plan in collaboration with his/her advisor, and defend it successfully before the Doctoral Committee.

Ph.D. Program in Chemistry - Environmental Studies Option

A Ph.D. in Chemistry with an option in Environmental Studies is offered jointly by the Department of Chemistry and the Department of Civil and Environmental Engineering. The program is described in detail in the Chemistry Department section of this catalog.

Graduate Certificates

Graduate Certificates in Civil &Environmental Engineering

The UMass Lowell Department of Civil &Environmental Engineering offers three interdisciplinary graduate certificates.

- Environmental Biotechnology
- Download A Graduate Certificate Application Form (https://www.uml.edu/docs/Graduate%20Certificate%20App%20Only%2082016_tcm18-3292.pdf) (pdf)

You will need Adobe Acrobat Reader
Environmental Biotechnology

**Biology, Chemistry, Civil & Environmental Engineering departments**

**Contact:**
Juliette Rooney-Varga, Ph.D.
978-934-4715
juliette_rooneyvarga@uml.edu

Environmental biotechnology refers to the application of biological technologies to monitor, understand, and remediate environmental problems. This certificate combines courses that explore the ecological impact of anthropogenic environmental change with courses that provide training in current biological technologies that can be brought to bear on environmental problems. Recent advances in biotechnology are providing new avenues for investigating biologically mediated environmental processes, many of which were inaccessible using traditional approaches. New biological technologies are being developed to mitigate environmental problems. These include the biological remediation of pollutants, biological treatment of wastewater and drinking water, source tracking of microbial pathogens, and mitigation of toxic algal blooms. As environmental resources are increasingly strained and new biological technologies with the potential to improve our environment become available, the demand for professionals with training in environmental biotechnology will continue to increase.

**Required Courses (choose two):**
- BIOL.5040 Environmental Microbiology (3 credits)
- BIOL.5230 Biology of Global Change (3 credits)
- CIVE.5780 Biological Wastewater Treatment (3 credits)

**Elective courses (choose six to eight credits):**
- CHEM.5800 Advanced Analytical Biochemistry (3 credits)
- CHEM.5140 Advanced Analytical Chemistry (3 credits)
- BIOL.5050/5070 Bioinformatics (4 credits)
- CHEM.5260 Chromatography (3 credits)
- CIVE.5670 Environmental Aquatic Chemistry (3 credits)
- CIVE.5680 Environmental Fate and Transport (3 credits)
- CIVE.5950 Hazardous Waste Site Remediation (3 credits)
- BIOL.5670 Recombinant DNA Techniques (3 credits)
- BIOL.5690L Recombinant DNA Techniques Laboratory (2 credits)

Total: 12-14 credits
CIVE.5010 Civil Engineering Research Seminar - Credits: 0

Research seminar for doctoral and Master’s students to listen to researchers from academia, industry, and government of research-related topics in civil and environmental engineering. Invited speakers will present recent research advances in fields of environmental engineering, geotechnical engineering, structural engineering and transportation engineering. Attendance is mandatory for doctoral and MS students with thesis option. Thesis requirements and research methods will be introduced in various talks.

CIVE.5030 Computer Based Analysis of Structures (Formerly 14.503) - Credits: 3

The course is an introduction to the finite element displacement method for framed structures. It identifies the basic steps involved in applying the displacement method that can be represented as computer procedures. The course covers the modeling and analysis of 2-dimensional and 3-dimensional structures, such as cable-stayed structures, arches, and space trusses, space frames, shear walls, and so on. The analysis is done for both static and dynamic loading. The study is done by using MATLAB, GTSTRUDL, and Mathcad software.

CIVE.5040 Advanced Strength Of Material (Formerly 14/10.504) - Credits: 3

Stress and strain at a point; curved beam theory, unsymmetrical bending, shear center, torsion of non-circular sections; theories of failure; selected topics in solid mechanics.

CIVE.5050 Concrete Materials (Formerly 14.505) - Credits: 3

This course introduces fundamental and advanced topics on the properties of concrete materials. Fundamental topics include the formation, structure, mechanical behavior, durability, fracture, and deterioration of concrete. Theoretical treatments on the deformation, fracture and deterioration of concrete are also addressed. Advanced topics include the electromagnetic properties of concrete, high performance concrete (HPC), high-strength concrete (HSC), fiber-reinforced concrete, other special concretes, and the green construction of concrete.

CIVE.5080 Practice of Structural Engineering (Formerly 14.508) - Credits: 3

This course covers the practice of structural engineering as it deals with the design of structures such as buildings and bridges, the identification of loads, and design variables, and design detailing for concrete and steel structures. The emphasis will be placed on the use and interpretation of the ACI318-09, AISD and AASHTO codes and the GTSTRUDL software.

CIVE.5110 Inspection and Monitoring of Civil Infrastructure (Formerly 14.511) - Credits: 3

In this course, principles and applications of inspection and monitoring techniques for the condition assessment of aged/damaged/deteriorated civil infrastructure systems such as buildings, bridges, and pipelines, are introduced. Current nondestructive testing/evaluation (NDT/E) methods including optical, acoustical/ultrasonic, thermal, magnetoelectrical, radiographic, microwave/radar techniques are addressed with a consideration of their theoretical background. Wired and wireless structural health monitoring (SHM) systems for civil infrastructure are also covered. Applications using inspection and monitoring techniques are discussed with practical issues in each application.

CIVE.5120 Structural Stability (Formerly 14.512) - Credits: 3

This course provides a concise introduction to the principles and applications of structural stability for their practical use in the design of steel frame structures. Concepts of elastic and plastic theories are introduced. Stability problems of structural members including columns, beam-columns, rigid frames, and beams are studied. Approaches in evaluating stability problems, including energy and numerical methods, are also addressed.

CIVE.5210 Reliability Analysis (Formerly 14.521) - Credits: 3

A review of the elementary principles of probability and statistics followed by advanced topics including decision analysis, Monte Carlo simulation, and system reliability. In-depth quantitative treatment in the modeling of engineering problems, evaluation of system reliability, and risk-benefit decision management.

CIVE.5270 Geotechnical and Environmental Site Characterization (Formerly 14.527) - Credits: 3

This course is designed to give students a comprehensive understanding of various site investigation and site assessment technologies employed in geotechnical and environmental engineering. The course begins with introduction to site investigation planning and various geophysical methods including: seismic measurements, ground penetrating radar, electrical resistivity, electromagnetic conductivity, time domain reflectometry. Drilling methods for soil, gas and ground water sampling; decontamination procedures; and long term monitoring methods are studied. Emphasis in this course is
placed on conventional and state-of-the-art in situ methods for geotechnical and environmental site characterization: standard penetration test, vane shear test, dilatometer test, pressuremeter test and cone penetration tests. Modern advances in cone penetrometer technology, instrumented with various sensors (capable of monitoring a wide range of physical and environmental parameters: load, pressure, sound, electrical resistivity, temperature, PH, oxidation reduction potential, chemical contaminants) are playing a major role in site characterization. Principles underlying these methods along with the interpretation of test data will be covered in detail. The course will also look into emerging technologies in the area of site characterization. (3-0)3

CIVE.5280 Drilled Deep Foundations (Formerly 14.528) - Credits: 3


CIVE.5290 Engineering with Geosynthetics (Formerly 14.529) - Credits: 3

Rigorous treatment in the mechanism and behavior of reinforced soil materials. Laboratory and insitu tests for determining the engineering properties of geosynthetics (geotextiles, geomembranes, geogrids and geocomposites). Design principles and examples of geosynthetics for separation, soil reinforcement and stabilization, filtration and drainage.

CIVE.5300 Driven Deep Foundations (Formerly 14.530) - Credits: 3

design and analyses of driven deep foundations including: Deep foundations classification and historical perspective. Effects of pile installation. Static capacity and settlement analysis of a single pile and a pile group under vertical loads. Insight of pile resistance including soil behavior and interfacial friction. Driven pile load test standards, construction, interpretation, and simulation. Dynamic analysis of driven piles, the wave equation analysis, dynamic measurements during driving and their interpretation. Reliability based design using the Load and Resistance Factor design (LRFD) methodology application for driven deep foundations.

CIVE.5310 Advanced Soil Mechanics (Formerly 14.531) - Credits: 3

Theories of soil mechanics and their application. Drained and undrained stress-strain and strength behavior of soils. Lateral earth pressures, bearing capacity, slope stability, seepage and consolidation. Lab and insitu testing.

CIVE.5320 Theoretical & Numerical Methods in Soil Mechanics (Formerly 14.532) - Credits: 3

Geotechnical practice employs computer programs that incorporate numerical methods to address problems of stability, settlement, deformation, and seepage. These methods are based on theoretical understanding of the behavior of soils, and correct use of commercial software requires that the engineer understand theoretical bases of the numerical algorithms and how they work. This course addresses the description of stress and strain in the context of geotechnical engineering and the basic concepts of numerical and computational methods, including discretization errors, computational procedures appropriate to different classes of problem, and numerical instability. It will then apply the insights to the three major problems of geotechnical analysis: settlement, stability, and fluid flow.

CIVE.5330 Advanced Foundation Engineering (Formerly 14.533) - Credits: 3

Design and analysis of shallow foundations, excavations and retaining structures including: site exploration, bearing capacity and settlement theories, earth pressures, braced and unbraced excavations, rigid and flexible retaining structures, reinforced earth, dewatering methods and monitoring techniques.

CIVE.5340 Soil Dynamics and Earthquake Engineering (Formerly 14.534) - Credits: 3

This course addresses the dynamic properties of soils and basic mechanical theory of dynamic response. It will apply these results to analysis and design of dynamically loaded foundations. A basic understanding of earthquakes - where they occur, their quantitate description, how the complicated patterns of motions are captured by techniques such as the response spectrum, and how engineers design facilities to withstand earthquakes, will be addressed. In particular, the course will consider three topics of current professional and research interest: probabilistic seismic hazard analysis (PHSA), soil liquefaction, and seismically induced displacements. The emphasis will be on geotechnical issues, but some time will be devoted to structural considerations in earthquake resistant design.

CIVE.5360 Soil Engineering (Formerly 14.536) -
Credits: 3
The study of soil as an engineering material, and its use in
earth structures (e.g. dams, road embankments), flow control,
and compacted fills. Stability of natural and man made slopes,
soil reinforcement and stabilization.

CIVE.5370 Experimental Soil Mechanics (Formerly
14.537) - Credits: 3
Application of testing procedures to the evaluation of soil type
and engineering properties. Testing for classification,
permeability, consolidation, direct and triaxial shear and field
parameters. The technical procedures are followed by data
analysis, evaluation and presentation. Critical examination of
standard testing procedures, evaluation of engineering
parameters, error estimation and research devices.

CIVE.5380 Soil Behavior - Credits: 3
Study of the physico-chemical and mechanical behavior of soil.
Topics include: soil mineralogy, formation, composition,
concepts of drained and undrained stress-strain and strength
behavior, frozen soils.

CIVE.5390 Ground Improvement (Formerly 14.539) -
Credits: 3
Design and construction methods for strengthening the
properties and behavior of soils. Highway embankments, soil
nailing, soil grouting, landslide investigation and mitigation,
dynamic compaction, stone columns.

CIVE.5400 Urban Transportation Planning (Formerly
14.540) - Credits: 3
Objectives and procedures of the urban transportation
planning process. Characteristics and current issues of urban
transportation in the United States (both supply and demand).
Techniques of analysis, prediction and evaluation of
transportation system alternatives. Consideration of economic,
environmental, ethical, social and safety impacts in the design
and analysis of transportation systems.

CIVE.5405 Advanced Highway Geometric Design -
Credits: 3
Development of the principals of modern roadway design while
addressing context specific design requirements and
constraints. Topics will include guidelines for highway design,
design and review of complex geometry, geometric design to
address safety and operational concerns, multi-modal design
for signalized and un-signalized intersections, complete streets
design concepts, and superelevation. Course-work will also
include principals to present transportation designs to the
public, transportation advocates, and private clients.

CIVE.5410 Traffic Engineering (Formerly 14.541) -
Credits: 3
Engineering principles for safe and efficient movement of goods
and people on streets and highways, including aspects of (a)
transportation planning; (b) geometric design; (c) traffic
operations and control; (d) traffic safety, and; (e) management
of transportation facilities. Topics include: traffic stream
characteristics; traffic engineering studies; capacity and level-
of-service analysis; traffic control; simulation of traffic
operations; accident studies; parking studies; environmental
impacts.

CIVE.5420 Transportation Network Analysis
(Formerly 14.542) - Credits: 3
This course is to introduce engineering students to basic
transportation network analysis skills. Topics covered include
fundamentals of linear and nonlinear programming,
mathematical representations of transportation networks,
various shortest path algorithms, deterministic user equilibrium
traffic assignment, stochastic user equilibrium traffic
assignment, dynamic traffic assignment, heuristic algorithms
for solving traffic assignment problems, and transportation
network design.

CIVE.5430 Traffic Principles for Intelligent
Transportation Systems (Formerly 14.543) - Credits:
3
The objective of this course is to introduce the student to the
traffic principles that are pertinent for the planning, design and
analysis of Intelligent Transportation Systems (ITS). The course
is oriented toward students that come from different disciplines
and who do not have previous background in traffic or
transportation principles. It is designed as an introductory
course that will enable the student to pursue more advanced
courses in transportation systems subsequently.

CIVE.5440 Transportation Economics and Project
Evaluation (Formerly 14.544) - Credits: 3
The course offers an overview of the fundamental principles of
transportation economics. Emphasizes theory and applications
concerning demand, supply and economics of transportation
systems. Covers topics such as pricing, regulation and the
evaluation of transportation services and projects.
Prerequisites: Students should have knowledge of
transportation systems and basic microeconomics.

CIVE.5450 Public Transit Plan and Design (Formerly
14.545) - Credits: 3
Planning and design of public transportation systems and their technical, operational and cost characteristics. Discussion of the impact of public transportation on urban development; the different transit modes, including regional and rapid rail transit (RRT), light rail transit (LRT), buses, and paratransit, and their relative role in urban transportation; planning, design, operation and performance of transit systems (service frequency and headways, speed, capacity, productivity, utilization); routes and networks; scheduling; terminal layout; innovative transit technologies and their feasibility.

CIVE.5460 Pavement Design (Formerly 14.546) - Credits: 3
Fundamentals of planning, design, construction and management of roadway and airport pavements. Introduction to the theory and the analytical techniques used in pavement engineering. Principal topics covered: pavement performance, analysis of traffic, pavement materials; evaluation of subgrade; flexible and rigid pavement structural analysis; reliability design; drainage evaluation; design of overlays; and pavement distresses.

CIVE.5470 Airport Planning and Design (Formerly 14.547) - Credits: 3
Planning and design of civil airports. Estimation of air travel demand. Aircraft characteristics related to design; payload, range, runway requirements. Analysis of wind data, runway orientation and obstruction free requirements. Airport configuration, aircraft operations, and capacity of airfield elements. Design of the terminal system, ground access system, and parking facilities.

CIVE.5480 Traffic Management and Control (Formerly 14.548) - Credits: 3
The course presents modern methods of traffic management, traffic control strategies and traffic control systems technology. Main topics covered, include: transportation systems management (TSM); traffic control systems technology; control concepts - urban and suburban streets; control and management concepts - freeways; control and management concepts - integrated systems; traveler information systems; system selection, design and implementation; systems management; ITS plans and programs. The course will also include exercises in the use and application of traffic simulation and optimization models such as: CORSIM, TRANSYT and MAXBAND/MULTIBAND.

Traffic flow theory seeks to describe through precise mathematical models (a) the interactions between the vehicle and the roadway system and (b) the interactions among vehicles. Such theories forms the basis of all the models and procedures used in design and operational analysis of streets and highways. The course examines the fundamental traffic flow characteristics: time headway, flow, time-space trajectories, speed, distance headway and density. In depth treatment of related analytical techniques including traffic stream modeling at both microscopic and macroscopic levels, supply and demand analysis, shock wave analysis, queuing analysis and simulation modeling of traffic systems.

CIVE.5500 Behavior of Structures (Formerly 14.550) - Credits: 3
Classical and matrix methods of structural analysis applied to complex plane trusses. Elementary space truss analysis. Elementary model analysis through the use of influence lines for indeterminate structures. The digital computer and problem oriented languages as analytical tools.

CIVE.5510 Advanced Steel Design (Formerly 14.551) - Credits: 3
Elastic and plastic design of structural steel systems, residual stresses, local buckling, beam-columns, torsion and biaxial bending, composite steel-concrete members, load and resistance factor design.

CIVE.5520 Behavior - Concrete Structure (Formerly 14.552) - Credits: 3
The main objective of this course is to expand the students’ knowledge and understanding of reinforced concrete behavior and design. Advanced topics at material, element, and system level are built on quick reviews of undergraduate level knowledge and are related to current design codes.

CIVE.5530 Wood Structures (Formerly 14.553) - Credits: 3
Review of properties of wood, lumber, glued laminated timber and structural-use panels. Review of design loads and their distribution in wood-frame buildings. Design of wood members in tension, compression and bending; and design of connections.

CIVE.5560 Finite Element Analysis (Formerly 14.556) - Credits: 3
Finite element theory and formulation, software applications, static and dynamic finite element analysis of structures and components.
CIVE.5570 Structural Dynamics (Formerly 14.557) - Credits: 3
Analysis of typical structures subjected to dynamic force or ground excitation using direct integration of equations of motion, modal analysis and approximate methods.

CIVE.5580 Bridge Design (Formerly 14.558) - Credits: 3
Analysis and design of modern bridges, using computer software for the 3-D modeling of sample bridges under dead and live loading and seismic excitation. AASHTO specifications are used for the design of superstructures and substructures (abutments, piers, and bearings) under group load combinations.

CIVE.5590 Design of Masonry Structures (Formerly 14.559) - Credits: 3
Fundamental characteristics of masonry construction. The nomenclature, properties, and material specifications associated with basic components of masonry. The behavior of masonry assemblages subjected to stresses and deformations. Design of un-reinforced and reinforced masonry structures in accordance with current codes.

CIVE.5610 Physical Chemical Treatment Processes (Formerly 14.561) - Credits: 3
Course provides a theoretical understanding of various chemical and physical unit operations, with direct application of these operations to the design and operation of water and wastewater treatment processes. Topics include colloid destabilization, flocculation, softening, precipitation, neutralization, aeration and gas transfer, packed &tray towers, oxidation, disinfection, reverse osmosis, ultrafiltration, settlings, activated carbon adsorption, ion exchange, and filtration.

CIVE.5640 Hydrology & Hydraulics (Formerly 14.564) - Credits: 3
This course utilizes engineering principles to quantitatively describe the movement of water in natural and manmade environmental systems. Topics include: hydrologic cycle, steam flow and hydrographs, flood routing, watershed modeling, subsurface hydrology, and probability concepts in hydrology, hydraulic structures, flow in closed conduits, pumps, open channel flow, elements of storm and sanitary sewer design will be addressed.

CIVE.5660 Environmental Applications and Implications of Nanomaterials - Credits: 3
This course will cover (I) novel properties, synthesis, and characterization of nanomaterials; (II) environmental engineering applications of nanomaterials, with an emphasis on nano-enabled water and wastewater treatment technologies such as membrane processes, adsorption, photo-catalysis, and disinfection; and (III) Health and Environmental impacts of nanomaterials, focusing on potential mechanisms of biological uptake and toxicity.

CIVE.5670 Environmental Aquatic Chemistry (Formerly 14.567) - Credits: 3
This course provides environmental understanding of the principles of aquatic chemistry and equilibria as they apply to environmental systems including natural waters, wastewater and treated waters.

CIVE.5680 Environmental Fate and Transport (Formerly 14.568) - Credits: 3
The fate of contaminants in the environment is controlled by transport processes within a single medium and between media. The similarities in contaminant dispersion within air, surface water and groundwater will be emphasized. Interphase transport processes such as volatilization and adsorption will then be considered from an equilibrium perspective followed by the kinetics of mass transfer across environmental interfaces. A professional presentation of a select paper or group of paper concerning a course topic is required.

CIVE.5690 Micropollutants in the Environment - Credits: 3
This course focuses on the generation, fate and transformation, transport, and the impacts of micropollutants in the environment, with emphasis on soil and water matrices. Topics will include nanomaterials and organic micropollutants such as pharmaceuticals, antimicrobials, illicit drugs, and personal care products. Course delivery will be a combination of lectures,
experimental analysis, and discussions of assigned reading materials.

CIVE.5700 Wastewater Treatment and Storm Water Management Systems (Formerly 14.570) - Credits: 3

The era of massive subsidies for construction of sanitary sewers and centralized, publicly operated treatment works (POTWs) has passed. Non-point pollution from sources such as onsite disposal systems has become a major focus of concern in our efforts to protect and improve ground and surface water quality. Much of the new construction in areas not already served by centralized collection and treatment must use the alternative technologies. This course is design oriented. The variously available technologies are studied in depth. Students evaluate various technologies as they may be applied to a complex problem for which information is available, and develop an optimum problem solution.

CIVE.5710 Surface Water Quality Modeling (Formerly 14.571) - Credits: 3

Theory and application of surface water quality modeling will be combined interactively throughout the course. Data from a stream will be utilized in order to bring a public domain model into operation.

CIVE.5720 Marine and Coastal Processes (Formerly 14.572) - Credits: 3

This course focuses on the coastal dynamics of currents, tides, waves, wave morphology and their effects on beaches, estuaries, mixing and sediment transport/accretion processes. Generalized global aspects of atmospheric and hydrospheric interactions with ocean currents are also presented.

CIVE.5730 Solid Waste Engineering (Formerly 14.573) - Credits: 3

Characterization, handling and disposal of municipal, industrial and hazardous wastes. Technologies such as landfills, recycling, incineration and composting are examined. A term paper and professional presentation in class regarding a relevant topic is required.

CIVE.5750 Groundwater Modeling (Formerly 14.575) - Credits: 3

Groundwater Modeling is designed to present the student with fundamentals, both mathematical and intuitive, of analytic and numeric groundwater modeling. An introductory course in groundwater hydrology is a prerequisite for Groundwater Modeling, and the student should be familiar with IBM computers in running text editors and spreadsheets. The semester will start with basic analytic solutions and image theory to aid in the development of more complex numeric models. Emphasis will then switch to numeric ground water flow models (MODFLOW) and the use of particle tracking models (GWSM) to simulate the movement of solutes in ground water. The numeric modeling process will focus on forming the problem description, selecting boundary conditions, assigning the model parameters, calibrating the model, and preparing the model report. Course topics include: Analytic Methods, Numeric Methods, Conceptual Model and Grid design, Boundary Conditions, Sources, and Sinks, and Particle Tracking.

CIVE.5760 GIS Applications in Civil and Environmental Engineering (Formerly 14.576) - Credits: 3

This course is to introduce students to the basic concepts of Geographic Information Systems (GIS) and GIS applications in Civil and Environmental Engineering. Topics to be covered include GIS data and maps, queries, map digitization, data management, spatial analysis, network analysis, geocoding, communication systems and map projections, editing. Examples related to transportation, environmental, geotechnical and structural engineering will be provided to help students better understand how to apply GIS in the real world and gain hands-on experience. This course will consist of lectures and computer work.

CIVE.5790 Green and Sustainable Civil Engineering (Formerly 14.579) - Credits: 3

This course focuses on various green and sustainable materials and technologies applicable to five areas of civil engineering: environmental engineering, water resources engineering, structural engineering, transportation engineering, and geotechnical engineering. This course also covers current green building laws and introduces fundamentals of entrepreneurship and patent/copyright laws.

CIVE.5800 Construction Law (Formerly 14.580) - Credits: 3

An introduction to contract, statutory and tort law governing the relationships between the multitude of parties involved in the construction process. The purpose of this course is to give students an understanding of how the law interacts with the construction industry. Course introduces students to the obligations, rights and risks of architects, engineers, general contractors, subcontractors, sureties and insurers throughout the construction process.

CIVE.5810 Engineering Systems Analysis (Formerly 14.581) - Credits: 3

This course is designed to present the student with fundamentals, both mathematical and intuitive, of analytic and numeric groundwater modeling. An introductory course in groundwater hydrology is a prerequisite for Groundwater Modeling, and the student should be familiar with IBM computers in running text editors and spreadsheets. The
The course presents advanced methods of operations research, management science and economic analysis that are used in the design, planning and management of engineering systems. Main topics covered, include: the systems analysis methodology, optimization concepts, mathematical programming techniques, Network analysis and design, project planning and scheduling, decision analysis, queuing systems, simulation methods, economic evaluation. The examples and problems presented in the course illustrate how the analysis methods are used in a variety of systems applications, such as: civil engineering, environmental systems, transportation systems, construction management, water resources, urban development, etc.

CIVE.5850 Transportation Safety (Formerly 14.585) - Credits: 3

Transportation Safety goes beyond the accepted standards for highway design. Providing a safe and efficient transportation system for all users is the primary objective of federal, state, and local transportation agencies throughout the nation. This class addresses fundamentals of highway design and operation, human factors, accident investigation, vehicle characteristics and highway safety analysis.

CIVE.5910 Capstone Practicum (Formerly 14.591) - Credits: 3

The course will include: directed study regarding the technical and also social, political and financial aspects of a project; and on-site project review and assessment and culminate with preparation of a professional project report and presentations. Not-for-profit domestic and international projects may be studied. Course will be open to those having completed preparatory work. Project availability will be by agreement of faculty advisor and project sponsors prior to enrollment. (Offered only upon availability of suitable projects and adequate outside financial support.)

CIVE.5950 Hazardous Waste Site Remediation (Formerly 14.595) - Credits: 3

This course focuses on the principles of hazardous waste site remediation (with an emphasis on organic contaminants) using physical, chemical or biological remediation technologies. Both established and emerging remediation technologies including: bioremediation, intrinsic remediation, soil vapor extraction (SVE), in situ air sparging (IAS), vacuum- enhanced recovery (VER), application of surfactants for enhanced in situ soil washing, hydraulic and pneumatic fracturing, electrokinetics, in situ reactive walls, phytoremediation, and in situ oxidation, will be addressed. A term paper and professional presentation in class regarding a relevant topic is required.

CIVE.5960 Grad Industrial Exposure (Formerly 14.596) - Credits: 0

CIVE.6510 Special Topics in Civil Engineering (Formerly 14.651) - Credits: 3

Course content and credits to be arranged with instructor who agrees to direct the student.

CIVE.6530 Special Topics (Formerly 14.653) - Credits: 3

CIVE.6930 Civil Engineering Individual Project (Formerly 14.693) - Credits: 3

CIVE.7050 Supervised Teaching in Civil Engineering (Formerly 14.705) - Credits: 0

CIVE.7330 Masters Project in Civil Engineering (Formerly 14.733) - Credits: 3

CIVE.7360 Masters Project in Civil Engineering (Formerly 14.736) - Credits: 6

CIVE.7410 Master's Thesis-Civil Engineering (Formerly 14.741) - Credits: 1

CIVE.7430 Master's Thesis - Civil Engineering (Formerly 14.743) - Credits: 3

CIVE.7460 Master's Thesis - Civil Engineering (Formerly 14.746) - Credits: 6

CIVE.7490 Master's Thesis - Civil Engineering (Formerly 14.749) - Credits: 9

CIVE.7510 Doctoral Dissertation (Formerly 14.751) - Credits: 1

CIVE.7520 Independent Study in Civil Engineering (Formerly 14.752) - Credits: 3

CIVE.7530 Doctoral Dissertation (Formerly 14.753) - Credits: 3

CIVE.7560 Doctoral Dissertation/Civil Engineering (Formerly 14.756) - Credits: 6

CIVE.7570 Doctoral Dissertation (Formerly 14.757) - Credits: 7

CIVE.7590 Doctoral Dissertation (Formerly 14.759) - Credits: 9

CIVE.7630 Continued Graduate Research (Formerly 14.763) - Credits: 3
CIVE.7660 Continued Graduate Research (Formerly 14.766) - Credits: 6
CIVE.7690 Continued Graduate Research (Formerly 14.769) - Credits: 9
ENGN.5010 Engineering for Teachers (Formerly 25.501) - Credits: 3

The course will focus on increasing teachers' understanding of the Engineering Design Process. The linkage between science, engineering and technology will be discovered as teachers engage in a variety of home-based projects requiring them to apply design principles to the building, testing and evaluating of prototypes. Teachers will also gain knowledge of the various fields of engineering. Through their participation in the course, teachers will discuss how they might integrate engineering-technology concepts with other areas of their curriculum.

ENGN.5400 Designing Sustainable Products - Credits: 3

The course introduces students to the sustainability aspects of product design. Sustainable products are designed to conserve materials and energy, select low-impact materials, eliminate toxic substances, extend product life, re-use materials, and reduce the generation of wastes. The entire product life cycle will be considered including: material extraction, material processing, manufacturing, transportation, product use, and disposal. Students will learn the impact of design solutions in a global, economic, environmental, and societal context. The students will learn strategies to identify the sustainability impacts throughout the product life cycle, as well as the application of sustainable product design principles and strategies to address these impacts.

ENGN.5500 Introduction to Nanotechnology (Formerly 25.550) - Credits: 3

This course is designed to provide you with a broad overview to the multi-disciplinary field of nanotechnology. The course is team-taught by researchers from science, engineering, health and environment, management, and humanities disciplines. The topics include an introduction to nanoscale phenomena; fundamental theoretical concepts and experimental techniques in nanotechnology; nanoscale manufacturing and processing; innovative nanomaterials for various applications; applications of the technology; and environmental and health impacts of nanotechnology.

ENGN.5700 Selected Issues in Nanomanufacturing (Formerly 25.570) - Credits: 0

A seminar course that examines the issues associated with high rate template-based nanomanufacturing, including: technologies for nanoscale templates, high rate assembly of nanoelements and polymer systems, registration at the nanoscale, interfacing with biological systems, measurement of nanoelements, and molecular modeling. Environmental, regulatory, and ethical issues associated with new technologies are also addressed. The course is co-taught by faculty from Northeastern University, the University of Massachusetts Lowell, and the University of New Hampshire. Meeting dates: January 27, February 10, February 24, March 10, March 24, and April 7. Time: 12:00 to 3:30, including lunch.

ENGN.5800 Thesis Review (Formerly 25.580) - Credits: 1

ENGN.5810 Project Review (Formerly 25.581) - Credits: 1

ENGN.5900 Graduate Industrial Cooperative Educational Experience I (Formerly 25.590) - Credits: 1

Industrial experience credit for co-op and internships with industry. Students must register with department co-op coordinator.

ENGN.5910 Graduate Industrial Cooperative Educational Experience II (Formerly 25.591) - Credits: 1

Industrial experience credit for co-op and internships with industry. Students must register with department co-op coordinator.

ENGN.5920 Graduate Industrial Cooperative Educational Experience III (Formerly 25.592) - Credits: 1

Industrial experience credit for co-op and internships with industry. Students must register with department co-op coordinator.

ENGN.5930 Graduate Industrial Cooperative Educational Experience (Formerly 25.593) - Credits: 3

Industrial experience credit for co-op and internships with industry. Students must register with department co-op coordinator.

ENGN.5980 Seminar for Teaching Assistants in Engineering - Credits: 0

Prepare graduate students for their role as teaching assistants in labs and lectures. Topics include: (1) classroom management, (2) grading strategies, (3) how to prepare for lecture and lab, (4) understanding the cultural differences that come with the diverse campus population, (5) balancing teaching and research responsibilities, (6) how to do graduate-level research. This
course is mandatory for all new teaching assistants in the College of Engineering.

ENGN.6010 Academic and Technical Writing for Research in Engineering - Credits: 0

This course addresses the complex nature of academic language and academic writing by focusing on sentence, paragraph and text structures, purposeful and appropriate word choices, and the writing process. Through attention to details and critical reading of various materials, students will enhance their writing skills by applying effective planning, drafting, rewriting and editing strategies. Students will further become adept at critically and creatively evaluating, analyzing, constructing and presenting their ideas and arguments. As a workshop class, the final product of the class will be one or more of (1) a journal paper that is ready for submission, (2) a conference paper, and (3) one or more chapters of a dissertation or thesis. Please Note: Advanced English language proficiency required.

ENGN.6020 Graduate Professional Development for Engineers - Credits: 1

This course is designed to provide master's students with the requisite preparation in understanding the expectations of the workplace and tools needed to engage in an effective job search process. The course will facilitate the transition and preparation to meet the increased expectations of a graduate student while on a graduate cooperative experience. The course will be comprised of a series of workshops and offer resources intended to provide students a good understanding of the US work environment, work culture and expectations. Topics include: workplace culture and expectations, professional communication skills, job search strategies, resume writing, mock interviews, technical writing.

ENGN.6030 Graduate Cooperative Experience - Credits: 0-1

This one-credit course is for co-op internship experience. There will be one credit whether the co-op experience is for three or six months. Learning objectives a s mutually agreed upon by the student and co-op supervisor will be required to be submitted at the beginning of the experience. A final evaluation by supervisor will be due before final grading. Full-time co-op is typically expected to be at a minimum of 30 hours per week.

ENGN.6040 Workforce Development - Credits: 1

Optional seminar series which will be comprised of weekly speakers from industry, government, academia and non-profit sectors with a focus on workforce development talks.
Department of Electrical & Computer Engineering

Graduate Degrees:
- Master's of Science in Electrical Engineering (M.S.E.)
- Master's of Science in Computer Engineering (M.S.E.)
- Doctor of Philosophy in Electrical Engineering (Ph.D.)
- Doctor of Philosophy in Computer Engineering (Ph.D.)
- Doctor of Engineering in Electrical Engineering (D.Eng.)
- Doctor of Engineering in Computer Engineering (D.Eng.)

Graduate Certificates:
- Electrical and Computer Engineering
  - Communications Engineering
  - Microwave and Wireless Engineering
  - VLSI and Microelectronics
- Co-op Option in Engineering
  The Department of Electrical & Computer Engineering participates in the Graduate Master's Co-op Option in Engineering. For detailed information about the Co-op Program and curriculum requirements, please see the Graduate Catalog Engineering Co-op page (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).
- Interdisciplinary
  - Biomedical Engineering
  - Energy Conversion
  - Integrated Engineering Systems
  - Nanotechnology
  - Photonics and Optoelectronics
  - Telecommunications

The Department of Electrical and Computer Engineering graduate program provides an education based on excellent teaching and cutting-edge research to qualify students as leaders in both industrial and academic environments. It is distinguished by an extensive set of courses in all of the major disciplines within electrical and computer engineering fields. Our mission is supported by six research centers, over ten research laboratories and a world-class faculty with ongoing research in a broad set of disciplines. The program offers masters degrees in both Electrical Engineering and Computer Engineering, as well as two doctoral degrees, Doctor of Philosophy and Doctor of Engineering, in Electrical Engineering and Computer Engineering.

Research is conducted and courses offered in the following areas:
- Artificial/Machine Intelligence
- Bio-Engineering/Bio-Informatics/Bio-Sensors
- Computational Engineering
- Computer Architecture and Embedded Systems
- Computer/Telecommunications/Sensor Networks
- Control Systems
- Distributed Systems and Networks
- Electric Vehicles and Battery Technology
- Electromagnetics
- Metamaterials
- Microwave Engineering
- Mobile/Wireless Communications
- Optoelectronic and Semiconductor Devices
- Power Systems
- Printable Electronics
- Quantum/Nano Electronics
- Signal/Image Processing and Computer Vision
- Solar Energy and Photovoltaics
- Stochastic Processes
- Storage and I/O Systems
- VLSI Design and Fabrication

Graduate Certificates
Three graduate certificates in Electrical and Computer Engineering and six interdisciplinary certificates in corporation with other departments are also offered. These certificates allow students who are not in a degree program to further their education. Approvals to take courses associated with these certificates are subject to approval of the certificate coordinator. Because there is no transfer policy for certificates, students should not take any course for certificates before being accepted.

Master's Programs
- Master's of Science in Engineering (M.S. Eng.) - Electrical Engineering (EE)
- Master's of Science in Engineering (M.S. Eng.) - Computer Engineering (CP)

Co-op Option in Graduate Engineering
- The Electrical & Computer Engineering Department
participates in the Graduate Master’s Co-op Option in Engineering. For detailed information about the Co-op Program and Curriculum requirements, please see the Graduate Catalog Engineering Co-op page (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).

- Graduate Admissions Requirements

- Academic Requirements
- Areas of Concentration in Electrical Engineering
  Information Systems (Telecommunications)
  Power and Energy Engineering
  Opto-Electronics
- Areas of Concentration in Computer Engineering
  Networking and Distributed Systems
  Computer Architecture and Embedded Systems

Graduate Admissions Requirements

1. General requirement for all applications:

   All applicants must submit the application materials supplied by the Graduate Admissions Office as well as the official score report for the Graduate Record Examination (GRE) Aptitude Test.

2. With a BS in Engineering and related areas:

   - Applicants to the MS Engineering in EE or CP programs should hold a BS degree in EE, CP, areas related to EE or CP, Computer Science, Mathematics, Physics, or other Engineering disciplines, with acceptable quality of undergraduate work from an accredited college or university.
   - Applicants to the MS Engineering in EE or CP should possess the following backgrounds and their pre-requisites.

   **Electrical Engineering**
   - EECE.2160 A high-level programming language such as C/C++
   - EECE.2650 Logic Design I

   **Computer Engineering**
   - EECE.2160 A high-level programming language such as C/C++
   - EECE.2650 Logic Design
   - EECE.3110 Electronics Lab I
   - EECE.3170 Microprocessor Systems Design
   - EECE.3620 Signal and Systems
   - EECE.3640 Engineering Mathematics (or another appropriate advanced course beyond MATH.2310 Calculus III and MATH.2360 Engineering Differential Equations)
   - EECE.3650 Electronics I

   Applicants who lack any of the above backgrounds and their pre-requisites are required to make up their deficiencies as conditions for acceptance.

3. With a BS in Technology

   Students who lack the BS Engineering in EE or CP but hold a bachelor's degree in Electrical or Computer Engineering Technology, or Electronics Technology may be admitted under special circumstances. These circumstances include an academic record of high achievement in their undergraduate studies in Technology as evaluated at the discretion of the Graduate Coordinator.

   In addition, such students must complete a series of analytically oriented courses in the Department of Electrical and Computer Engineering, University of Massachusetts Lowell.

4. Applicants applying for the Accelerated Bachelor’s to Master’s program

   The Bachelor’s to Master’s program is an accelerated program offered by the Department of Electrical and Computer Engineering to encourage its outstanding undergraduate students to continue study at graduate level. Undergraduate students who have a GPA of 3.00 or better at the end of their junior year and are interested in this program must apply for this program before they complete the undergraduate...
graduation requirements. Students who apply for the BS/MS program are not required to submit the Graduate Record Examination (GRE) scores and are exempted from the application fee. With the approval of the Graduate Coordinator, students in the BS/MS program may use up to six credits of graduate courses with an earned grade of B or better for both graduate and undergraduate degrees.

Academic Requirements

Graduate students can choose to complete a thesis or a non-thesis option. Students are required to take 9 credits of core courses as well as elective courses to complete their program of study.

1. Credit Requirements

Non-Thesis Option

<table>
<thead>
<tr>
<th>Courses</th>
<th>Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Requirements</td>
<td>9</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>21</td>
</tr>
<tr>
<td>Advanced Project</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total credit hours</strong></td>
<td><strong>33 credits</strong></td>
</tr>
</tbody>
</table>

Thesis Option

<table>
<thead>
<tr>
<th>Courses</th>
<th>Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Requirements</td>
<td>9</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>15</td>
</tr>
<tr>
<td>Thesis</td>
<td>6</td>
</tr>
<tr>
<td>Graduate Seminar (16.601/601)</td>
<td></td>
</tr>
<tr>
<td><strong>Total credit hours</strong></td>
<td><strong>30 credits</strong></td>
</tr>
</tbody>
</table>

With the approval of the Graduate Coordinator, students in the BS/MS program may use up to six credits of graduate courses with an earned grade of B or better for both graduate and undergraduate degrees.

Technical electives are Electrical and Computer Engineering graduate course and concentration courses. Students may choose their technical electives in their area of concentration and across other areas to establish a broad knowledge base. Graduate courses in Computer Science, Mathematics, Physics, and other engineering disciplines may be taken as technical electives only if they are pre-approved by the Graduate Coordinator for non-thesis option, or concurrently by the Graduate Coordinator and the students thesis advisor for thesis option.

The credits for Advanced Graduate Project (EECE.7330) cannot be counted toward the requirement for the thesis option. It can be replaced with a 3-credit technical elective for the non-thesis option.

2. Core Requirement

The objective of the core requirement is to guarantee broad analytical strength for the MS Engineering students.

**Required Core Courses for MS in Electrical Engineering**
(choose 3 courses)

- EECE.5070 Electromagnetic Waves and Materials
- EECE.5080 Quantum Electronics for Engineers
- EECE.5090 Linear Systems Analysis
- EECE.5130 Control Systems
- EECE.5150 Power Electronics
- EECE.5200 Computer-Aided Engineering Analysis
- EECE.5430 Introduction to Communications Theory
- EECE.5840 Probability and Random Processes
- EECE.5950 Solid State Electronics

Students in Electrical Engineering must take three of the above courses that may be pertinent to their area of concentration.

**Required Core Courses for MS in Computer Engineering**
(choose 3 courses)

- EECE.5530 Software Engineering
- EECE.5610 Computer Architecture and Design
- EECE.5620 VHDL/Verilog Synthesis and Design
- EECE.5730 Operating Systems and Kernel Design
- EECE.5740 Advanced Logic Design

Students in Computer Engineering must take three of the above courses that may be pertinent to their area of concentration.

3. Concentration

A concentration is generally defined by a coordinated and approved sequence of at least four graduate courses. Each student can choose to work out a concentration either with the graduate coordinator or with his/her academic advisor. Completion of a specific concentration is not required for graduation. The course sequences in the concentrations serve as a starting point for establishing a program of study in consultation with the Graduate Coordinator or the students academic/thesis advisor to meet his/her educational objectives. It is expected that the courses comprising the concentration will complement the work the student will undertake in fulfillment of the research requirement.

4. Research for Thesis Option

The research requirement may be fulfilled by completion of an MS Thesis, including registration for six credits of EECE.7430/EECE.7460 - MS Thesis Research, oral defense of
Areas of Concentration

In addition to the required three core courses (9 credits), three additional courses from a concentration are recommended depending upon whether a thesis is selected or not.

1. Concentration courses in Electrical Engineering


- Opto-Electronics EECE.5080 Quantum Electronics for EngineersEECE.5180 Electromagnetic Materials for Optics EngineeringEECE.5190 Engineering of Submicron MachinesEECE.5230/4230 Introduction to Solid State ElectronicsEECE.5320 Computational ElectromagneticsEECE.5830 Wave Propagation in PlasmasEECE.5900 Fiber Optic CommunicationsEECE.5950 Solid State ElectronicsEECE.6070 Electromagnetics of Complex MediaEECE.6080 Scattering and Diffraction of EM WavesEECE.6100 Optics for Information ProcessingPHYS.6310 Non-Linear Optics

Opto-Electronics is an option in cooperation with the Department of Physics, and may be pursued by students enrolled in the MS Eng in EE program. This option contains required and recommended courses designed to provide a fundamental background in optical devices and systems, as well as in optical physics and in the electro-optical properties of materials.

In addition to the required three core courses, students pursuing this option must take 16.568 Electro-Optics and Integrated Optics and two other courses from the above list.

Other concentrations in Electrical Engineering can be found from the clusters of courses specified as ECE certificates in the "Graduate Certificates" section.

2. Concentration courses in Computer Engineering


- Computing and Embedded Systems Hardware and Architecture EECE.5020 VLSI DesignEECE.5040 VLSI FabricationEECE.5170 MMIC Design and FabricationEECE.5500 Advanced Digital Systems
Doctoral Programs

Doctor of Philosophy Programs

- Doctor of Philosophy Program in Electrical Engineering (EE)
- Doctor of Philosophy Program in Computer Engineering (CP)

Doctor of Engineering Programs

- Doctor of Engineering Program in Electrical Engineering (EE)
- Doctor of Engineering Program in Computer Engineering (CP)

There are two types of doctoral degrees, the Doctor of Philosophy (Ph.D.) and the Doctor of Engineering (D.Eng.). The former is more research oriented while the latter is more industrially oriented. The primary difference between the two types of doctoral degrees is the requirement of 9 management credits for the D.Eng degrees. There may also be differences in the content of the dissertations.

Objective

The primary goal of the Ph.D. and D.Eng. in Electrical and Computer Engineering is to provide a research intensive program with the rigorous course work to strengthen the student's knowledge in the fundamentals of Electrical and Computer Engineering. A secondary goal for Doctor of Engineering Program is for them to develop an appreciation for the social and economic issues connected with the operation of a modern high technology enterprise. The programs include advanced graduate coursework in Electrical/Computer Engineering and allied subjects, a non-technical component (in the case of the Doctor of Engineering programs), and research culminating in a doctoral dissertation.

A complete description of the doctoral programs are found in the Department of Electrical and Computer Engineering Doctoral Student Handbook which is updated annually and available from the department office.

Admission Requirements

Applicants must have a BS or MS degree in Electrical Engineering or Computer Engineering or their equivalent from a recognized college or university with an acceptable quality of prior academic work. Applicants must submit official transcripts of all prior undergraduate and graduate courses. Each applicant must submit an official report of Graduate Record Examination (GRE) General Test scores. The TOEFL exam is required for students from abroad whose native language is not English.

Plan of Study

Each student entering the program must develop a plan of study in consultation with his/her advisor.

Visit the ECE Graduate Website (http://www.uml.edu/ecegrad).

Residency Requirement

One year of full-time residence is required of all students in the program.

Program Duration
The time for graduation for full-time students is expected to range from a minimum of three and a half years to a maximum of five years after BS Engineering and a minimum of two and a half years to a maximum of four years after MS Engineering.

Transfer Credit

Up to 24 semester credits in graduate courses in Electrical/Computer Engineering and allied subjects are transferable to the doctoral program upon approval by the Doctoral Committee of the Department of Electrical and Computer Engineering.

Candidacy Requirements

1. Qualifying Examination

   The qualifying examination is a written exam will be held twice a year at the beginning of each semester. A PhD candidate ONLY has 2 chances to pass the exam. If the student fails the exam twice, then they are dismissed from the program and are not eligible to be re-admitted to the Department. If the student wishes to appeal this they can follow the guidelines provided in the Graduate Policies University Appeals process. The exact dates will be announced on the website and in the ECE office. A doctoral student must take this examination no later than the first year of study at UML as an EE/CP doctoral student. So, if a student is accepted into the Doctoral Program in the Fall, the student must take the exam in the following Spring semester. If a student is accepted into the Doctoral Program in the Spring, the student must take the exam in the following Fall semester. The doctoral committee reserves the right to drop from the program those students who do no comply with the requirements of this clause. A doctoral student who fails at the first attempt will be allowed one more opportunity to retake this examination an this must be done the next time it is held. So, if the student fails the exam in the Fall, he/she must retake the exam in the Spring OR if the student fails the exam in the Spring, then he/she must retake the exam in the Fall.

2. Thesis Proposal and Oral Exam

3. Having passed the qualifying examination, a student may submit his/her dissertation proposal and defend the proposal before the Doctoral Committee. The proposal examination will also include an oral examination on topics connected with the student's area of research. On passing this examination, the student's name will be submitted to the College Doctoral Committee and the Registrar’s Office for acceptance as a candidate for the Doctor of Philosophy or Doctor of Engineering Degree. Admission to candidacy status does not guarantee the obtaining of the degree.

4. Final Defense of Dissertation

   This is the final oral examination, conducted by the Doctoral Committee. The membership of the committee may be augmented by non-voting faculty. The candidate has to submit a written Dissertation based on the research during the period of the Ph.D. degree. After receiving the approval of the advisor and the Doctoral Committee, the final oral examination shall be conducted. In order to pass, the candidate may not receive more than one dissenting vote from the membership of the examination committee.

Academic Requirements

1. Credit Requirement

   - The Doctor of Philosophy (Ph.D.) degree requires completion of a minimum of 63 semester hours of academic credit beyond the Bachelor of Science degree. A typical program consists of the following:

<table>
<thead>
<tr>
<th>Courses</th>
<th>Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE and Allied Subjects</td>
<td>30</td>
</tr>
<tr>
<td>Thesis</td>
<td>21</td>
</tr>
<tr>
<td>Courses/Thesis *</td>
<td>12</td>
</tr>
<tr>
<td>Graduate Seminar ** (16.601/602)</td>
<td>0</td>
</tr>
<tr>
<td>Total credit hours</td>
<td>63</td>
</tr>
</tbody>
</table>

   * Graduate level engineering courses including associated science and math course OR Dissertation credits approved by faculty advisor and dissertation committee.

   **All Doctoral students (Ph.D. and D.Eng.) who have been admitted Fall 2012 or later must take the Graduate Seminar
course for a total of TWO semesters during their doctoral studies. This course is mandatory for doctoral students.

For more information, please go to this link: [Graduate Seminar](https://www.uml.edu/docs/Graduate%20seminar_Dec2012_tcm18-87489.pdf)

- The Doctor of Engineering (D.Eng.) degree requires completion of a minimum of 63 semester hours of academic credit beyond the Bachelor of Science degree. A typical program consists of the following:

<table>
<thead>
<tr>
<th>Courses</th>
<th>Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECE and Allied Subjects</td>
<td>33</td>
</tr>
<tr>
<td>Thesis</td>
<td>21</td>
</tr>
<tr>
<td>Non-Technical Component</td>
<td>9</td>
</tr>
<tr>
<td>Total credit hours</td>
<td>63</td>
</tr>
</tbody>
</table>

The Doctoral Program Coordinator of the Department of Electrical and Computer Engineering will assist students in selecting courses to meet the non-technical component of the Doctor of Engineering program.

2. Core Requirement

The core courses are beginning graduate courses. They emphasize the fundamentals, concepts, and analytical techniques relevant to Electrical/Computer Engineering. They also help the student prepare for the qualifying examination.

Required Core Courses for Ph.D. and D.Eng degrees in Electrical Engineering: (choose three courses)

- ECE.5070 Electromagnetic Materials and Waves
- ECE.5080 Quantum Electronics for Engineers
- ECE.5090 Linear Systems Analysis
- ECE.5130 Control Systems
- ECE.5150 Power Electronics
- ECE.5200 Computer-Aided Engineering Analysis
- ECE.5430 Introduction to Communications Theory
- ECE.5840 Probability and Random Processes
- ECE.5950 Solid State Electronics

Students in Electrical Engineering must take three courses of the above courses.

Required Core Courses for Ph.D. and D.Eng degrees in Computer Engineering:

- ECE.5530 Software Engineering
- ECE.5610 Computer Architecture and Design
- ECE.5620 VHDL/Verilog Synthesis and Design
- ECE.5730 Operating Systems and Kernel Design
- ECE.5740 Advanced Logic Design

3. Grade-Point Average (GPA) Requirement

To successfully complete the program, a student must achieve a cumulative grade-point average (GPA) of at least 3.25 in all course work.

Graduate Certificates

Electrical and Computer Engineering Graduate Certificates:

- Additive Manufacturing (AM) in Radio Frequency (RF) & Microwave (MW) Applications
- Communications Engineering?
- Field Programmable Gate Array
- Microwave and Wireless Engineering
- VLSI and Microelectronics

Interdisciplinary Graduate Certificates:

- Biomedical Engineering and Biotechnology
- Energy Conversion
- Integrated Engineering Systems
- Medical Imaging and Instrumentations
- Photonics and Optoelectronics

Graduate certificate programs are ideal for bachelor’s degree-prepared engineers who wish to continue their studies without making the commitment of a master’s program. Students may want to brush-up on new developments in their field or investigate another specialty. Certificates are earned by taking four courses from a list associated with each certificate. ECE certificates can be used as concentrations in the ECE Masters programs.

Credits earned from these graduate certificates may be used toward a graduate degree with the approval of the graduate program coordinator.

Each of these certificates are described below and include the name and contact information of the certificate coordinator.
About Graduate Certificates

Most graduate certificates are comprised of four courses (12 graduate credits) designed to provide specific knowledge and expertise vital to today’s changing and complex needs in the workplace. In most cases courses may be applied toward a degree program.

Requirements to Complete a Graduate Certificate

The four courses must be completed within a five year period with a minimum 3.0 grade point average, and with no more than 6 credits below B. Courses completed for one certificate may not be used for another certificate.

Certificate Application Process

Individuals must complete a simplified application, provide an official undergraduate transcript indicating that a baccalaureate degree has been awarded, and submit a nominal application fee. GRE’s are not required.

Download Graduate Certificate Application Form (pdf) at [https://www.uml.edu/docs/Graduate%20Certificate%20Only%20082016_tcm18-3292.pdf](https://www.uml.edu/docs/Graduate%20Certificate%20Only%20082016_tcm18-3292.pdf).

You will need Adobe Acrobat Reader (https://get.adobe.com/reader/) to view any pdf files. It can be downloaded for free from the Adobe website (https://get.adobe.com/reader/).

Communications Engineering Certificate

Electrical and Computer Engineering Department

**Contact:** Kavitha Chandra, Ph.D., 978-934-3356, kavitha_chandra@uml.edu

This certificate provides a fundamental background in the understanding of information transmission, statistical properties of signals and noise, and both analog and digital modulation/demodulation techniques. Advanced topics in modern communications and the characterization of communication channels are covered in optional courses in coding, error correction, information measures, stochastic system modeling and wireless communications. The holder of the certificate will have both analytical and practical competence to contribute significantly to the design and development of new and updated communications systems.

This is a 12 credit certificate; all courses are 3 credits each.

**Required Courses:**

- EECE.5430 Communications Theory
- EECE.5840 Probability and Random Processes

**Elective Courses:** (Choose two of the following)

- EECE.5480 Coding and Information Theory
- EECE.5820 Wireless Communication
- EECE.6180 Performance of Wireless Communications Networks
- EECE.6850 Statistical Communication Theory
- EECE.6870 Applied Stochastic Estimation

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Communications%20Engineering%20-%2014.9999-Gedt.html).

Field Programmable Gate Array

**Electrical and Computer Engineering Department**

**Contact:** Yan Luo, Ph.D., 978-934-2592, yan_luo@uml.edu

The 12-credit certificate is a valuable credential for engineering professionals in the private and public sectors who wish to master the theoretical and practical skills in FPGA development and applications. Certificate holders will acquire additional academic credentials to advance within their organization or to change their career paths and improve their competitive position in the job market. For many employees working in the technical and scientific fields without any FPGA background, the GCFPGA will provide them with the knowledge needed for effectively applying FPGA’s in the design of mission-critical and reliable digital systems.

Please note, if you are a BAE employee, there is a fixed set of six courses you must complete to obtain the GCFPGA and to be recognized by BAE systems internally as proficient in FPGA technologies.

**Required three 3-credit courses:**

- EECE.5750 FPGA Logic Design Techniques
- EECE.5620 VHDL/Verilog Synthesis and Design
- EECE.5770 Verification of Digital Systems

**Elective: (Choose one) 3-credit courses:**

- EECE.6510 Advanced Embedded System Design and FPGA
- EECE.5780 Modeling and Implementation of Digital System using MATLAB
The Electrical and Computer Engineering Department also participates in the following interdisciplinary certificate programs:

**Biomedical Engineering & Biotechnology Certificate**

**Electrical & Computer Engineering Department**

The Biomedical Engineering and Biotechnology Graduate Certificate is a multidisciplinary certificate program, spanning courses in the Francis College of Engineering, the Kennedy College of Sciences, and the College of Health Sciences. The graduate certificate is comprised of a coordinated program of courses jointly offered by the participating departments. This certificate is a 12-credit program comprised of two required three-credit courses and two elective three-credit courses.

The BMEBT Graduate Certificate is intended for students who have successfully graduated with a baccalaureate degree and are possibly interested in pursuing a Master’s degree in Biomedical Engineering and Biotechnology, BMEBT, but do now wish to commit to the master’s degree at this time or who are simply interested in earning credentials beyond those from their undergraduate degree in the area of BMEBT.

**Application Process**

Individuals must apply and complete an application form in accordance with the university’s Graduate Admissions website at: www.uml.edu/grad/. Applicants must submit an official undergraduate transcript indicating that a baccalaureate degree was awarded. GRE scores are not required for the certificate program. All applications will be reviewed by the Biomedical Engineering and Biotechnology Program Director. A decision will be made in writing to the applicant.

**Requirements to Complete the Graduate Certificate**

To complete the certificate program, students must successfully complete 12-credits of coursework with a cumulative GPA of 3.0 or greater, and with no more than three credits with a grade of less than B. For students who wish to continue onto the Master’s degree in Biomedical Engineering and Biotechnology, all four of the Certificate courses can be used towards satisfying the course requirements of the master’s degree program; students must meet all University requirements for earning the Master’s degree. In addition, a waiver of the GRE requirement for the master’s degree will be provided to those students who achieve a GPA of 3.5 or greater.

**BMEBT Certificate Curriculum:**

- BMBT.5000 Introduction to Biomedical Engineering and Biotechnology
- BMBT.5750 Quantitative Physiology or Cardiovascular Physiology
Elective Courses: (Choose any two 3-credit courses)
- BMBT.5500 BMEBT Lab Experience
- BIOL.6660 Molecular and Cellular Biology
- MATH.5550 Applied Math for Life Science
- PUBH.5311 Occupational Biomechanics
- PLAS.5530 Medical Device Design

Gainful Employment Disclosure Information
Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/BiomedicalEngineering%20-%20.%202014.9999-Gedt.html).

For more information, contact: Stephen McCarthy, Ph.D. at: Stephen_McCarthy@uml.edu

Energy Conversion Certificate

Electrical and Computer Engineering Department

Contact: Mufeed Mahd (mailto:mufeed_mahd@uml.edu), 978-934-3317

Energy conversion is a discipline that spans across three departments: Electrical, Mechanical and Chemical &Nuclear Engineering. Interest is rising for practical applications in the housing industry to supply houses with clean sources of energy to meet electrical supply needs, as well as for space heating/cooling. All renewable energy sources will be considered (e.g. wind energy and photovoltaics). Information about batteries, battery charging stations, battery chargers and energy conversion devices (such as rectifiers, inverters, choppers, controllers) is presented as related to the development of low emission vehicles.

Choose four of the following courses:
- EECE.5150 Power Electronics
- EECE.5250 Power Systems Distribution
- EECE.5280 Alternative Energy Sources
- EECE.5290 Electric Vehicle Technology
- MECH.5210 Fundamentals of Solar Energy Engineering
- MECH.5270 Solar Energy Engineering

Gainful Employment Disclosure Information
Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Energy Conversion Disclosure Information (https://www.uml.edu/gainful-employment/EnergyConversion%20-%20.%202014.9999-Gedt.html).

Integrated Engineering Systems Certificate

Applied Physics, Computer Engineering, Computer Science, Electrical Engineering, Materials Engineering, Mechanical Engineering, Plastics Engineering Departments

Contact: Xuejun Lu, Ph.D. (mailto:xuejunlu@uml.edu), 978-934-3359

As companies increasingly undertake engineering projects that bring together a wide range of disciplines for manufacturing an integrated product, it is often necessary to assemble teams of experts in these various disciplines, and prepare managers who have a fundamental, overall understanding of several different engineering areas. The certificate is designed to respond to the need for trained professionals who are responsible for managing complex engineering systems integrating algorithms, information, software and hardware. Completion of certificate courses in areas complementary to the individual’s specific training will serve as an important starting point for engineering managers (and prospective managers) who need to solve complex interdisciplinary problems at the interfaces of electrical, computer, mechanical, materials engineering, and computer science and applied physics.

The program consists of six clusters:
- Applied Physics
- Computer Engineering
- Computer Science
- Electrical Engineering
- Materials Engineering
- Mechanical Engineering

Within each cluster, there are a number of carefully selected courses ranging from introductory graduate level to more advanced, specialized electives.

Students must successfully complete four courses (12 credits), one or two of which may be taken in their area of expertise. The remaining courses must be taken in separate and different cluster areas. Courses are selected in consultation with one (or more) graduate program coordinators to best meet the student’s needs in terms of background, interests, and work requirements. It may be necessary for students to take prerequisite course(s) if they do not have appropriate backgrounds for a particular cluster course.

CLUSTER AREAS AND DESIGNATED COURSES:

Applied Physics
• PHYS.5530 Electromagnetism I
• PHYS.5540 Electromagnetism II
• PHYS.5400 Image Processing (4 credits)
• PHYS.5780 Integrated Optics: Wave Guide and Lasers
• PHYS.5350 Introduction of Quantum Mechanics I
• PHYS.5470 Laser Physics and Applications
• PHYS.5770 Solid State Electronic and Opto-Electronic Devices
• PHYS.5210 Statistical Thermodynamics

Computer Engineering
• EECE.5500 Advanced Digital System Design
• EECE.5610 Computer Architecture Design
• EECE.5810 Computer Vision and Digital Image Processing
• EECE.5100 Digital Signal Processing
• EECE.5720 Embedded Real-Time Systems
• EECE.5750 FPGA Logic Design Techniques
• EECE.5520 Microprocessors Systems II and Embedded Systems
• EECE.5820 Wireless Communications
• EECE.5730 Operating Systems and Kernel Design
• EECE.5210 Real Time DSP
• EECE.5020 VLSI Design
• EECE.5040 VLSI Fabrication

Materials Engineering
• PLAS.5440 Advanced Plastics Materials
• CHEN.5060 Interfacial Science and Engineering and Colloids
• PLAS.5030 Mechanical Behavior of Polymers
• CHEN.5230 Nanodevices and Electronic Materials
• CHEN.5410 Nanostructural Characterization by SEM, TEM, and AFM
• PLAS.5180 Plastics Product Design

Mechanical Engineering
• MECH.5120 Applied Finite Element Analysis
• MECH.5710 Concurrent Engineering and Quality
• MECH.5230 Cooling of Electronic Equipment
• MECH.5740 Design for Reliability Engineering
• MECH.5160 Experimental Modal Analysis
• MECH.5240 Fundamentals of Acoustics
• MECH.5750 Industrial Design of Experiments
• MECH.5910 Mechanical Behavior of Materials
• MECH.5150 Modal Analysis- Theoretical Methods
• MECH.5790 Robotics
• MECH.5620 Solid Mechanics
• MECH.5270 Solar Systems Engineering
• MECH.5500 Vibrations
Gainful Employment Disclosure Information


Medical Imaging & Instrumentations Certificate (MIIC)

The Medical Imaging and Instrumentations Graduate Certificate is an interdisciplinary certificate spanning courses in the Department of Electrical & Computer Engineering in the Francis College of Engineering and the Biomedical Engineering and the Biotechnology (BMEBT) Program across the UMass system. This certificate provides and excellent opportunity to learn the principles and applications of imaging technology. It is comprised of a coordinated collection of courses, laboratories and advanced simulation experiences and allows for in-person and remote enrollment. Students are required to complete 12 credits of coursework, comprised of four elective three-credit courses from two different pools of electives. Students must successfully complete two courses from Group A and two from Group B. The Medical Imaging and Instrumentations Graduate Certificate is intended for individuals who have successfully graduated with a baccalaureate degree and are interested in pursuing a Master’s degree in Electrical Engineering, Computer Engineering, or Biomedical Engineering and Biotechnology (BMEBT).

Application Process:

Individuals must apply and complete an application form in accordance with the university’s Graduate Admissions website (https://www.uml.edu/grad/). Applicants must submit an official undergraduate transcript indicating that a baccalaureate degree was awarded. GRE scores are required for the certificate program. All applications will be reviewed by the Medical Imaging and Instrumentation Certificate coordinator. A decision will be made in writing to the applicant.

Requirements to Complete the Graduate Certificate

To complete the certificate program, students must successfully complete a 12-credits of coursework with a cumulative GPA of 3.0 or greater, and with no more than three credits with a grade of less than 3.00.

For students who wish to continue onto the Master’s degree in Electrical and Computer Engineering, or Biomedical Engineering and Biotechnology Program completed courses of the Certificate can be used towards satisfying the course requirements of the master’s degree program. In addition, a waiver of the GRE requirement for the master’s degree will be provided to those students who achieve a GPA of 3.5 or greater.

Program of Study:

Students must successfully complete two elective courses from Group A and two elective courses from Group B.

- **Group A**: EECE.5110 Medical Imaging Diagnosis  
  EECE.5410 Introduction to Biosensors  
  EECE.5600 Biomedical Instrumentation  
  EECE.6150 Medical Image Reconstruction

- **Group B**: EECE.5100 Digital Signal Processing  
  EECE.5520 Embedded System Design  
  EECE.7100 Selected Topics: Biomedical Imaging and Data Science  
  BMBT.5000 Introduction to Biomedical Imaging and Data  
  BMBT.5120 Medical Image Processing  
  BMBT.5160 Biomedical Analytics and Informatics  
  BMBT.5160 Principles of Nuclear Magnetic Resonance Imaging

For more information contact: Mufeed Mahd, Ph.D. 978-934-3317 mufeed_mahd@uml.edu (mailto:mufeed_mahd@uml.edu)

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Disclosure Information.

Photonics & Opto-Electronic Devices Certificate

Physics Department and Electrical & Computer Engineering Department

Contact: James Egan, 978-934-3774 / 978-934-3300, James_Egan@uml.edu (mailto:James_Egan@uml.edu)

The certificate is offered jointly by the Electrical & Computer Engineering & Physics Departments and reflects the strong interests in the physics and technologies of electro-optics. Extensive research facilities include: new materials growth (molecular beam epitaxy) and device fabrication and testing laboratories.

Required Courses:

- PHYS.5770 Solid State Electronic & Opto-electronic Devices  
  -OR-

- PHYS.5390 Electro-optics  
  -OR-

- EECE.5950 Solid State Electronics  
  -OR-

- EECE.5680 Electro Optics and Integrated Optics
Elective Courses: (choose two of the following):

- EECE.5070 Electromagnetic Waves and Materials
- EECE.5080 Quantum Electronics for Engineers
- EECE.5900 Fiber Optic Communications
- EECE.6070 Electromagnetics of Complex Media
- EECE.6690 Opto Electronic Devices
- PHYS.5470 Laser Physics & Applications
- PHYS.6310 Nonlinear Optics
- PHYS.5780 Integrated Optics: Wave Guides & Lasers

Gainful Employment Disclosure Information

EECE.5040 VLSI Fabrication (Formerly 16.504) - Credits: 3

Fabrication of resistors, capacitors, p-n junction and Schottky Barrier diodes, BJTs and MOS devices and Integrated circuits. Topics include: silicon structure, wafer preparation, sequential techniques in micro-electronic processing, testing and packaging, yield and clean room environments. MOS structures, crystal defects, Fick’s laws of diffusion; oxidation of silicon, photolithography including photoresist; development and stripping. Metallization for conductors, Ion implantation for depletion mode and CMOS transistors for better yield speed, low power dissipation and reliability. Students will fabricate circuits using the DSPI Laboratory.

EECE.5050 Microwave Electronics (Formerly 16.505) - Credits: 3

Review of p-n junction theory, depletion layer width and junction capacitance, Schottky barrier diodes, pin diodes and applications in switches and phase shifters, varactors and step recovery diodes, tunnel diodes and circuits, Gunn devices and circuits, avalanche diodes, IMPATT, TRAPATT and BARRITT diodes, microwave bipolar junction transistors (BJT) and field effect transistors (FET), small signal amplifier design, new devices like HEMT and Si-Ge devices, traveling wave tubes and klystrons.

EECE.5060 Antenna Theory and Design (Formerly 16.506) - Credits: 3


EECE.5070 Electromagnetic Materials and Waves (Formerly 16.507) - Credits: 3

This is a graduate core course, which serves the needs of students who study electromagnetics as a basis for a number of electromagnetic technologies including photonic technologies. Study of Electromagnetic Wave Interactions with Bounded Simple Media: transmission lines, Green’s function, fibers, conducting waveguides and cavity resonators, Plane waves in Complex Electromagnetic Materials: plasmas, dispersive dielectrics, mixing formulas, optical waves in metals, superconductors, chiral media, crystals, magnetized plasma and time-varying media, layered and periodic media.

EECE.5080 Quantum Electronics for Engineers (Formerly 16.508) - Credits: 3

Introduction to the fundamental postulates of quantum theory: Planck’s quantization hypothesis; wave-particle duality; time-dependent & time-independent Schrödinger’s Equation; simple quantum mechanical systems. Radiation and quanta; quantization of the radiation field and cavity modes; absorption and emission of radiation; coherence functions; coherent states; importance of quantum fluctuations and quantum nature of light; laser amplifiers and amplifier non-linearity; electromagnetics and quantum theory of laser oscillators; photons in semiconductors; semiconductor photon sources and detectors.

EECE.5090 Linear Systems Analysis (Formerly 16.509) - Credits: 3


EECE.5100 Digital Signal Processing (Formerly 16.510) - Credits: 3


EECE.5110 Medical Diagnostic Imaging (Formerly 16.511 & IB.511) - Credits: 3

This course covers the physics and electrical engineering aspects of how signals are acquired from which images will be formed, and the principal methods by which the signals are processed to form useful medical diagnostic images. Modalities studied include: x-rays, ultra-sound, computed tomography, and magnetic resonance imaging. The principles of signal processing via Fourier transform will be reviewed. Noise and other artifacts that degrade the medical diagnostic of images
ECE.5120 Mixed-Signal VLSI Design (Formerly 16.512) - Credits: 3

The course covers a wide spectrum of topics related to challenges in modern VLSI design. Students will learn the skills of overcoming these problems when two opposing signal domains are integrated onto a single chip. Understanding physical layout representation and the effects of alternative layout solutions on circuit and system specifications is critical in modern designs. Students will learn to use the CAD tools widely used by the semiconductor industry for layout, schematic capture, advanced simulation, parasitic extraction, floorplanning and place and route. Specifically, the course provides a review of fundamentals of semiconductor components. In the next step, basic building blocks of digital and analog design are described. The course concludes with challenges of large scale integration under varying operation conditions. An individual project involving a layout design from specification to implementation is included.

ECE.5130 Control Systems (Formerly 16.513) - Credits: 3

System representations, state variables, transfer functions, controllability and observability, phase variables, canonical variables, representation of nonlinear systems, Lagrange’s equations, generalized co-ordinates, time response of linear systems, state transition matrix, Sylvester’s expansion theorem, stability and state function of Liapunov, transient behavior estimation, optimal control, state function of Pontryagin, variational calculus, Hamilton Jacobi method, matrix Riccati equation, linear system synthesis.

ECE.5140 Integrated Power Systems (Formerly 16.414/514) - Credits: 3

Power System Operations and Electricity Markets provide a comprehensive overview to understand and meet the challenges of the new competitive highly deregulated power industry. The course presents new methods for power systems operations in a unified integrated framework combining the business and technical aspects of the restructured power industry. An outlook on power policy models, regulation, reliability, and economics is attentively reviewed. The course lay the groundwork for the coming era of unbundling, open access, power marketing, self-generation, and regional transmission operations.

ECE.5170 MMIC Design and Fabrication (Formerly 16.517) - Credits: 3

The domain of microwave monolithic integrated circuits (MMIC) design and fabrication engineer stretches from realms of device physics and microwave circuit theory in the frequency range from 300MHz to 300 GHz. The main goal of the course is to embody most of the application of the spectrum that have been deployed during the past five decades due to advances of many microwave solid-state devices. The principles of semiconductors emphasizing 1) the properties which predominate at microwave frequencies, 2) the theories for circuit design techniques required to utilize them at microwave frequencies, and 3) practical engineering applications for controlling microwave signals in amplitude and phase using semiconductors, will be treated in great details. Special emphasis will be laid on correlation of S-parameters with microwave device parameters and their usage in designing Low-noise amplifiers, High-power amplifiers and oscillators and their integration in MMIC design.

ECE.5190 Engineering of Submicron Machines (Formerly 16.519) - Credits: 3

Recently fabrication of Very Large Scale Integrated circuits has spin-off a new technology of micro-machines (MEMS) and sensors on a semiconductor wafer. These new devices are ideally located next to a microprocessor on the same wafer or a separate chip. The data transfer to and from a miniature machine, sensor or transducer is processed and controlled on site. Topics include design of mechanical, electrical and biological transducers; properties of electronic materials; pattern generation on a semiconductor wafer; interface of a micromachine and processor; applications and markets for submicron machines.

ECE.5200 Computer Aided Engineering Analysis (Formerly 16.520) - Credits: 3

An advanced programming course, which considers the digital computer as a tool for solving significant engineering problems. The course is based on a specific area in engineering which will be selected from such topics as digital and image processing, spectral estimation, optimization techniques, etc. Typical algorithms related to the specific topic will be studied. User oriented programs or subroutine packages will be developed in a project.

ECE.5210 Real Time Digital Signal Processing (Formerly 16.521 & IB.511) - Credits: 3

This course provides an introduction to real-time digital signal processing techniques using the TMS320C3x floating point and TMS320C5x fixed point processors. The architecture, instruction set and software development tools for these processors are studied via a series of C and assembly language computer projects where real time adaptive filters, modems, digital control systems and speech recognition systems are
EECE.5230 Introduction to Solid State Electronics  
(Formerly 16.523) - Credits: 3


EECE.5240 Computational Methods for Power System Analysis  
(Formerly 16.424/524) - Credits: 3

The course explores some of the mathematical and simulation tools used for the design, analysis and operation of electric power systems. Computational methods based on linear and nonlinear optimization algorithms are used to solve load flow problems, to analyze and characterize system faults and contingencies, and to complete economic dispatch of electric power systems. Real case studies and theoretical projects are assigned to implement the techniques learned and to propose recommendations. Different software applications will be used concurrently including ATP, PowerWorld Simulator, Aspen, MatLab with Simulink and Power System Toolbox, PSCAD, etc.

EECE.5250 Power Distribution Systems  
(Formerly 16.525) - Credits: 3

An intermediate course in analysis and operation of electrical power distribution systems using applied calculus and matrix algebra. Topics include electrical loads characteristics, modeling, metering, customer billing, voltage regulation, voltage levels, and power factor correction. The design and operation of the power distribution system components will be introduced: distribution transformers, distribution substation, distribution networks, and distribution equipment.

EECE.5260 Power Systems Stability and Control  
(Formerly 16.426/526) - Credits: 3


EECE.5270 Advanced VLSI Design Techniques  
(Formerly 16.427/527) - Credits: 3

This course builds on the previous experience with Cadence design tools and covers advanced VLSI design techniques for low power circuits. Topics covered include aspects of the design of low voltage and low power circuits including process technology, device modeling, CMOS circuit design, memory circuits and subsystem design. This will be a research-oriented course based on team projects.

EECE.5280 Alternative Energy Sources  
(Formerly 16.528) - Credits: 3

PV conversion, cell efficiency, cell response, systems and applications. Wind. Energy conversion systems: Wind and its characteristics; aerodynamic theory of windmills; wind turbines and generators; wind farms; siting of windmills. Other alternative energy sources: Tidal energy, wave energy, ocean thermal energy conversion, geothermal energy, solar thermal power, satellite power, biofuels. Energy storage: Batteries, fuel cells, hydro pump storage, flywheels, compressed air.

EECE.5290 Electric Vehicle Technology  
(Formerly 16.529) - Credits: 3

Electric vehicle VS internal combustion engine vehicle. Electric vehicle (EV) saves the environment. EV design, EV motors, EV battery chargers and charging algorithms, EV instrumentation and EV wiring diagram. Hybrid electric vehicles. Fuel cells. Fuel cell electric vehicles. The course includes independent work.

EECE.5310 RF Design  
(Formerly 16.531) - Credits: 3

Two-port network parameters, Smith chart applications for impedance matching, transmission line structures like stripline, microstrip line and coaxial line, filter designs for low-pass, high-pass and band-pass characteristics, amplifier design based on s-parameters, bias network designs, one port and two port oscillator circuits, noise in RF systems.

EECE.5320 Computational Electromagnetics  
(Formerly 16.532) - Credits: 3


EECE.5330 Microwave Engineering  
(Formerly 16.533)
An introductory course in the analysis and design of passive microwave circuits beginning with review of time-varying electromagnetic field concepts and transmission lines. Smith Chart problems; single and double stub matching; impedance transformer design; maximally flat and Chebyshev transformers; microstrip transmission lines, slot lines, coplanar lines; rectangular and circular waveguides; waveguide windows and their use in impedance matching; design of directional couplers; features of weak and strong couplings; microwave filter design; characteristics of low-pass, high-pass, band-pass, band-stop filter designs; two-port network representation of junctions; Z and Y parameters, ABCD parameters, scattering matrix; microwave measurements; measurement of VSWR, complex impedance, dielectric constant, attenuation, and power. A design project constitutes a major part of the course.

EECE.5340 Microwave Engineering Lab - Credits: 1
This lab course is offered as a practical supplement to the material taught in EECE.5330 Microwave Engineering. The students will develop skills in EM modeling (Ansys HFSS) and measurement of microwave transmission lines, waveguides and passive structures such as combiners and filters. Students will design basic microwave structures utilizing EM modeling tools, measure the resulting performance and provide justification of differences. Students will also perform basic antenna measurements of gain and patterns in an anechoic chamber.
This course will consist of five three-hour labs, each requiring a detailed report of the results.

EECE.5350 Microwave Metrology - Credits: 3
Laboratory measurement techniques that are typical of those used to characterize wireless devices and systems, including network analyzer calibration, measurements of noise in amplifiers, mixers and oscillators; measurements of distortion in amplifiers and mixers; and characterizing the dynamic range of a receiver.

EECE.5360 Microwave Metrology Lab - Credits: 1
This lab course is offered as a practical supplement to the material taught in EECE.5350 Microwave Metrology. The students will calibrate test equipment and perform measurements of the following parameters: phase noise, noise figure, intermodulation distortion, translated frequency, gain compression, and high-power characterization. Students will also perform probe measurements and demonstrate de-embedding techniques. This course will consist of five three-hour labs, each requiring a detailed report of the results.

EECE.5370 Microwave Systems Engineering - Credits: 3
This course will explore concepts related to the design, analysis, and construction of systems and will examine the fundamental tradeoffs governing microwave system design: the hardware components and technologies that comprise working systems, the models used for characterizing the transmission and reception of signals, the physics of wave propagation and interaction, and estimation theory which seeks to separate signals from sources of error and guide algorithms for extracting information from received signals.

EECE.5380 Microwave Systems Engineering Lab - Credits: 1
This lab course is offered as a practical supplement to the material taught in EECE.5370 Microwave Systems Engineering. The students will perform cascade analyses using measured data to compare with analysis computed from nominal values given in component specifications. Monte Carlo analyses will also be performed to predict performance variation. Students will configure test setups to illustrate signal generation, up/down conversion and signal detection. Additionally, the students will configure a radiated test setup in an anechoic chamber to measure and validate link budget calculations based on the Friis transmission equation. This course will consist of five three-hour labs, each requiring a detailed report of the results.

EECE.5410 Introduction to Biosensors (Formerly 16.441/541) - Credits: 3
This course introduces the theory and design of biosensors and their applications for pathology, pharmacogenetics, public health, food safety civil defense, and environmental monitoring. Optical, electrochemical and mechanical sensing techniques will be discussed.

EECE.5430 Theory of Communication (Formerly 16.543) - Credits: 3
Information transmission and deterministic signals in time and frequency domains. Relationship between correlation and power or energy spectra. Statistical properties of noise. Spectral analysis and design of AM, FM and pulse modulation systems, continuous and discrete. AM, FM, and various pulse modulation methods, in the presence of noise. Digital modulation & demodulation technique.

EECE.5440 Computational Data-Driven Modeling I - Credits: 3
Computational Data-Driven Modeling (CDM) I is the first in a sequence of two courses designed to introduce the student to basics in exploratory data analysis and data-driven computational modeling using foundational concepts drawn...
from linear algebra, probability, statistics, random processes, time-series analysis and dynamical systems. In CDM-I students will learn to apply regression and classification algorithms on multivariate data and assess performance of these models. An interactive project-driven approach is taken using the Python programming platform and its associated open-source libraries for statistical modeling, data analysis and machine-learning. A review of the tools and techniques from probability and statistics will be undertaken.

EECE.5460 Communication Networks (Formerly 16.546) - Credits: 3

An in depth survey of the elements of the modern computer based telecommunications system. Discussion of media used to transport voice and data traffic including twisted pair, baseband and broadband coaxial cable, fiber optic systems and wireless systems. Techniques for sending data over the media are presented including modems, baseband encoding, modulation and specific cases such as DSL, cable modems, telephone modems. Architecture and functionality of telephone system that serves as backbone for moving data, including multiplexing, switching, ATM, ISDN, SONET. Layered software architectures are discussed including TCP/IP protocol stack and the ISO/OSI seven layer stacks are examined in depth from data link protocols to transport protocols. LAN and WAN architectures including media access control (MAC) techniques are discussed for Ethernet, token ring and wireless LAN applications. Internetworking protocols and the role of repeaters, routers, and bridges. Voice over IP and state of the art applications.

EECE.5470 Computational Data-Driven Modeling II - Credits: 3

Computational Data-Driven Modeling (CDM) II is the second in a sequence of two courses designed to introduce the student to skills in exploratory data analysis and data-driven computational modeling. CDM-II extends the students' knowledge on application of regression and classification algorithms in CDM-I to more complex structures such as Bayesian networks and Hidden-Markov models. The focus will be on time-varying data using time-series and state-space models such as Kalman filters, Markov Processes and Particle filters for prediction and forecasting. The application of neural networks and deep-learning will be discussed. Students will undertake case-studies in data analytics with collaboration from professionals in industry.

EECE.5480 Coding and Information Theory (Formerly 16.548) - Credits: 3

Probabilistic measure of information. Introduction to compression algorithms including L-Z, MPEG, JPEG, and Huffman encoding. Determination of the information handling capacity of communication channels and fundamental coding theorems including Shannon's first and second channel coding theorems. Introduction to error correcting codes including block codes and convolutional coding and decoding using the Viterbi algorithm. Applications of information theory and coding to advanced coding modulation such as Trellis code Modulation (TCM) and turbo modulation.

EECE.5500 Advanced Digital System Design (Formerly 16.550) - Credits: 3

Design of logic machines. Finite state machines, gate array designs, ALU and 4 bit CPU unit designs, micro-programmed systems. Hardware design of advanced digital circuits using XILINX. Application of probability and statistics for hardware performance, and upgrading hardware systems. Laboratories incorporate specification, top-down design, modeling, implementation and testing of actual advanced digital design systems hardware. Laboratories also include simulation of circuits using VHDL before actual hardware implementation and PLDs programming.

EECE.5510 Advanced Robotics Automation and Machine Intelligence (Formerly 16.551) - Credits: 3

Covers advanced foundations and principles of robotic manipulation; includes the study of advanced robot motion planning, task level programming and architectures for building perception and systems for intelligent robots. Autonomous robot navigation and obstacle avoidance are addressed. Topics include computational models of objects and motion, the mechanics of robotic manipulators, the structure of manipulator control systems, planning and programming of robot actions. Components of mobile robots, perception, mechanism, planning, and architecture; detailed case studies of existing systems. Pre-Req: Permission of Instructor.

EECE.5520 Microprocessor Systems II & Embedded Systems (Formerly 16.552) - Credits: 3

Continuation of 16.317. CPU architecture, memory interfaces and management, coprocessor interfaces, bus concepts, bus arbitration techniques, serial I/O devices, DMA, interrupt control devices. Including Design, construction, and testing of dedicated microprocessor systems (static and real-time). Hardware limitations of the single-chip system. Includes micro-controllers, programming for small systems, interfacing, communications, validating hardware and software, microprogramming of controller chips, design methods and testing of embedded systems.

EECE.5530 Software Engineering (Formerly 16.553) - Credits: 3
Introduces software life cycle models, and engineering methods for software design and development. Design and implementation, testing, and maintenance of large software packages in a dynamic environment, and systematic approach to software design with emphasis on portability and ease of modification. Laboratories include a project where some of the software engineering methods (from modeling to testing) are applied in an engineering example.

EECE.5560 Robotics (Formerly 16.556) - Credits: 3
Introduces the basic aspects of mobile robotics programming, starting at low-level PID control and behavioral robot control. Covers the analysis, design, modeling and application of robotic manipulators. Forward and inverse kinematics & dynamics, motion and trajectory control and planning are also covered. Laboratories include design, analysis and simulation of real life industrial robots.

EECE.5590 Introduction to Nanoelectronics (Formerly 16.459/559) - Credits: 3
This course introduces the use of nanomaterials for electronic devices such as sensors and transistors. Synthesis methods for nanoparticles, nanotubes, nanowires, and 2-D materials such as graphene will be covered. The challenges in incorporating nanomaterials into devices will also be discussed. These methods will be compared to techniques used in the semiconductor industry and what challenges, technically and financially, exist for their widespread adoption will be addressed. Finally, examples of devices that use nanomaterials will be reviewed. The course will have some hands on demonstrations.

EECE.5600 Biomedical Instrumentation (Formerly 16.460/560) - Credits: 3
A survey of biomedical instrumentation that leads to the analysis of various medical system designs and the related factors involved in medical device innovation. In addition to the technical aspects of system integration of biosensors and physiological transducers there will be coverage of a biodesign innovation process that can translate clinical needs into designs. A significant course component will be project-based prototyping of mobile health applications. The overall goals of the course are to provide the theoretical background as well as specific requirements for medical device development along with some practical project experience that would thereby enable students to design electrical and computer based medical systems.

EECE.5610 Computer Architecture and Design (Formerly 16.561) - Credits: 3

EECE.5620 VHDL/Verilog Synthesis & Design (Formerly 16.562) - Credits: 3
Circuit and system representations including behavioral, structural, and physical descriptions using HDL. Modeling of short and narrow MOS transistors for submission applications. Overview of CMOS technology including oxidation, epitaxy, deposition, ion implantation and diffusion essential for multi-layer vias. 2-0 and 4-0 memory structures, I/O structures and PADS. System design including structural, hierarchy, regularity, modularity and programmable gate arrays. RTL synthesis, layout and placement, design capture tools, including schematic, netlist, verification and simulation. Fast adders, subtractors, multipliers, dividers, ALUs, CPUs, RAMs, ROMs, row/column decoders, FIFOs, and FSMs with detailed examples. A RISC microcontroller, pipeline architecture including logic blocks, data paths, floor planning, functional verification and testing. Layout and simulation of chips as well as of PCs based on VHDL, verilog, and HILO will be encouraged. A project of industrial vigor for fabrication at MOSIS is required.

EECE.5680 Electro Optic Systems (Formerly 16.568) - Credits: 3
Introduction to optoelectronics and laser safety; geometrical optics; waves and polarization; Fourier optics; coherence of light and holography; properties of optical fibers; acousto-optic and electro-optic modulation; elementary quantum concepts and photon emission processes; optical resonators; Fabry Perot etalon; laser theory and types; review of semiconductor lasers
and detectors; nonlinear optics.

EECE.5700 Radar Systems Lab - Credits: 3

This lab course is offered as a practical supplement to the material taught in EECE.5710 Radar Systems. Students will build functional radar using a COTS-based radio system to demonstrate the detection of canonical targets (plates, spheres, corner reflectors) of known radar cross sections. This course will consist of five three-hour labs, each requiring a detailed report of the results.

EECE.5710 Radar Systems (Formerly 16.571) - Credits: 3


EECE.5720 Embedded Real Time Systems (Formerly 16.572) - Credits: 3

Designing embedded real-time computer systems. Types of real-time systems, including foreground/background, non-preemptive multitasking, and priority-based pre-emptive multitasking systems. Soft vs. hard real time systems. Task scheduling algorithms and deterministic behavior. Ask synchronization: semaphores, mailboxes and message queues. Robust memory management schemes. Application and design of a real-time kernel. A project is required.

EECE.5730 Operating Systems (Formerly 16.573) - Credits: 3

Covers the components, design, implementation, and internal operations of computer operating systems. Topics include basic structure of operating systems, Kernel, user interface, I/O device management, device drivers, process environment, concurrent processes and synchronization, inter-process communication, process scheduling, memory management, deadlock management and resolution, and file system structures. Laboratories include examples of components design of a real operating systems.

EECE.5740 Advanced Logic Design (Formerly 16.574) - Credits: 3


EECE.5750 Field Programmable Gate Arrays Logic Design Techniques (Formerly 16.575) - Credits: 3

Advanced logic design techniques using field programmable gate arrays (FPGAs), programmable logic devices, programmable array logic devices, and other forms of reconfigurable logic. Architectural descriptions and design flow will be covered as well as rapid prototyping techniques, ASIC conversions, in-system programmability, high level language design techniques, and case studies highlighting the tradeoffs involved in designing digital systems with programmable devices. This course is generally offered summers only.

EECE.5760 Principles of Solid State Devices (Formerly 16.576) - Credits: 3

EECE.5770 Verification of Digital Systems (Formerly 16.577) - Credits: 3

EECE.5780 Modeling and Implementation of Digital Systems using MATLAB - Credits: 3

The course covers the methodology and tools to design digital systems with MATLAB. Topics include algorithm design and analysis with MATLAB, MATLAB Simulink development, conversion from algorithm to VHDL implementation, synthesis to FPGA and performance evaluation. Labs are included to practice design methodology and tools with FPGA or other platforms.

EECE.5800 Robotics, Automation and Machine Intelligence (Formerly 16.580) - Credits: 3

Covers advanced foundations and principles of robotic manipulation; includes the study of advanced robot motion planning, task level programming and architectures for building perception and systems for intelligent robots. Autonomous robot navigation and obstacle avoidance are addressed. Topics include computational models of objects and motion, the mechanics of robotic manipulators, the structure of manipulator control systems, planning and programming of robot actions. Components of mobile robots, perception, mechanism, planning and architecture; detailed case studies of existing systems.

EECE.5810 Computer Vision and Digital Image Processing (Formerly 16.581) - Credits: 3

Introduces the principles and the fundamental techniques for
Image Processing and Computer Vision. Topics include programming aspects of vision, image formation and representation, multi-scale analysis, boundary detection, texture analysis, shape from shading, object modeling, stereovision, motion and optical flow, shape description and objects recognition (classification), and hardware design of video cards. AI techniques for Computer Vision are also covered. Laboratories include real applications from industry and the latest research areas.

EECE.5820 Wireless Communications (Formerly 16.582) - Credits: 3

Cellular systems and design principles, co-channel and adjacent channel interference, mobile radio propagation and determination of large scale path loss, propagation mechanisms like reflection, diffraction and scattering, outdoor propagation models, Okumura and Hata models, small scale fading and multipath, Doppler shift and effects, statistical models for multipath, digital modulation techniques QPSK, DPSK, GMSK, multiple access techniques, TDMA, FDMA, CDMA, spread spectrum techniques, frequency hopped systems, wireless systems and worldwide standards.

EECE.5830 Network Design: Principles, Protocols and Applications (Formerly 16.583) - Credits: 3

Covers design and implementation of network software that transforms raw hardware into a richly functional communication system. Real networks (such as the Internet, ATM, Ethernet, Token Ring) will be used as examples. Presents the different harmonizing functions needed for the interconnection of many heterogeneous computer networks. Internet protocols, such as UDP, TCP, IP, ARP, BGP and IGMP, are used as examples to demonstrate how internetworking is realized. Applications such as electronic mail and the WWW are studied.

EECE.5840 Probability and Random Processes (Formerly 16.584) - Credits: 3


EECE.5880 Www Programming (Formerly 16.588) - Credits: 3

EECE.5900 Fiber Optic Communication (Formerly 16.590) - Credits: 3

Optical fiber; waveguide modes, multimode vs single mode; bandwidth and data rates; fiber losses; splices, couplers, connectors, taps and gratings; optical transmitters; optical receivers; high speed optoelectronic devices; optical link design; broadband switching; single wavelength systems (FDDI, SONET, ATM); coherent transmission; wavelength division multiplexing and CDMA; fiber amplifiers.

EECE.5930 Industrial Experience (Formerly 16.593) - Credits: 1

EECE.5950 Solid State Electronics (Formerly 16.595) - Credits: 3

Topics included are physical limits of microminiaturization, metal semiconductor junctions, p-n junctions diodes, (rectifiers, varactors, tunnel diodes and photodetectors and solar cells); bipolar junction transistors, field effect transistors (junction FET, MESFET, MOSFET); heterojunction devices and high speed devices; quantum dots, wires and two dimensional quantum well devices; light emitting devices; flat panels, liquid crystals and hot electron eitters. Prerequisite: 16.323 or Permission of Instructor.

EECE.5980 Seminar for Teaching Assistants (Formerly 16.598) - Credits: 0

This course will meet once per week and attendance is mandatory for all TAs. The course will cover an overview of laboratories for the following week.

EECE.6010 Graduate Seminar (Formerly 16.601) - Credits: 0

There will be a series of seminars by distinguished researchers form academia and industry in addition to UML faculty. Moreover, there will be seminars dedicated to instructional sessions in library services, introduction to Department and Faculty research, and information on thesis requirements and professional ethics. Attendance is mandatory for doctoral and MS students with thesis option. The students are required to write short reports summarizing the talk after each seminar. This course is offered in the fall semester.

EECE.6020 Graduate Seminar (Formerly 16.602) - Credits: 0
There will be a series of seminars by distinguished researchers from academia and industry, in addition to UML faculty. Moreover, there will be seminars dedicated to instructional sessions in library services, introduction to Department and Faculty research, and information of thesis requirements and professional ethics. Attendance is mandatory for doctoral and MS students with thesis option. The students are required to write short reports summarizing the talk after each seminar. This course is offered in the spring semester.

EECE.6120 Converged Voice and Data Network  
(Formerly 16.612) - Credits: 3
Covers the technologies and protocols used to transport voice and data traffic over a common communication network, with emphasis on voice over IP (VoIP). The specific topics covered include voice communication network fundamentals, data networking fundamentals, voice packet processing, voice over packet networking, ITU-T VoIP architecture, IETF VoIP architecture, VoIP over WLAN, access networks for converged services: xDSL and HFC networks, and IP TV service.

EECE.6150 Medical Image Reconstruction - Credits: 3
This course will deliver the students both traditional and state-of-the-art algorithms in a unified way, which can make the students qualify for a medical image reconstruction engineer. The topics includes central slice theorem, 2D parallel-beam, 2D fan-beam and 3D cone-beam reconstruction algorithms in terms of analytic and iterative methods. It will cover the state-of-the-art Katsevich algorithm, interior tomography, compressive sensing, and spectral CT.

EECE.6160 Computational Power Systems Analysis  
(Formerly 16.616) - Credits: 3
Power system metrics, power flow studies, fault studies, state estimation, optimal power dispatch, and stability studies.

EECE.6170 Modelling Of Communication Networks  
(Formerly 16.617) - Credits: 3
Overview of general architectures for B-ISDN and Internet, network layering, signaling, performance requirements, traffic management strategies, usage parameter control, connection admission control, congestion control, stochastic processes, Markov chains and processes, stochastic models for voice, video and data traffic, Poisson processes, Markov-modulated processes, traffic analysis, queuing systems, M/M/1, M/M/m, M/G/1 queues, fluid buffer models, effective band-width approaches, simulation modeling, discrete event simulation of transport and multiplexing protocols, and validation and sensitivity analysis.

EECE.6500 Advanced Computing Systems Hardware Architecture (Formerly 16.650) - Credits: 3
Covers the latest advanced techniques in CPU design, floating point unit design, vector processors, branch prediction, shared memory versus networks, scalable shared memory systems, Asynchronous shared memory algorithms, systems performance issues, advanced prototype hardware structures, and future trends including TeraDash systems.

EECE.6510 Advanced Embedded System Design with FPGA - Credits: 3
This course covers the topics related to FPGA based embedded systems, including microprocessor architectures, embedded system architecture, firmware, bootloader, JTAG etc., bare metal processor vs embedded OS, ars and soft core IP’s, interconnects between processor and FPGA, buses and interfaces, and external devices such as sensors and cameras. Labs are included for practice the design of FPGA based embedded systems.

EECE.6520 Parallel & Mp Architect (Formerly 16.652) - Credits: 3
EECE.6530 AI and Machine Learning (Formerly 16.653) - Credits: 3
EECE.6540 Heterogeneous Computing - Credits: 3
This course introduces heterogeneous computing architecture and the design and optimization of applications that best utilize the resources on such platforms. The course topics include heterogeneous computer architecture, offloading architecture/API, operating systems for heterogeneous resources, GPU/FPGA acceleration, OpenCL programming framework, performance optimization, and software development. Labs are included to practice design methodology and tools.

EECE.6550 Advanced Computing Systems Hardware Architecture (Formerly 16.650) - Credits: 3
EECE.6560 Fault Tolerant System Design (Formerly 16.656) - Credits: 3
EECE.6570 High Speed Integrated Network (Last Term 2004 Fall)(Formerly 16.657) - Credits: 3
EECE.6580 Computer Network Security (Formerly 16.658) - Credits: 3
This course will cover two categories of topics: One part is the fundamental principles of cryptography and its applications to network and communication security in general. This part focuses on cryptography algorithms and the fundamental network security enabling mechanisms. Topics include attack analysis and classifications, public key cryptography (RSA,
Diffie-Hellman), Secret key cryptography (DES, IDEA), Hash (MD5, SHA-1) algorithms; Key distribution and management; Security handshake pitfalls and authentications; and well known network security protocols such as Kerberos, IPSec, SSL/SET, PGP & PKI, WEP. The second part covers the advanced topics on the security issues of MANET (including VANET), WSN, Smart Grid, Cognitive Radio Network, and Cloud Computing. This part involves diverse literature review on the unique security challenges and open issues faced by these emerging network technologies, and the state-of-the-art security solutions in literature. Pre-Req: Permission of Instructor.

EECE.6590 Distributed Systems (Formerly 16.659) - Credits: 3
EECE.6600 Mobile Communication Networks (Formerly 16.660) - Credits: 3

The goal of this course is to enable students to understand communication systems that permit a user to be either continuously or intermittently connected to a communication network as he/she moves from one place to another. The key issue in these communications systems, which are referred to as mobile communication systems, is that there is provision for handling a device, service or user, over from one network to another. That is, mobility management is an essential aspect of mobile communication networks. The learning objectives of the course include enabling the student to understand mobile radio propagation, antenna and communications systems; the so-called 2G, 2.5G, 3G and 4G networks; mobile IP and mobile TCP; mobile ad hoc networks; WiMAX networks; and cognitive radio networks.

EECE.6660 Storage Area Networks (Formerly 16.666) - Credits: 3
EECE.6690 Opto Electronic Devices (Formerly 16.669) - Credits: 3
EECE.6870 Applied Stochastic Estimation (Formerly 16.687) - Credits: 3


EECE.6880 Theoretical Acoustics (Formerly 16.688) - Credits: 3
EECE.6920 Directed Studies/Electrical Engineering (Formerly 16.692) - Credits: 3

Provides opportunity for students to get a specialized or customized course in consultation with a faculty member.

EECE.7100 Selected Topics (Formerly 16.710) - Credits: 3

Topics of current interest in Electrical Engineering. Subject matter to be announced in advance.

EECE.7110 Special Topics (Formerly 16.711) - Credits: 3

Topics of current interest in Electrical Engineering. Subject matter to be announced in advance.

EECE.7120 Special Topics in Electrical Engineering (Formerly 16.712) - Credits: 3

Topics of current interest in Electrical Engineering. Subject matter to be announced in advance.

EECE.7150 Special Topics (Formerly 16.715) - Credits: 3
EECE.7290 Selected Topics in Electrical Engineering (Formerly 16.729) - Credits: 3

Advanced topics in various areas of Electrical Engineering and related fields. Prerequisite: specified at the time of offering.

EECE.7300 Thesis - Electrical Engineering (Formerly 16.730) - Credits: 6
EECE.7320 Systems Engineering Thesis (Formerly 16.732) - Credits: 3
EECE.7330 Advance Graduate Project (Formerly 16.733) - Credits: 3

The Advanced Project is a substantial investigation of a research topic under the supervision of a faculty member. A written proposal must be on file in the Electrical & Engineering Graduate Office before enrollment. A written report is required upon completion of the project. This course can be taken only once, and may evolve into a master’s thesis. However, credit for this course will not be given if thesis credit is received.

EECE.7360 Graduate Project - Electrical Engineering (Formerly 16.736) - Credits: 6
EECE.7390 Graduate Project - Electrical Engineering
(Formerly 16.739) - Credits: 9
EECE.7400 Advanced Project In Electrical Engineering
(Formerly 16.740) - Credits: 3
EECE.7430 Master's Thesis in Electrical Engineering
(Formerly 16.743) - Credits: 1-3
Master's Thesis Research

EECE.7460 Master's Thesis in Electrical Engineering
(Formerly 16.746) - Credits: 6

Co-requisites: Minimum of 6 credit-hours of graduate courses at an acceptable level when registering for first three credits and 12 credit hours when registering for subsequent credits; matriculated status in the M.S. Eng. Program in Electrical, Computer or Systems Engineering; approval of a written proposal outlining the extent and nature of proposed research work. The report on the research work, performed under the supervision of a faculty member, must be published in appropriate form and presented to a committee of three faculty members appointed at the time of acceptance of the thesis proposal. The student is required to give an oral defense of the thesis before the committee and other faculty members.

EECE.7490 Master's Thesis - Electrical Engineering
(Formerly 16.749) - Credits: 9
EECE.7510 Doctoral Thesis (Formerly 16.751) - Credits: 1
EECE.7520 PhD Thesis (Formerly 16.752) - Credits: 2
EECE.7530 Doctoral Dissertation/EE (Formerly 16.753) - Credits: 3
Doctoral Dissertation Research

EECE.7540 Doctoral Thesis - Electrical Engineering
(Formerly 16.754) - Credits: 4
EECE.7550 Doctoral Dissertation (Formerly 16.755) - Credits: 5
EECE.7560 Doctoral Dissertation/Electrical Engineering (Formerly 16.756) - Credits: 6
Doctoral Dissertation Research

EECE.7570 Doctoral Dissertation (Formerly 16.757) - Credits: 7

EECE.7590 Doctoral Dissertation/Electrical Engineering (Formerly 16.759) - Credits: 9

No more than 9 credits of doctoral dissertation research may be taken before passing the doctoral qualifying examination. No more than 15 credits of doctoral dissertation research may be taken before passing the defense of the thesis proposal examination.

EECE.7660 Continued Grad Research (Formerly 16.766) - Credits: 1-6
EECE.7710 Eng Sys Analysis I (Formerly 16.771) - Credits: 3

Study of the key areas in multiple engineering disciplines including Mechanical, Electrical, Software, Systems and Optical. Students are introduced to weekly topics and then work in multidiscipline teams to solve technical assignments. Topics covered include: Concept of Operations and Requirements development, integration, test and verification, vibration/shock analysis, thermal analysis, power supply design, digital electronics &FPGA, intro to optical engineering, SCRUM planning, continuous integration and UML/SW design. Content may vary year to year. This course is part of the Engineering Leadership Development Program (ELDP) and team taught by industry experts at BAE Systems.

EECE.7720 Eng Sys Analysis II (Formerly 16.772) - Credits: 3

Introduction and analysis of complex systems aligned with the key product lines of BAE Systems. Students are introduced to multiple types of systems and then work in multidiscipline teams to solve technical assignments. The systems covered include but are limited to: Electronic Warfare (EW), Communications Electronic Attack (Comms EA), Wide Area Airborne Surveillance (WAAS), Signal Intelligence (SIGINT), RADAR Navigation, Radio Communications, and Infrared Countermeasures (IRCM). Content may vary year to year. This course is part of the Engineering Leadership Development Program (ELDP) and team taught by industry experts at BAE Systems.

EECE.7730 Eng Sys Analysis III (Formerly 16.773) - Credits: 3

Study of project management concepts, product development methods, transition to operations and new business capture. Topics covered include but are not limited to risks and opportunities management, earned value management, lean product development, business strategy, design for manufacturability/maintainability (DFM*2), and request for information (RFI) response. Content may vary year to year.
This course is part of the Engineering Leadership Development Program (ELDP) and team taught by industry experts at BAE Systems.
Energy Engineering

Energy Engineering Program

Graduate Programs offered:

- **Doctor of Engineering** (D.Eng.) Energy Engineering Option
- **Doctor of Philosophy** (Ph.D.) Energy Engineering Option
- **Master of Science in Engineering** (M.S.E.) Renewable (Solar) Engineering Option - administered through the Mechanical Engineering Department
- **Master of Science in Engineering** (M.S.E.) Nuclear Engineering Option - administered through the Chemical Engineering Department
- **Bachelor’s-Master’s Program**

Energy Engineering offers professional training at the doctoral and master’s degree levels designed to prepare the student to perform state-of-the-art research and design work on energy systems.

Co-op Option in Engineering (Solar)

The Department of Energy Engineering participates in the Graduate Master’s Co-op Option in Engineering. For detailed information about the Co-op Program and curriculum requirements, please see the Graduate Catalog Engineering Co-op page (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).

For additional information, contact the graduate coordinator for Renewable (Solar) Engineering (mailto:robert_parkin@uml.edu) or the graduate coordinator for Nuclear Engineering. (mailto:sukesh_aghara@uml.edu)

Master’s Program

Master of Science Degree Program in Energy Engineering

The UMass Lowell graduate program in Energy Engineering offers professional training at the master’s degree level designed to prepare the student to perform state-of-the-art work on energy systems. There are two options:

- **Renewable (Solar) Engineering**
- **Nuclear Engineering**

The programs are designed to achieve a balance between hands-on experience and theory. Energy engineering draws students from all branches of engineering, mathematics, physics and chemistry.

Thesis, Project, and Course-Only Requirements

There are three pathways to earning an MS degree in Energy Engineering:

1. **Thesis:** 30 credits - 24 credits of courses (15 credits from core), plus 6 credits of thesis,
2. **Project:** 30 credits - 27 credits of courses (15 from core), plus 3 credits of project, (available to Nuclear option students only).
3. **Course-Only:** 30 credits - all from courses (15 from core, none from thesis or project credits)

A student’s thesis must be defended in an oral examination conducted by the student’s thesis committee.

Course Requirements

Students may choose to specialize in any area of interest in the college related to the energy field. Each student must take a series of core courses appropriate for the area of specialization. The exact makeup of the core curriculum will be guided and approved by the Graduate Committee of the Energy Engineering program. All students working toward the Master of Science Degree in Energy Engineering must take the following core courses:

**Nuclear Option Required core courses:**

- ENGY.5040 Energy Engineering Workshop
- ENGY.5050 Nuclear Reactor Physics
- ENGY.5070 Nuclear Reactor Engineering Analysis
- ENGY.5090 System Dynamics
- CHEN.5280 Advanced Transport Phenomena

**Renewable (Solar) Option Required core courses**

All Solar Option students must take the following courses (the semesters in which they are normally taught are also listed):

**One Advanced Mathematics course from the list:**

- MECH.5200 Numerical Methods for Partial Differential Equations (Spring)
• MECH.5260 Transport Processes in Energy Systems (Spring)
• MECH.5540 Dynamic Systems and Controls (Fall)

Three "core" courses from this list:

• MECH.5210 Fundamentals of Solar Utilization (Fall)
• MECH.5220 Wind Energy Fundamentals (Fall)
• MECH.5270 Solar Systems Engineering (Spring)
• MECH.5491 Advanced Thermodynamics (Spring)
• MECH.5350 Fundamentals of Sustainable Energy (Spring of even numbered years)

During their last or next to last semester:

• MECH.5040 Energy Engineering Workshop (Fall or Spring)

For Both the Renewable and Nuclear Option
For all students, the remainder of the course requirements are to be made up of elective courses which should be approved by the appropriate graduate coordinator.

Courses that are typically taken as elective courses include, but are not restricted to:

• CHEN.5060 Colloidal, Interfacial and Nanomaterials Science and Engineering
• CHEN.5080 Material Science and Engineering
• CHEN.5100 Advanced Separation Processes
• CHEN.5200 Advanced Thermodynamics
• CHEN.5230 Nanodevices and Electronic Materials
• CHEN.5350 Principles of Cell and Microbe Cultivation
• CHEN / ENGY.5390 Mathematical Methods for Engineers
• EECE.5130 Control Systems
• EECE.5150 Power Electronics
• EECE.5250 Power Distribution Systems
• EECE.5280 Alternative Energy Systems
• EECE.5840 Probability and Random Processes
• ENGY.5180 Energy Technology, Economics and Policy
• MECH.2580 Aero/Wind Engineering
• MECH.5050 Directed Studies
• MECH.5130 Finite Element Analysis I
• MECH.5200 Numerical Methods for Partial Differential Equations

• MECH.5210 Fundamentals of Solar Utilization
• MECH.5220 Wind Energy Fundamentals
• MECH.5250 Grid-Connected Solar Electrical Systems
• MECH.5260 Transport Processes in Energy Systems
• MECH.5270 Solar Systems Engineering
• MECH.5280 PV Manufacturing
• MECH.5285 Energy Policy and Energy Codes
• MECH.5290 Fuel Cell Fundamentals
• MECH.5320 Off-Grid Solar Electric Systems
• MECH.5330 Nanomaterials for Energy
• MECH.5340 Green Combustion and Bio-Fuels
• MECH.5350 Fundamentals of Sustainable Energy
• MECH.5491 Advanced Thermodynamics
• MECH.5540 Dynamic Systems and Controls
• MECH.5710 Quality Engineering
• MECH.5740 Design for Reliability Engineering
• MECH.5750 Industrial Design of Experiments
• MECH.5760 Engineering Project Management
• MECH.5810 Advanced Fluid Mechanics
• MECH.5890 Finite Element in Thermo-Fluids
• MECH.6020 Special Topic: Thermo-Fluids
• PLAS.5470 Materials for Renewable Energy and Sustainability
• MATH.5300 Applied Math I
• PHYS.5380 Physical Optics
• PHYS.5390 Electro-Optics
• PHYS.5770 Solid State Electronic and Optoelectronic Devices

Energy Engineering Doctoral Programs

• Doctor of Engineering (D.Eng.)
• Doctor of Philosophy (Ph.D.)

The objective of UMass Lowell's doctoral program in energy engineering is to prepare engineers for leadership positions in industry, academia and government to provide society with sustainable energy systems. Presently there are two areas of concentration: renewable (solar) and nuclear. The renewable
(solar) concentration is administered by the Mechanical Engineering Department and the nuclear engineering concentration is administered by the Chemical Engineering Department.

Admission Requirements

The applicant is required to have an M.S. degree in engineering or other suitable technical area, or its equivalent, or to have completed fifteen credit hours of graduate study, with a minimum grade point average of 3.25.

Students may be required to make up prerequisites which they lack in comparison to the equivalent Engineering curriculum at the University of Massachusetts Lowell. In cases where a student has an M.B.A. or has completed the Business Administration Minor for Engineering students, in addition to a B.S. in engineering or its equivalent, portions or all of the management/non-technical component of the Doctor of Engineering program may be waived upon review by the administering Department. Students may apply for transfer of up to a maximum of 24 credits in acceptable graduate engineering courses (with grade of B or better) towards the doctoral program, upon approval by the Program Doctoral Committee.

Course Requirements

A total of 63 credit hours of graduate level courses are required for both the Ph.D. and D.Eng. degrees. These credits are composed of the following components:

- **The Ph.D. degree** must involve a traditional research-based dissertation, plus: A minimum of 30 approved credit hours of graduate-level engineering including associated science and math courses. A minimum of 21 credit hours of doctoral dissertation. The balance of the remaining 12 credits can be a mix of graduate-level engineering including associated science and math course and dissertation credits at the discretion of the department, faculty advisor and dissertation committee.

- **The D.Eng. degree** must involve a dissertation, which can be either a traditional research-based dissertation or an industry-based project, plus: 33 approved credit hours of graduate-level engineering including associated science and math courses. 21 credit hours of doctoral dissertation. 9 credit hours of approved management-type courses.

  - In addition to this 63 semester hours of approved graduate courses and dissertation: The student must have a minimum grade point average of 3.25 to graduate. The student is required to take and pass the doctoral qualifying examination.

  - Dissertations which are industrial in orientation should use the D.Eng. degree, based upon discussion with the supervising faculty advisor. Students may elect either degree designation with the consent of the faculty advisor, subject to the requirements of each degree.

Core Courses

The core requirements will consist of two courses in advanced mathematics, two courses in thermal/fluid processes, one course in materials, and one course in systems/controls. The specific courses follow:

**Advanced Mathematics** (select two of these or suitable alternatives with approval of the graduate coordinator):

- CHEN./ENGY.5090 Systems Dynamics
- CHEN./ENGY.5390 Mathematical Methods for Engineers
- MECH.5200 Numerical Methods for Engineers
- MATH.5300 Applied Math
- MATH.5840 Stochastic Process

**Thermal/Fluid Processes** (select two of these or suitable alternatives with approval of the graduate coordinator):

- CHEN.5100 Advanced Separation Processes
- CHEN.5200 Advanced Thermodynamics
- CHEN.5280 Advanced Transport Phenomena
- MECH.5260 Transfer Processes in Energy Engineering
- MECH.5810 Advanced Fluid Mechanics
- MECH.5890 Finite element in Thermo-Fluids
- MECH.5130 Finite Element Methods

**Materials** (select one of these or a suitable alternative with approval of the graduate coordinator):

- CHEN.5060 Interfacial Science and Engineering and Colloids
- CHEN.5080 Material Science and Engineering
- CHEN.5230 Nanodevices and Electronic Materials
- PLAS.5470 Materials for Renewable Energy and Sustainability
- CHEN.5350 Principles of Cell and Microbe Cultivation
- PHYS.5390 Electro_Optics
Systems/Controls (select one of these or a suitable alternative with approval of the graduate coordinator):

- EECE.5130 Control Systems
- EECE.5840 Probability and Random Processes
- MECH.5750 Industrial Design of Experiments
- MECH.5540 Dynamic Systems and Control

Concentration Courses

A total of 12 credits of concentration courses must be taken, either from the renewable area or from the nuclear area. The specific courses in those areas follow:

Renewable (select four of these or suitable alternatives with approval of the graduate coordinator):

- EECE.5150 Power Electronics
- EECE.5280 Alternative Energy Systems
- MECH.5040 Energy Systems Design Workshop
- MECH.5210 Solar Engineering Fundamentals
- MECH.5250 Grid-Connected Solar Electric Systems
- MECH.5270 Solar Systems Engineering
- MECH.5280 PV Manufacturing
- MECH.5340 Green Combustion and Bio-Fuels
- MECH.5580 Aero/Wind Engineering
- PHYS.5770 Solid State Electronic and Optoelectronic Devices

Nuclear (select five of these or suitable alternatives with approval of the graduate coordinator):

- ENGY.5040 Energy Engineering Workshop
- ENGY.5050 Nuclear Reactor Physics
- ENGY.5060 Special Topics in Nuclear Reactor Physics
- ENGY.5070 Nuclear Reactor Engineering and Safety Analysis
- ENGY.5080 Special Topics in Nuclear Reactor Engineering
- ENGY.5110 Advanced Reactor Concepts
- ENGY.5140 Hazardous and Nuclear Waste Management
- ENGY.5190 Nuclear Reactor Operator Training I
- ENGY.5200 Nuclear Reactor Operator Training II

Qualifying Examination

Students are required to take the qualifying examination within their first year of residency in the program. The first part of the exam is intended to cover knowledge of undergraduate engineering and is satisfied by passing the Professional Engineering Fundamentals Exam. The second part is intended to cover topics in an area of energy engineering of the student's interest, with the approval of the student’s thesis advisor. The written part of this examination is closed book and composed of two sections, each of three hours duration. The examination is set and evaluated by the program Graduate Examination Committee, which determines whether or not a student shall be eligible to take the oral portion. Students who pass the written part of the qualifying examination must take the oral part of the examination within 6 weeks of notification of results of the written exam. The student is permitted two attempts at passing the qualifying examination which is administered on a declared schedule. Students who fail the qualifying examination the first time must retake the exam at its next scheduled offering. Students failing the doctoral exam twice will be automatically dismissed from the doctoral program.

Dissertation

Students may register for no more than six credit hours of research in preparing a formal dissertation proposal. This proposal, and the student’s ability to perform the research, must be orally defended before the student’s doctoral committee and other interested parties. The written proposal and oral defense constitute the candidacy examination. Upon passing this examination and completing all course requirements, the student becomes a candidate for the D.Eng./Ph.D. degree and may register for additional research credit with the adviser’s approval.

The research work for the dissertation shall be conducted under the supervision of a program faculty advisor and a committee of two others, at least one of whom must be a faculty member in the university with the appropriate background for the thesis topic.

For Renewable Option Students:

Combined Qualifying Examination and Dissertation Proposal

The Doctoral Qualifying Exam will consist of a written dissertation proposal (a document of typically 20 to 50 pages with appendices) and associated oral presentation by the examinee to an audience of peers and a committee of faculty members (minimum of three) where one of whom must be the examinee’s dissertation adviser. The committee may have in addition one of more members from outside UMass Lowell.

At least one week prior to the date of the presentation of the dissertation proposal, an announcement document must be submitted to the department graduate coordinator and to the Associate Dean of Graduate Studies in the College of Engineering by the Associate Dean of Graduate Studies.
The dissertation proposal is open to the public. The proposal will outline the motivation for the research, give a summary of the related past work in the area and present the scope of the proposed dissertation research. The presentation should be approximately 30 minutes. The proposal should clearly articulate the proposed contribution of the student to the knowledge base and how it differs from the past work. The examinee will be expected to answer questions from the audience that demonstrate his/her understanding of the proposed research, as well as demonstration his/her proficiency in the general research field related to the dissertation proposal.

Other Requirements

- The student is required to be in full time residency at the university for at least one year.
- The student must have a minimum grade point average of 3.25 in order to graduate.
Mechanical Engineering

Department of Mechanical Engineering

The UMass Lowell Department of Mechanical Engineering offers the following graduate programs:

- Doctor of Philosophy (Ph.D.) Option in Mechanical Engineering
- Doctor of Engineering (D.Eng.) Option in Mechanical Engineering
- Master of Science in Mechanical Engineering (M.S. Eng.)
- Master of Science in Energy Engineering - Renewable (Solar) Option
- Graduate Certificates
- Design Manufacturing Engineering
- Structural Dynamics and Acoustic Modeling Techniques
- Microelectromechanical Systems / Nanoelectromechanical Systems (interdisciplinary)
- Composites and Materials
- Renewable Engineering Systems
- Integrated Engineering Systems
- Nanotechnology (interdisciplinary)
- Wind Energy Engineering
- Bachelor’s/Master’s Program

The admission requirements of the University are to be followed for all degree programs in Mechanical Engineering. The student is required to submit official transcripts for all prior college level studies, official score report for the Graduate Record Examination Aptitude Test, and three letters of recommendation. Applicants for Master or Doctor of Engineering Degrees in Mechanical Engineering must be in possession of a bachelor’s degree in engineering or equivalent. Mechanical Engineering graduates can also apply for the Ph.D. degree in Applied Physics.

Co-op Option in Engineering

The Department of Mechanical Engineering participates in the Graduate Master’s Co-op Option in Engineering. For detailed information about the Co-op Program and curriculum requirements, please see the Graduate Catalog Engineering Co-op page (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).

Degree Requirement

All MSE degree candidates must satisfy each of the following four requirements. No course can count towards more than one requirement:

1. Three (3) credit hours of advanced mathematics from the following list: MECH.5200 Numerical Methods for Partial...
Differential Equations ENGY.5390 (CHEN.5390)
Mathematical Methods for Engineers MATH.5450 Partial
Differential Equations MATH.5300 Applied Math I

2. Three (3) credit hours of solid mechanics courses from
the following list: MECH.5130 Theory of Finite Element
Analysis MECH.5620 Solid Mechanics IMECH.5630
Dynamic behavior of Materials MECH.5910 Mechanical
Behavior of Materials MECH.5960 Mechanics of
Composite Materials

3. Three (3) credit hours of thermofluid courses from the
following list: MECH.5410 Advanced Heat
Transfer MECH.5491 Advanced
Thermodynamics MECH.5590 Multi-Scale Computational
fluid Dynamics IMECH.5810 Advanced Fluids
Mechanics MECH.5260 Transport Processes in Energy
Systems

4. Either 1. or 2. below: Thesis Track: Nine (9) credit hours of
thesis research, twelve (12) credit hours of coursework
approved by the thesis advisor, and at least one semester
of the 0 credit research seminar (MECH.5010). M.S.
students on the thesis track will design a student-specific
curriculum sequence of twelve credit hours of coursework
(in consultation with the thesis advisor and approved in
writing by the student and their thesis advisor) within the
first semester of graduate study. The contract will be sent
to the graduate coordinator and to the Registrar’s
office. Non-Thesis Track: Nine (9) credit hours of course
work in a Mechanical Engineering Concentration and
twelve (12) credit hours of coursework approved by the
graduate coordinator. Nine (9) of these twelve credits
may be taken in second concentration. In their first year
students must submit on a non-thesis track must submit a
plan of study to the graduate coordinator and obtain
his/her approval. Any change to the submitted plan
requires the approval of the graduate coordinator.

Mechanical Engineering Concentrations (for student on non-
thesis track)

1. Mechanics & Materials Concentration: MECH.5120
Applied Finite Elements MECH.5130 Finite Element
Analysis IMECH.5140 Finite Element Analysis of
Composites MECH.5620 Solid Mechanics IMECH.5630
Dynamic Behavior of Materials MECH.5690 Fracture
Mechanics MECH.5910 Mechanical Behavior of
Materials MECH.5960 Composite Materials IMECH.5970
Processing of Composites MECH.5980 Experimental
Characterization of Composite
MECH.6010 Special Topics: Mechanics/Materials
MECH.6150 Advanced Finite Elements Methods
MECH.6150 Micromechanics of Composites and Metamaterials
PLAS.5890 Polymer Nanocomposites

2. Thermofluids Concentration: MECH.5260 Transport
Processes in Energy Systems MECH.5290 Fuel Cell
Fundamentals MECH.5340 Green Combustion and
Biofuels MECH.5420 Convective Heat and Mass
Transfer MECH.5450 Advanced Industrial Heat and Mass
Transfer MECH.5490 Cooling of Electronic
Equipment MECH.5530 MEMS
& Microsystems MECH.5580 Aero/Wind
Engineering MECH.5590 Multi-Scale Computational Fluid
Dynamics IMECH.5600 Multi-Scale Computational Fluid
Dynamics IMECH.5810 Advanced Fluid
Mechanics MECH.5830 Advanced
Aerodynamics MECH.5840 Ocean
Engineering MECH.5890 Finite Element in
Thermofluids CHEN.5280 Advanced Transport
Phenomena

Workshop MECH.5210 Solar Fundamentals MECH.5250
Grid-Connected Solar Electric Systems MECH.5260
Transport Processes in Energy Systems MECH.5270 Solar
Energy Engineering MECH.5280 Photovoltaics
Manufacturing MECH.5290 Fuel Cell
Fundamentals MECH.5320 Off-Grid Electric
System MECH.5330 Nanomaterials for
Energy MECH.5340 Green Combustion and
Biofuels MECH.5440 Combustion Modeling CHEN.5280
Advanced Transport Phenomena ENGY.5050 Reactor
4. **Vibrations/Dynamics/Controls Concentration:**
- **MECH.5100** Dynamics and Diagnostics of Rotating Machinery
- **MECH.5130** Finite Element Analysis
- **IMECH.5150** Modal Analysis
- **MECH.5160** Experimental Techniques
- **MECH.5170** Structural Health Monitoring
- **MECH.5240** Fundamentals of Acoustics
- **MECH.5300** Autonomous Robotic Systems
- **MECH.5500** Vibrations
- **MECH.5520** Probabilistic Methods and Analysis
- **MECH.5540** Dynamic Systems and Controls
- **MECH.5710** Quality Engineering
- **MECH.5740** Design for Reliability Engineering
- **MECH.5750** Industrial Design of Experiments
- **MECH.5760** Engineering Project Management
- **MECH.5790** Robotics

5. **Design and Manufacturing Concentration:** MECH.5120
- **MECH.5490** Cooling of Electronic Equipment
- **MECH.5530** MEMS & Microsystems
- **MECH.5710** Quality Engineering
- **MECH.5740** Design for Reliability Engineering
- **MECH.5750** Industrial Design of Experiments
- **MECH.5760** Engineering Project Management
- **MECH.5790** Robotics

**Second Concentrations:**

Students on a non-thesis track can take nine (9) credit hours in a second concentration, which will normally consist of nine (9) credit hours from one of the graduate certificates listed below. Students can suggest their own second concentration, but prior approval must be obtained from the graduate coordinator.

**Courses from one of the following graduate certificates offered out of the ME department are acceptable:**

- Applied Statistics
- Biomedical Engineering
- Biotechnology & Bioprocessing
- Communications Engineering
- Elastomeric Materials
- Energy Conversion
- Environmental Biotechnology
- Environmental Risk Assessment
- Foundations of Business
- Identification & Control of Ergonomic Hazards
- Integrated Engineering Systems
- Materials Sciences & Engineering
- Medical Plastics Design & Manufacturing
- Microwave and Wireless Engineering
- Modeling, Simulation, and Control of Systems and Processes
- Molecular & Cellular Biotechnology
- Nanotechnology
- New Venture Creation
- Plastics Design
- Plastics Materials
- Plastics Processing
- Stochastic Systems
- Sustainable Infrastructure for Developing Nations
- Telecommunications
- VLSI & Microelectronics

**Energy Engineering Option**

The University offers a Master of Science degree in Energy Engineering. This unique area of concentration represents a separate multidisciplinary program that is administered jointly by the Mechanical Engineering Department (Solar Option) and the Chemical and Nuclear Engineering Department (Nuclear Option). The Energy Engineering Program has two M.S. degree options: Renewable (Solar) Engineering and Nuclear Engineering. Students interested in either of these program options should refer to the catalog section focused specifically on the Energy Engineering Program.

**ME-Based Certificate Programs**

Non-degree candidates who have a BS in engineering or a physical science are encouraged to apply to take a **graduate certificate** in which the ME department participates. A paper certificate will be awarded upon successful completion.

- Bachelor’s-Master’s Program

**Doctoral Program**

Doctoral Programs in Mechanical Engineering
The UMass Lowell Department of Mechanical Engineering offers two doctoral degree tracks with one option each.

- **Doctor of Philosophy (Ph.D.) Option in Mechanical Engineering**
- **Doctor of Engineering (D.Eng.) Option in Mechanical Engineering**

**Ph.D. Option in Mechanical Engineering**

The intent of the Doctor of Philosophy program is to prepare engineers for leadership positions in industry, academia and government. The program includes advanced graduate course work in engineering and allied subjects and research, culminating in a doctoral dissertation. The Ph.D. degree is oriented toward academic research.

**Admission Requirements**

Applicants must have a minimum of a B.S. in Mechanical Engineering, or a closely related field with a minimum grade point average of 3.0 and a min GPA of 3.25 in science and engineering courses. Applicants with a M.S. in Mechanical Engineering, or a closely related field, must have a minimum graduate GPA of 3.25.

**Transfer Credits**

1. A student with a master’s degree in Engineering or a closely related field may apply to have coursework for the master’s degree up to a total of 24 credits.
2. A student with graduate-level work completed at an accredited US or Canadian university may apply for transfer of up to 24 semester credits in acceptable graduate engineering courses (with grade of B or better) towards the doctoral program, upon approval by the Department Graduate Coordinator.
3. In cases where a student has an M.B.A., or has completed the Business Administration Minor for Engineering students, in addition to a B.S. in engineering or a closely related field, portions of the management component of the Doctor of Engineering program may be waived upon review by the administering department.

Note: Students may be required to make up prerequisites which they lack in comparison to the equivalent Engineering curriculum at the University of Massachusetts Lowell.

**Degree Requirements**

A total of 63 credit hours of graduate level courses are required for the Ph.D. degree. The Ph.D. degree must involve a traditional research-based dissertation, plus:

- A minimum of 30 approved credit hours of graduate-level engineering courses, including associated science and math courses.
- A minimum of 21 credit hours of doctoral dissertation.
- The balance of the remaining 12 credits can be a mix of graduate-level engineering including associated science and math course and dissertation credits at the discretion of the department, faculty advisor and dissertation committee.
- At least two semesters of the 0 credit research seminar MECH.5010

In addition to these 63 semester hours of approved graduate courses and thesis:

- The student must have a minimum grade point average of 3.25 in order to graduate.
- The student is required to take and pass the doctoral qualifying examination.

Concerning graduate-level STEM courses, the Ph.D candidate must take the following:

- At least twelve (12) credit hours (four courses), to be selected by the Ph.D. candidate in consultation with their dissertation advisor and approved in writing by both during the first semester of graduate study. The coursework contract will be sent to the graduate coordinator and the Registrar’s office.

**Combined Qualifying Examination and Dissertation Proposal**

The Doctoral Qualifying Exam will consist of a written dissertation proposal (a document of typically 20 to 50 pages
without appendices) and associated oral presentation by the examinee to an audience of peers and a committee of faculty members (minimum of three) where one of whom must be the examinee’s dissertation advisor. The committee may have in addition one or more members from outside UML.

At least one week prior to the date of the presentation of the dissertation proposal, an announcement document must be submitted to the department graduate coordinator and to the Associate Dean of Graduate Studies in the College of Engineering by the Associate Dean of Graduate Studies.

The dissertation proposal is open to the public. The proposal will outline the motivation for the research, give a summary of the related past work in the area and present the scope of the proposed dissertation research. The presentation should be approximately 30 minutes. The proposal should clearly articulate the proposed contribution of the student to the knowledge base and how it differs from the past work. The examinee will be expected to answer questions from the audience to demonstrate his/her understanding of the proposed research, as well as his/her proficiency in the general research field related to the dissertation proposal.

D.Eng. Option in Mechanical Engineering

The intent of the Doctor of Engineering program is to prepare engineers for leadership positions in industry, academia and government. The programs includes advanced graduate course work in engineering and allied subjects and research, culminating in a doctoral dissertation. Compared to the Ph.D. degree, the D.Eng is oriented toward industry.

Admission Requirements

Applicants must have a minimum of a B.S. in Mechanical Engineering, or a closely related field with a minimum grade point average of 3.0 and an min GPA of 3.25 in science and engineering courses. Applicants with a M.S. in Mechanical Engineering, or a closely related field, must have a minimum graduate GPA of 3.25.

In the cases where a student has an M.B.A., or has completed the Business Administration Minor for Engineering students, in addition to a B.S. in engineering or a closely related field, portions of the management component of the Doctor of Engineering program may be waived upon review by the administering department.

One of the letters of recommendation submitted as part of the graduate school application should be from a mechanical engineering department faculty member willing to act as thesis advisor.

Transfer Credits

1. A student with a master’s degree in engineering or a closely related field may apply to have coursework for the master’s degree up to a total of 24 credits.
2. A student with graduate-level work completed at an accredited US of Canadian university may apply for transfer of up to 24 semester credits in acceptable graduate engineering courses (with grade of B or better) towards the doctoral program, upon approval by the Department Graduate Coordinator.
3. In cases where a student has an M.B.A., or has completed the Business Administration Minor for Engineering students, in addition to a B.S. in engineering or a closely related field, portions of the management component of the Doctor of Engineering program may be waived upon review by the administering department.

Note: Students may be required to make up prerequisites which they lack in comparison to the equivalent Engineering curriculum at the University of Massachusetts Lowell.

Degree Requirements

A total of 63 credit hours of graduate level courses are required for the D.Eng degree. These credits are composed of the following three components:

- 33 approved credit hours of graduate-level engineering courses, which must include doctoral core, described below.
- 9 credit hours of approved management-type courses.
- 21 credit hours of doctoral dissertation. The D.Eng. degree can involve a dissertation that involves an industry-based project.

In addition to these 63 semester hours of approved graduate courses and thesis:

- The student must have a minimum grade point average of 3.25 in order to graduate.
- Students are required to take and pass the doctoral qualifying examination.
- Students must take a doctoral candidacy (thesis defense) examination.

Doctoral Core Requirement

Students must satisfy the following doctoral core requirement:
• One Course in solid mechanics
• One Course in Thermal fluids (approved by grad coordinator)
• Two Courses in advanced mathematics (approved by grad coordinator)
• Four courses from the following five areas of concentration:

1. Mechanics & Materials Concentration:
   - MECH.5120 Applied Finite Elements
   - MECH.5130 Finite Element Analysis I
   - MECH.5140 Finite Element Analysis of Composites
   - MECH.5620 Solid Mechanics I
   - MECH.5690 Fracture Mechanics
   - MECH.5910 Mechanical Behavior of Materials
   - MECH.5960 Composite Materials
   - MECH.5970 Processing of Composites
   - MECH.6010 Special Topics: Mechanics/Materials
   - MECH.6140 Finite Element Analysis II

2. Thermofluids Concentration:
   - MECH.5400 Heat Conduction
   - MECH.5420 Convective Heat and Mass Transfer
   - MECH.5450 Advanced Industrial Heat and Mass Transfer
   - MECH.5490 Cooling of Electronic Equipment
   - MECH.5530 MEMS & Microsystems
   - MECH.5580 Aero/Wing Engineering
   - MECH.5590 Multi-Scale Computational Fluid Dynamics I
   - MECH.5600 Multi-Scale Computational Fluid Dynamics II
   - MECH.5810 Advanced Fluid Mechanics
   - MECH.5830 Advanced Aerodynamics
   - MECH.6020 Special Topics: Thermofluids
   - CHEN.5280 Advanced Transport Phenomena

3. Energy Concentration:
   - MECH.5040 Energy Engineering Workshop
   - MECH.5210 Solar Fundamentals
   - MECH.5250 Grid-Connected Solar Electric Systems
   - MECH.5260 Transport Processes in Energy Systems

4. Vibrations/Dynamics/Controls Concentration:
   - MECH.5100 Dynamics and Diagnostics of Rotating Machinery
   - MECH.5130 Finite Element Analysis I
   - MECH.5150 Modal Analysis
   - MECH.5160 Experimental Modal Analysis
   - MECH.5180 Signal Processing Techniques
   - MECH.5240 Fundamentals of Acoustics
   - MECH.5300 Autonomous Robotic Systems
   - MECH.5500 Vibrations
   - MECH.5540 Dynamic Systems and Controls
   - MECH.5790 Robotics
   - MECH.6030 Special Topics: Vibration Dynamics
   - MECH.6110 Matrix Methods
   - EECE.5130 Control Systems
   - EECE.5840 Probability and Random Processes

5. Manufacturing Concentration:
   - MECH.5120 Applied Finite Elements
   - MECH.5490 Cooling of Electronic Equipment
   - MECH.5530 MEMS & Microsystems
   - MECH.5710 Collaborative Engineering
   - MECH.5720 Manufacturing Processes
   - MECH.5740 Design for Reliability Engineering
   - MECH.5750 Industrial Design of Experiments
   - MECH.5760 Engineering Project Management
   - MECH.5790 Robotics

Management Courses for the Doctor of Engineering Degree

D.Eng. students are required to take 9 credits of graduate management courses from the following list:
The following graduate certificates are offered in Mechanical Engineering:

- Design and Manufacturing Engineering
- Structural Dynamics and Acoustic Modeling Techniques
- Microelectromechanical Systems/Nanoelectromechanical Systems (interdisciplinary)
- Composites and Materials
- Renewable Energy Engineering
- Integrated Engineering Systems (interdisciplinary)
- Nanotechnology (interdisciplinary)
- Wind Energy Engineering

Apply for a graduate certificate

Design & Manufacturing Engineering

Contact:
Sammy Shina, Ph.D.
978-934-2950
Sammy_Shina@uml.edu (mailto:sammy_shina@uml.edu)

This 12 credit certificate program is aimed at educating engineers in modern design and manufacturing practices for developing world class products at the highest customer satisfaction and quality, at lowest cost and within engineering project budgets and schedules. It has a strong practice oriented curriculum and is taught by experienced faculty drawn from both academia and senior engineers and managers of high technology companies.

Required Course (one 3-credit course):

- MECH.5750 Industrial Design of Experiments
- MECH.5760 Engineering Project Management

Choose Three of the Following Courses (three 3-credit courses):

- MECH.5710 Collaborative Engineering and Quality
- MECH.5740 Design for Reliability Engineering
- MECH.5750 Industrial Design of Experiments
- MECH.5760 Engineering Project Management
- MECH.5790 Robotics
- CHEN.5230 Electronic Material Processes
Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/catalog/graduate/gainful-employment-grad.aspx).

Structural Dynamic Modeling Techniques

Contact persons:

Peter Avitabile
978-934-3176
Peter_Avitabile@uml.edu (mailto:peter_avitabile@uml.edu)

Christopher Niezrecki
Christopher_Niezrecki@uml.edu (mailto:christopher_niezrecki@uml.edu)
978-934-2963

This certificate is aimed at educating engineers in very critically needed techniques for modeling structural dynamic applications. In all undergraduate curriculums accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org (http://www.abet.org), the materials presented bring the student to a firm comprehension and understanding of static design configurations but does not go beyond this point to address the practical reality of structural dynamic response for meaningful design configurations. Therefore, many new or practicing engineers are not prepared to address these types of problems. These suite of courses in this certificate provides materials that has strong, practical relevance and provides tools and techniques to address these structural dynamic applications. Both hands-on and product oriented practice will be emphasized.

A total of four courses (12 credits) are required for the certificate with one required course (which must be either MECH.550 Advanced Vibrations or MECH.515 Structural Dynamic Modeling Techniques).

The courses in this certificate are:

- MECH.5100 Dynamics and Diagnostics of Rotating Machinery
- MECH.5130 Finite Element Analysis I
- MECH.5150 Structural Dynamic Modeling Techniques
- MECH.5160 Experimental Modal Analysis
- MECH.5170 Structural Dynamics
- MECH.5180 Signal Processing
- MECH.5240 Fundamentals of Acoustics
- MECH.5500 Vibrations
- MECH.6030 Special Topics in Structural Dynamics and Modal Analysis
- MECH.6110 Matrix Methods

MEMS/NEMS (Microelectromechanical Systems/Nanoelectromechanical Systems)

Contact:
Hongwei Sun
978-934-4391
Hongwei_Sun@uml.edu (mailto:hongwei_sun@uml.edu)

This 12-credit certificate program provides an interdisciplinary education and training for engineers who will work in the fast growing MEMS/NEMS industry with microsystems design methods, advanced microfabrication, packaging and assembly techniques, VLSI circuits design and fabrication, nanoelectronics, nano-assembly and integration, material processing. Both hands-on and product oriented practice are emphasized.

Choose four courses with at least one course from Group 1 and at least one course from Group 2.

Group 1

- MECH.5570 Microsystem Design
- MECH.5530 MEMS &Microsystems

Group 2

- EECE.7100 Special Topics in Nanoelectronics
- CHEN.5240 Self Assembly and Nanotechnology

Group 3

- CHEN.5230 Electronic Material Process
- EECE.5020 VLSI Design
- EECE.5040 VLSI Fabrication
Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Microelectromechanical%20Systems-Nanoelectromechanical%20Systems%20-%202014.1901-Gedt.html)

Composites and Materials

Contact persons:

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Emmanuelle Reynaud
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mailto:Emmanuelle_Reynaud@uml.edu

James Sherwood
978-934-2992
James_Sherwood@uml.edu
mailto:James_Sherwood@uml.edu

This certificate is aimed at educating engineers in the design, manufacture and structural analysis of composite materials. The use of composite materials is growing in the transportation, defense and recreational industries, and thus there is a need for engineers with expertise in composite materials. The design of composites is explained through classical laminate theory and micro- and mesomechanics. Various methods such as resin-transfer molding, compression molding, are discussed. Structural analysis of composites is presented using classical laminate theory and finite element methods with applications in the determination of structural stiffness, ultimate failure, fracture and fatigue. Both hands-on and product oriented practice will be emphasized.

Choose any four courses from the following list with at least one course from Group 1 and at least one course from Group 2.

Group 1

- MECH.5620 Solid Mechanics

Group 2

- MECH.5960 Composite Materials
- MECH.5970 Processing of Composites

Group 3

- MECH.5140 Finite Element Analysis of Composites
- MECH.5690 Fracture Mechanics
- MECH.5890 Polymer Nanocomposites
- Material processing course from Plastics Engineering with permission of certificate coordinators

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Composites%20and%20Materials%20-%202014.1901-Gedt.html)

Renewable Energy Engineering

Contact:
Walter D. Thomas
Walter_Thomas@uml.edu
mailto:walter_thomas@uml.edu
978-934-5276

This 12 credit certificate provides engineers and scientists with a rigorous but practical grounding in the fundamentals of renewable energy systems for design, research, development and manufacture. The certificate is part of a long-standing interdisciplinary graduate degree program in renewable energy engineering with experienced faculty. The courses address topics ranging from green building technologies (basic insulation and efficiency, passive solar heating and cooling, daylighting, solar hot water) to photovoltaic and wind systems, solar electrolyzers and fuel cells to stochastic process modeling of irradiation.

Choose any four classes from the following list with at least one of the four being MECH.5210 Solar Fundamentals or MECH.5270 Solar Energy Engineering. Other suitable courses may used for the certificate with the permission of the coordinator.

- EECE.5280 Alternative Energy Systems
- MECH.5040 Energy Systems Design Workshop
- MECH.5090 Dynamic Systems Analysis
- MECH.5210 Fundamentals of Solar Engineering
• MECH.5250 Grid-Connected Solar Electric Systems
• MECH.5260 Transfer Processes in Energy Systems
• MECH.5270 Solar Energy Engineering
• MECH.5280 Photovoltaic Manufacturing
• MECH.5340 Green Combustion and Bio-Fuels
• PLAS.5470 Materials for Renewable Energy and Sustainability
• PHYS.5770 Solid State Electronic and Optoelectronic Devices

Other suitable courses may be used as electives for the certificate with prior permission of the coordinator.

**Gainful Employment Disclosure Information**


**Integrated Engineering Systems**

Applied Physics, Computer Engineering, Computer Science, Electrical Engineering, Materials Engineering, Mechanical Engineering, Plastics Engineering departments

**Contact persons:**
Craig Armiento  
978-934-3395  
Craig_Armiento@uml.edu (mailto:craig_armiento@uml.edu)

As companies increasingly undertake engineering projects that bring together a wide range of disciplines for manufacturing an integrated product, it is often necessary to assemble teams of experts in these various disciplines, and prepare managers who have a fundamental, overall understanding of several different engineering areas. The certificate is designed to respond to the need for trained professionals who are responsible for managing complex engineering systems integrating algorithms, information, software and hardware. Completion of certificate courses in areas complementary to the individual’s specific training will serve as an important starting point for engineering managers (and prospective managers) who need to solve complex interdisciplinary problems at the interfaces of electrical, computer, mechanical, materials engineering, and computer science and applied physics.

The program consists of six clusters:

1. Applied Physics
2. Computer Engineering
3. Computer Science
4. Electrical Engineering
5. Materials Engineering
6. Mechanical Engineering

Within each cluster, there are a number of carefully selected courses ranging from introductory graduate level to more advanced, specialized electives.

Students must successfully complete four courses (12 credits), one or two of which may be taken in their area of expertise. The remaining courses must be taken in separate and different cluster areas. Courses are selected in consultation with one (or more) graduate program coordinators to best meet the student’s needs in terms of background, interests, and work requirements. It may be necessary for students to take prerequisite course(s) if they do not have appropriate backgrounds for a particular cluster course.

**Cluster Areas and Designated Courses:**

**Applied Physics**

- PHYS.5530 Electromagnetism I
- PHYS.5540 Electromagnetism II
- PHYS.5400 Image Processing (4 credits)
- PHYS.5780 Integrated Optics: Wave Guide and Lasers
- PHYS.5350 Introduction of Quantum Mechanics I
- PHYS.5770 Solid State Electronic and Optoelectronic Devices
- PHYS.5210 Statistical Thermodynamics

**Computer Engineering**

- EECE.5500 Advanced Digital System Design
- EECE.5610 Computer Architecture Design
- EECE.5810 Computer Vision and Digital Image Processing
- EECE.5100 Digital Signal Processing
- EECE.5720 Embedded Real-Time Systems
- EECE.5750 FPGA Logic Design Techniques
- EECE.5520 Microprocessors Systems II and Embedded Systems
- EECE.5820 Network Design: Principles, Protocols, and
Applications
- EECE.5730 Operating Systems and Kernel Design for Computer Engineers
- EECE.5210 Real Time DSP
- EECE.5020 VLSI Design
- EECE.5040 VLSI Fabrication

COMPUTER SCIENCE
- COMP.5610 Computer Security I
- COMP.5620 Computer Security II
- COMP.5630 Data Communications I
- COMP.5640 Data Communications II
- COMP.5490 Mobile Robots
- COMP.5150 Operating Systems I
- COMP.5160 Operating Systems II
- COMP.5480 Robot Design
- COMP.5230 Software Engineering I
- COMP.5240 Software Engineering II

ELECTRICAL ENGINEERING
- EECE.5280 Alternative Energy Sources
- EECE.5060 Antenna Theory and Design
- EECE.5320 Computational Electromagnetics
- EECE.5130 Control Systems
- EECE.5290 Electric Vehicle Technology
- EECE.5070 Electromagnetic Waves and Materials
- EECE.5120 Electronic Materials
- EECE.5190 Engineering of Submicron Machines
- EECE.5900 Fiber Optic Communications and Networks
- EECE.5430 Introduction to Communication Theory
- EECE.5090 Linear System Analysis
- EECE.5050 Microwave Electronics
- EECE.5330 Microwave Engineering
- EECE.5150 Power Electronics
- EECE.5840 Probability and Random Processes
- EECE.5710 Radar Systems
- EECE.5170 MMIC Design and Fabrication
- PLAS.5440 Advanced Plastics Materials
- CHEN.5060 Interfacial Science and Engineering and Colloids
- CHEN.5070 Material Science and Engineering
- PLAS.5030 Mechanical Behavior of Polymers
- CHEN.5230 Nanodevices and Electronic Materials
- CHEN.5270 Nanomaterials Science and Engineering
- CHEN.5410 Nanostructural Characterization by SEM, TEM, and AFM
- PLAS.5180 Plastics Product Design

MECHANICAL ENGINEERING
- MECH.5120 Applied Finite Element Analysis
- MECH.5710 Concurrent Engineering and Quality
- MECH.5230 Cooling of Electronic Equipment
- MECH.5740 Design for Reliability Engineering
- MECH.5160 Experimental Modal Analysis
- MECH.5240 Fundamentals of Acoustics
- MECH.5750 Industrial Design of Experiments
- MECH.5730 Manufacturing Systems Engineering
- MECH.5910 Mechanical Behavior of Materials
- MECH.5150 Modal Analysis- Theoretical Methods
- MECH.5790 Robotics
- MECH.5620 Solid Mechanics
- MECH.5270 Solar Systems Engineering
- MECH.5500 Vibrations

Gainful Employment Disclosure Information

Nanotechnology
Civil &Environmental, Mechanical, Plastics Engineering departments

Contact:
Jackie Zhang
978-934-2287
Jackie_Zhang@uml.edu (mailto:jackie_zhang@uml.edu)
The program will provide students with a fundamental knowledge of nanotechnology and is intended to respond to the increasing demand for trained professionals in nanoscience and technology. The certificate is designed for students with a background in chemistry, physics, biology, or any branch of engineering who want nanotechnology and nanomanufacturing workforce preparation. Students may focus on a concentration area based on their interests and background. Courses in each concentration area are carefully designed to provide both analytical and practical competence. Students may take any combination from the electives list.

**Core Course: (required)**

- ENGN.5500 Introduction to Nanotechnology

**Core Courses: (Choose one)**

- CHEN.5410 Nanostructural Characterization by SEM, TEM, and AFM
- CHEM.5100 Electron Microscopy of Advanced Materials
- CHEM.5250 Analysis of Advanced Materials

**Elective Courses: (choose two courses)**

**Materials**

- CHEN.5060/5270 Interfacial Science and Engineering and Colloids
- MECH.5780 Advanced Materials
- PLAS.5130 New Plastics Materials
- PLAS.5980 Smart Polymers

**Manufacturing**

- CHEN.5230 Electronic Materials Processing
- CHEN.5240 Self-assembly and Nanotechnology
- CHEN.5350 Cell & Microbe Cultivation
- CHEN.5450 Isolation & Purification of Biotech Products
- EECE.5040 VLSI Fabrication
- ENGN.5510 Nanomanufacturing I
- ENGN.5260 Nanoscale Plastics Processing
- PLAS.5020 New Plastics Processing Techniques

**Design and Devices**

- EECE.5020 VSLI Design
- EECE.5120 Electronic Materials
- EECE.5080 Quantum Electronics for Engineers

**Health and Environmental Impacts**

- PUBH.5030 Toxicology and Health
- PUBH.5140 Aerosol Science
- PUBH.5250 Industrial Hygiene and Ergonomics 19.557
- PUBH.6100 Exposure Assessment
- PUBH.6170 Measurements of Airborne Contaminants

**WIND ENERGY ENGINEERING**

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This certificate is open to applicants with a BS in Mechanical Engineering or a related field, such as Materials Science or Physics, who have an interest in modern wind turbines, including their aerodynamics, what materials go into their construction, and how they are integrated into our electrical system. The one required course, Wind Energy Fundamentals, introduces the student to multiple topics concerning wind energy and wind turbines. The student can then pursue one or more of these topics in greater depth through the available electives. Upon completion, the student will be well-prepared either to continue graduate studies in wind energy engineering, or to work in the growing wind energy industry.

A total of four courses (12 credits) are required for the certificate with one required course (MECH.5220).

**Required Courses:**

- MECH.5220 Wind Energy Fundamentals

**Elective Courses (choose three)**

- MECH.5230 Structural Health Monitoring
- MECH.5260 Transport Processes in Energy Systems
- MECH.5580 Aero/Wind
- MECH.5830 Advanced Aerodynamics
- MECH.5840 Ocean Engineering
- MECH.5960 Mechanics of Composite Materials
- MECH.5970 Processing of Composites
- MECH.6140 Advanced Finite Elements
- MECH.5TBA Condition Monitoring
- EECE.5250 Power Distribution Systems

**Gainful Employment Disclosure Information**
Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information.
MECH.5010 Graduate Research Seminar - Credits: 0-1
Research seminar for students to listen to and engage with engineering-relevant researchers. Invited speakers will present recent research advances in fields relevant to mechanical engineering, and engage with the audience through a question and answer session.

MECH.5040 Energy Engineering Workshop (Formerly 22.504) - Credits: 3
A group design of an innovative energy system. Integration of many aspects of the student's engineering background, including design concepts, technical analyses, economic and safety considerations. Ideally the whole design cycle of design, build, test. A formal report and oral presentation.

MECH.5050 Directed Studies - ME (Formerly 22.505) - Credits: 1-3
MECH.5100 Dynamics and Diagnostics of Rotating Machinery (Formerly 22.510) - Credits: 3
Course provides the theoretical and practical background in the fundamentals of dynamics and diagnostics of rotating machinery. The course starts with an overview of rotating machinery components and systems with emphasis on their designs, and then builds and in-depth understanding of the dynamics of rotating systems by analyzing the design and dynamics of their component. Diagnostics, health monitoring, and associated signal processing theories regarding rotating machinery are emphasized, with applied examples such as aircraft engines, gas turbines, rotorcrafts, wind turbines, and automotive drivetrains, along with other turbomachines.

MECH.5110 FEA of Textiles and Composites - Credits: 3
This course covers applications of finite element analysis to the mechanical behavior of textiles and composites, including topics such as mechanics of orthotropic materials, elasticity and strength of laminates, computational micromechanics, meso-scale finite element modeling, material testing, modeling techniques. These topics will be studied using software packages such as ABAQUS and MATLAB.

MECH.5120 Applied Finite Element Analysis (Formerly 22.512) - Credits: 3
An introduction to finite element methods using popular commercial packages. The features common to different programs as well as special features of particular programs are presented. Primary focus is on hands-on familiarity with the software with a limited discussion of the underlying finite element theory. ALGOR, ADINA, ABAQUS, LS-DYNA, HyperMesh, and FEMAP are among the pre/post-processing and analysis packages used in the class. This is a WWW based course and access to a PC, the Internet, and a frames-capable browser is required.

MECH.5130 Theory of Finite Element Analysis (Formerly 22.513) - Credits: 3
Matrix algebra and the Rayleigh-Ritz technique are applied to the development of the finite element method. The minimum potential energy theorem, calculus of variations, Galerkin’s and the direct-stiffness method are used. Restraint and constraint conditions are covered. C0 and C1 continuous shape functions are developed for bar, beam, and two and three dimensional solid elements. Recovery methods, convergence and modeling techniques are studied. Applications to problems in static stress analysis and heat conduction.

MECH.5140 Finite Element Analysis of Composites (Formerly 22.514) - Credits: 3
MECH.5150 Structural Dynamic Modeling Techniques (Formerly 22.515) - Credits: 3

MECH.5160 Experimental Modal Analysis (Formerly 22.516) - Credits: 3
Prerequisite: 22.4xx/5xx Experimental Modal Analysis I (or permission of instructor) Review of system transfer and FRF matrices for development of a modal model. Review of DSP techniques for experimental modal analysis. Excitation techniques for the development of the system FRF matrix; SISO and MIMO techniques. Modal parameter estimation using time and frequency domain techniques. Advanced data manipulation for dynamic analysis. Introduction to structural dynamic modification and system modeling concepts. Models developed using MATLAB and commercially available software.

MECH.5170 Structural Dynamics (Formerly 22.517) - Credits: 3
Prerequisite: MECH.5150 Development of system equations of motion for mdof systems. Proportional and non-proportional
damping. Dynamic response using mode superposition, maximum response, frequency domain techniques and direct integration using central difference, Runge-Kutta, Wilson theta, and other techniques. Models developed using MATLAB.

MECH.5180 Signal Proc Techniques (Formerly 22.518) - Credits: 3


MECH.5190 Engineering Spectral Analysis (Formerly 22.519) - Credits: 3

Analytical and experimental background for the fundamental understanding of time and frequency domain signals, required for digital signal processing, vibration, and acoustic signal analysis. Introductory theory is based on simplified concepts form different mechanical signatures in the time domain. The spectral conversion from time domain to frequency domain is illustrated from a phenomenological perspective using examples and dynamic signal analyzer illustrations. The concepts of vibration and acoustic measurement methods are studied through practical projects and LabVIEW exercises. Students will be prepared for more advanced topics on dynamic systems, controls, vibrations, advanced signal processing, acoustics, and experimental structural dynamics. Familiarity with Matlab required.

MECH.5200 Numerical Methods for Partial Differential Equations (Formerly 22.520) - Credits: 3

Mathematical approaches for numerically solving partial differential equations. The focus will be (a) iterative solution methods for linear and non-linear equations, (b) spatial discretization and meshing (c) finite difference methods (FDM), (d) finite volume methods (FVM), (e) finite element methods (FEM) and (f) boundary element methods (BEM). The theory behind of each of these methods will be developed and discussed. Computer programming applications involving the solution of linear and non-linear PDEs in multiple dimensions will play a key role in this course. Unique computer programming assignments will be selected from different engineering/science fields (possibilities include: fluid flow, heat transfer, electrostatics, electromagnetism, structural analysis, medical, ocean engineering etc.) to illustrate the broad applicability of numerical methods. Students will be expected to complete programming assignments -- while most class examples will deal with pseudo code and/or matlab, a working knowledge of one of the following programming languages is recommended: Matlab, Octave, C, C++, fortran, Java, BASIC, or Python.

MECH.5210 Solar Fundamentals (Formerly 22.521) - Credits: 3

Utilization Terrestrial irradiation on tilted surfaces; radiation, conduction, convection in collectors; absorptance, emittance, reflection, transmittance of solar irradiation; energy flow in flat plate and concentrator collectors; storage; design tools; small project; web-based.

MECH.5220 Wind Energy Fundamentals - Credits: 3

An overview of all aspects of wind energy power generation: The nature of and statistics of wind, turbine siting requirements, aerodynamics of the rotor system, mechanical power transmission, generators, blade construction, structural analysis of turbine components, electrical power distribution.

MECH.5230 Structural Health Monitoring (Formerly 22.523) - Credits: 3

Detail the entire process of structural health monitoring applications, including operational evaluation, data acquisition, normalization and cleansing, feature extraction and data compression, and statistical model development and pattern recognition. Aiming at detecting, localizing, and evaluating the damage severeness, topics that will be covered in this course include: sensors and sensor networks, signal processing and detection theory, nondestructive evaluation techniques, time and frequency modeling, damage prognosis, unsupervised/supervised learning, probability and statistics in feature evaluation. Case study of SHM activities will be conducted throughout the entire course, including mechanical, aerospace and civil structures.

MECH.5240 Fund of Acoustics (Formerly 22.524) - Credits: 3

Fundamentals of acoustics are introduced. Topics include: Motivation for studying acoustics, oscillatory motion, harmonic waves, the wave equation, sound pressure levels, decibel scale, frequency analysis, sound power, intensity, acoustic sources, directivity, sound radiation, sound power measurement, sound in enclosures, acoustic mode shapes, reverberation time, sound absorbing material, impedance, transmission loss, cavity resonators, reactive and dissipative mufflers, and applications to noise control.

MECH.5250 Grid-Connected Solar Electric Systems
Students will study the concepts and design considerations of grid-connected, solar-powered, electrical generation systems, from residential through utility scale. Emphasis will be on practical applications that help make the student "work ready" at graduation. Grading consists of two tests during semester; one individual project (residential scale PV system); and one group project (commercial-scale system). This course fulfills an elective requirement for renewable energy students.

**MECH.5260 Transport Processes in Energy Systems** (Formerly 22.526) - Credits: 3

Course focuses on the development of a fundamental understanding of transport processes from a multi-scale and multi-physics perspective, and the application of such understanding to the analysis of energy engineering systems. Derivations of the equations describing the mechanisms for mass, momentum, and energy transport are presented, together with approaches for the evaluation of material properties and constitutive relations. Emphasis is placed on a holistic view of transport processes as combinations of transient, advective, diffusive, and reactive phenomena.

**MECH.5270 Solar Energy Engineering** (Formerly 22.527) - Credits: 3

Systems engineering, stochastic modeling, design, and life-cycle cost analysis of several solar systems: photovoltaics, passive heating, solar cooling, and daylighting; Web Based.

**MECH.5280 Photovoltaics Manufacturing** (Formerly 22.528) - Credits: 3

Overview of the manufacturing processes used to make a typical crystalline solar cell. Detailed study of selected processes and manufacturing problems, such as solar cell testing, characterization, reliability issues, factors affecting yields, automated material handling, affect of impurities in crystal growth.

**MECH.5285 Energy Policy and Energy Codes** - Credits: 3

Explore and codify the status of the world's energy infrastructure and discuss energy-related policies. Identify areas of energy inefficiency and examine pathways to a future dominated by renewable and sustainable resources.

**MECH.5290 Fuel Cell Fundamentals** (Formerly 22.529) - Credits: 3

The primary objective of this course is to understand the fundamental science and engineering of fuel cells and redox flow batteries (i.e., reversible fuel cells). The fundamental principles of electrochemistry, thermodynamics, and kinetics of electrochemical reaction processes, as well as mass transport in electrochemical energy systems will be considered. Emphasis will be placed on operating principles and the design and diagnostics of the proton exchange membrane fuel cell as a portable energy conversion system, and the vanadium redox flow battery as a large-scale energy storage system. Cell components and their influence on the overall performance of these systems will be discussed in detail. An introduction to the cost analysis of electrochemical energy storage will be presented.

**MECH.5300 Autonomous Robotic Systems** (Formerly 22.530) - Credits: 3

This course covers concepts related to autonomous robotic systems, emphasizing the synthesis and design of control algorithms for autonomous robotic vehicles. Topics that will be covered in the course include: Linear and nonlinear systems analysis, stability in the sense of Lyapunov, linearization of nonlinear dynamic equations, rigid body equations of motion in three dimensions, dynamic model derivation of aerial, space, marine and ground vehicles, fundamentals of flight dynamics, feedback control design for autonomous robotic vehicles, guidance and navigation, description of components typically encountered to autonomous robotic vehicles, cooperative control of multi-robot teams and state estimation.

**MECH.5310 Math Methods In Mechanical Engineering** (Formerly 22.531) - Credits: 3

Introduction to the analysis and design of feedback controllers for linear systems using the state-space formulation. Topics covered include linear algebra, vector spaces, state-space representation, realization theory, stability in the sense of Lyapunov, controllability and observability, Kalman decomposition, pole placement via state-feedback, observer design, linear quadratic regulators and introduction to nonlinear systems.

**MECH.5320 Off-Grid Solar Electric System** (Formerly 22.532) - Credits: 3

This course examines the technical, financial and societal aspects of photovoltaic (PV) systems that are not connected to the electrical grid. Topics include: reasons for going off the grid, the components of an off-grid PV system, how to size a PV system to meet the required load, site impacts on performance, determining the loss of load probability (LOLP)
for a system, hybrid systems, e.g. solar plus a generator, energy storage solutions, regulatory issues, and cost. Systems sized to meet the annual load requirements of a remote communication system, a net-zero home, and a small village will be examined. HOMER/Microgrid, PVWatts, and other software will be used to design these systems.

MECH.5330 Nanomaterials for Energy - Credits: 3

Introduction of fundamental materials development and principles in addressing issues associated with affordable and sustainable energy. The course starts with basic concepts in materials science and engineering, with special attention paid to the origin of size effects in controlling the properties of nanomaterials. Then a range of materials issues related to development of renewable energy resources and sustainable energy technologies will be discussed. Topics to be covered include: photovoltaic materials and solar energy conversion; thermoelectric materials; materials for electrical energy storage and generation; materials for hydrogen production; piezoelectric energy harvesting; and materials for other emerging energy processes.

MECH.5340 Green Combustion and Biofuels (Formerly 22.534) - Credits: 3

Fundamentals of combustion and pollutant formations in application to internal combustion engines, turbines, and fire safety. Concepts include flame structure, flame speed, flammability, ignition, reaction kinetics, nonequilibrium processes, diffusion flames, and boundary layer combustion. Additional specific emphasis on combustion modeling, green approaches to energy production, and biofuels.

MECH.5350 Fundamentals of Sustainable Energy - Credits: 3

Introduction to scientific principles associated with sustainable energy technologies. Topics include: thermodynamic laws and engineering fundamentals in energy processes, thermodynamic energy conversion, wind and geothermal energy, photovoltaics, ocean thermal energy conversion, electrochemical energy, biomass, and selected emerging energy technologies.

MECH.5420 Convective Heat/Mass Transfer (Formerly 22.542) - Credits: 3


MECH.5440 Combustion Modeling - Credits: 3

This course is focused on combustion modeling and computational combustion. It will introduce methods for modeling laminar and turbulent premixed and non-premixed flames, as well as particulate combustion. Specific emphasis will be placed on the theory and derivation of the methods, their implementation, and the use of existing computational tools. Models will include combustion kinetics, convective and diffusive transport, equilibrium, simple reactors, canonical premixed and non-premixed flames, and methods for treating turbulent flows. Practical applications include internal combustion engines and gas turbines.

MECH.5450 Advanced Industrial Heat and Mass Transfer (Formerly 22.545) - Credits: 3

This course specializes in obtaining practical solutions for applied and industrial heat transfer problems related to device development and production processes. Topics include review of heat transfer modes (i.e. conduction, convection and radiation), transport phenomena in material processing and manufacturing, analytical models and numerical simulations. Representative problems include curing of polymers, thermal conditioning of human body, food packaging and long-term food preservation, thermal management of electrical and electronic equipment, control of water vapor and pollutant transfer, material processing, and heat and mass exchangers.

MECH.5490 Cooling of Electronic Equipment (Formerly 22.549) - Credits: 3

This course focuses on teaching the primary techniques for cooling electronics, and methods for modeling their performance. Heat-transfer fundamentals: conduction, convection, radiation, phase change, and heat transfer across solid interfaces. Heat-generating electronic equipment: ICs, power converters, circuit cards and electrical connectors. Thermal management equipment: heat sinks, interface materials, heat spreaders including liquid loops, and air movers. System design: system packaging architectures, facilities, system analysis. Advanced Topics: spray cooling, refrigeration

MECH.5491 Advanced Thermodynamics - Credits: 3

The primary objective of this course is to prepare upper-level engineering students to effectively solve problems directly related to the fundamental science and engineering of thermodynamic systems. The course expands upon the first and second laws of thermodynamics. A significant emphasis is placed on the concepts of entropy generation and its transport mechanisms with respect to single-phase, multi-phase, chemically reacting and non-reacting systems. The methods of entropy generation minimization for commonly studied thermodynamic systems are discussed.

MECH.5500 Vibrations (Formerly 22.550) - Credits: 3
This course provides the analytical background for the fundamental understanding of vibration analysis, modeling and testing of mechanical systems. The course starts with an overview of the concepts in vibrations and later builds an in-depth understanding of the vibrations of single degree of freedom and multi degree of freedom systems. Both free and forced vibrations of these systems under steady-state and transient mechanical excitations will be investigated. The important concepts of modal analysis and vibration measurement methods will be studied. The continuous system modeling, nonlinear and random vibrations will also be touched upon.

MECH.5520 Probabilistic Methods and Analysis - Credits: 3

The course will review the fundamentals of probability and statistics, and introduce the methodologies that are commonly adopted in mechanical engineering domain. The concepts of uncertainty, confidence and risk of engineering decision-making will be emphasized. Specific topic areas will include: random vibration and analysis, random data processing, probability evolution, uncertainty quantification in system modeling, model validation and verification, data fusion and model updating, Bayesian inference and statistical learning. Course assignments will be primarily deployed in Matlab environment.

MECH.5530 MEMS & Microsystems (Formerly 22.553) - Credits: 3

The purpose of this course is to give a broad introduction to Micro-electro-mechanical Systems (MEMS) technology, and will provide graduate students in mechanical, electrical, manufacturing and related engineering disciplines with necessary fundamental knowledge and experience in the design, manufacture, and packaging of microsystems. The topics include basic sensing and actuating principles, modeling of electromechanical components, material properties, fabrication technologies, process integration, system design, and packaging of MEMS and Microsystems. The course will also cover current literature, MEMS markets and applications. The course will be a combination of lectures, case studies and homework assignments. The students are expected to possess prerequisite knowledge in college mathematics, physics, and chemistry, as well as in engineering subjects such as fundamental materials science, electronics, thermal-fluid, and machine design.

MECH.5540 Dynamic Systems and Controls (Formerly 22.554) - Credits: 3

Matrix-based classical and modern techniques are applied to the dynamics of control systems. Design of controllers, and full and reduced-order observers. Introduction to optimal control and Kalman filters.

MECH.5570 Microsystem Design (Formerly 22.557) - Credits: 3

Design aspects of Microsystems (MEMS). Topics covered include working principles of various microsystems, analytical and numerical modeling, and case studies. Course incorporates lectures, computer laboratories and term project presentations.

MECH.5580 Aero/Wind Eng (Formerly 22.558) - Credits: 3

This course will introduce and examine classical and modern theoretical and computational two and three dimensional aerodynamics and aeroelastic modeling with applications in wind and subsonic aero/thermodynamics applications. In addition, wind and meteorological science as well as simple FEM structural modeling and coupling concepts will be examined. The class will comprise scheduled lectures and discussions. Students will be expected to perform presentations and directed projects which involve computer programming.

MECH.5590 Multi-Scale Computational Fluid Dynamics I (Formerly 22.559) - Credits: 3

Derivation of governing equations; Scale analysis; Role of relative dimensionless parameters; Discretization of the governing equations; Finite-Difference, Finite-Volume, and/or Finite Element Techniques; Solutions of several problems in micro/meso/macro scale applications.

MECH.5600 Multi-Scale Computational Fluid Dynamics II (Formerly 22.560) - Credits: 3

Applications of CFD methods to the solution of multi-phase problems such as: heat pipes, fuel cells, nanofluidics, material processing and manufacturing, etc.

MECH.5620 Solid Mechanics I (Formerly 22.562) - Credits: 3

Topics covered include the theory of stress, kinematics of strain, Hooke’s Law, work and energy, equations of stress equilibrium, Navier’s equations, strain compatibility, and the Beltrami-Michell equations. Problems for uniformly varying 3-D states of stress, torsion, and plane deformation are studied. Axisymmetric deformation is considered. Green’s function solutions for plane and axisymmetric problems are studied.

MECH.5630 Dynamic Behavior of Materials - Credits: 3

The time-dependent material behavior and stress-wave propagation in solids. Topics will be selected from applied
mechanics and materials science, e.g. mathematical and physical description of one dimensional and three dimensional waves in solids, strain rate-dependent behavior of materials, viscoelasticity of materials and its time-and frequency-domain descriptions including relaxation and creep, introduction to shock waves, introduction to experimental techniques for material characterization in dynamic environment such as ultrasonic testing, split Hopkinson bar technique, dynamic mechanical analysis, and drop tower and impact experiments.

MECH.5710 Quality Engineering (Formerly 22.571) - Credits: 3
Focuses on methodologies used by world class companies to guide the design and development of high quality, low cost products in the most timely manner through the use of analytical tools in case studies: Topics include: new product creation strategy and process, organizational aspects of multi-disciplinary design teams, concurrent project management, and structural methodologies for identifying customer requirements and manufacturing process design, control and selection. In particular, focus is on the interrelationship of CE, manufacturing and Quality tools and methodologies and how they contribute in determining the appropriate level of product/process quality and design efficiency.

MECH.5740 Design For Reliability Engineering (Formerly 22.574) - Credits: 3
(3-0)3 Design for Reliability Engineering provides a systematic approach to the design process that is focused on reliability and the physics of failure. It provides the requirements on how, why, and when to use the wide variety of reliability engineering tools available in order to achieve the reliability goals of the total design cycle. Topics include the product design cycle and customer requirements, analytical reliability, reliability statistics, accelerated testing, accelerated reliability growth, industry standard predictive models, design reliability assessment, reliability FMEA, product risk evaluation and thermodynamic reliability.

MECH.5750 Industrial Design of Experiment (Formerly 22.575) - Credits: 3
Concepts of Robust Design and statistical Design Of Experiments (DOE) as applied to the design and manufacturing of new high technology products. Classical and current methodologies of DOE including Full Factorial, Fractional Factorial, Taguchi, Central Composite and Yates Algorithms. The course will also provide for different methods for experimental design and analysis, including average and variability analysis. Commercial software packages and case studies using industrial experiments will be used to illustrate the material.

MECH.5760 Engineering Project Management (Formerly 22.576) - Credits: 3
Skills are developed enabling engineers to be effective decision makers and technical leaders in an environment where technology management, business operations and strategies for contract compliance are critical to achieving competitive advantage. Elements of the Project Planning and Control System are presented along with analytical methods important for maintaining Projects on schedule and within budget.

MECH.5790 Robotics (Formerly 22.579) - Credits: 3
Common robotics joints and robotics classification. Planes of motion and fold lines. Robotics capability. Forward and inverse kinematics and the RobSim software package. Trajectory planning and elementary obstacle avoidance. Robotics dynamics and feasible trajectory evaluation. Design of the control system for the non-linear robotics problem. Classroom studies are followed by hands-on applications in the Automated Manufacturing Assembly and Robotics Laboratory.

MECH.5800 Adv Grad Res Dev Proj (Formerly 22.580) - Credits: 3
MECH.5810 Advanced Fluid Mechanics (Formerly 22.581) - Credits: 3
Fundamental equations of fluid motion, kinematics, vorticity, circulation, Crocco’s theorem, Kelvin’s theorem, Helmholtz’s velocity laws, secondary flows. Stream function, velocity potential, potential flows. Unsteady Bernoulli equation, gravity water waves.

MECH.5830 Advanced Aerodynamics (Formerly 22.583) - Credits: 3

MECH.5840 Ocean Engineering (Formerly 22.584) - Credits: 3
Physical Properties of the Ocean Environment, ocean wave mechanics, computer solutions of wave interactions, physical modeling of marine vehicles and coastal environments (modeling and scaling laws), resistance and propulsion of
surface ships and submarines, and forces on floating and submerged objects such as buoys, pipelines, piers, and breakwaters. Research report required summarizing some aspect of ocean engineering.

MECH.5890 Finite Element in Thermofluids (Formerly 22.589) - Credits: 3

The Galerkin finite element technique is first applied to a simple one-dimensional steady state convection/conduction equation. The element equations are derived and the assembly process is described. These concepts are then extended to two-dimensional transient problems. A finite element package is used to solve a variety of fluid flow problems. All course materials are available on the WWW.

MECH.5910 Mechanical Behavior of Materials (Formerly 22.591) - Credits: 3

Quantification of structure-property relationships requires application of solid mechanics concepts to materials microstructure. Using micromechanics approach, the course focuses on the deformation and fracture behavior of metals, ceramics, composites and polymeric. Topics include: elastic behavior, dislocations, crystal plasticity, strengthening mechanisms, composite materials, glassy materials, creep and creep fracture, tensile fracture, and fatigue.

MECH.5930 Graduate Co-op Education (Formerly 22.593) - Credits: 0

The prediction, analysis, and prevention of failure in mechanical design is covered. Failure mechanisms such as creep, plastic deformation, crack propagation, cyclic fatigue, thermal fatigue, fretting and galling are considered. Theories of failure such as Colomb-Mohr, Beltrami, and Huber-Von Mises are used to predict failure. Cumulative damage theories such as those of Gatts, Corten and Dolan, Marin, and Manson will be studied. Statistical methods of analysis and test data interpretation are studied. Materials such as steels, aluminum alloys, solders, plastics, and composites will be considered.

MECH.5950 Graduate Co-op II (Formerly 22.595) - Credits: 0

MECH.5960 Mechanics of Composite Materials (Formerly 22.596) - Credits: 3

Analysis of anisotropic lamina and laminated composites. Methods of fabrication and testing of composites. Other topics include environmental effects, joining and machining.

MECH.5970 Processing of Composites (Formerly 22.597) - Credits: 3

Methods of fabrication. Analysis of forming, fiber orientation, permeability, polymer rheology, flow through porous media, consolidation, cure kinetics, combined flow and cure models. Effect of manufacturing defects.

MECH.5980 Experimental Characterization of Composites - Credits: 3


MECH.6020 Special Topic: Thermo-Fluids (Formerly 22.602) - Credits: 3

Study of advanced topics in thermo-fluid energy systems and processes not covered in the regular curriculum. Contents may vary from year to year.

MECH.6030 Special Topic: Vibration Dynamics (Formerly 22.603) - Credits: 3

Study of advanced topics in vibrations/dynamics not covered in the regular curriculum. Contents may vary from year to year.

MECH.6040 Special Topic: Finite Element Methods - Credits: 3

Study of advanced topics in finite element methods not covered in the regular curriculum. Contents may vary from year to year.

MECH.6110 Matrix Methods for Structural Dynamics (Formerly 22.611) - Credits: 3

3-0)3 Prerequisite: 22.515 Matrix linear algebra. Solution of algebraic equations using Gaussian elimination and decomposition variants. Eigenanalysis using various direct similarity techniques and simultaneous vector iteration methods. Algorithm development of solution techniques. Solution techniques for structural mechanics, dynamic systems and stability. Models developed using MATLAB.

MECH.6140 Advanced Finite Element Methods (Formerly 22.614) - Credits: 3
Nonlinear finite element methods as applied to large deformation and nonlinear material behavior are the focus of this course. Various classical and contemporary constitutive models and their implementation in the finite element method are considered. Procedures for determining material parameters from a matrix of material test results are investigated.

**MECH.6150 Micromechanics of Composites and Metamaterials - Credits: 3**

Overall behavior of composite materials and metamaterials. The fundamentals of homogenization for elastic composites, variational principles and energy-based bounds, and dynamic homogenization concepts and techniques are introduced. Voigt and Reuss mixture rules are discussed and expanded to dilute distribution, self-consistent, Mori-Tanaka, and periodic approaches with examples from particulate, whisker, platelet, and fiber-reinforced composites. The effects of damage and cracks and the concept of metamaterial are discussed and examples are presented. The use of finite element calculations for static, nonlinear, and dynamic homogenization will be discussed and the application to non-mechanical and coupled problems are explored.

**MECH.6220 Family Violence (Formerly 22.622) - Credits: 3**

**MECH.6500 Nano. Transport Phen. for Manufacturing Nanodevice (Formerly 22.650) - Credits: 3**

This course on nanoscale transport phenomena constitutes a bridge between existing fluid and heat transfer courses in multiple disciplines and emerging nanoscale science and engineering concepts to reflect the forefront of nanomanufacturing. The course is designed to incorporate recent advances in manufacturing polymer-based nanodevices. Key issues of the implementation and maintenance costs for fabrication will be addressed. Hands-on laboratory experiments will be performed to complement the lectures with the ultimate goal of designing and building a complete nanodevice at the end of the course. The course will prepare graduates for employment focused on designing and manufacturing nano/microfluidic systems, lab-on-a-chip devices, electronics devices, medical devices, and other emerging.

**MECH.6690 Fracture Mechanics (Formerly 22.569) - Credits: 3**

The application of fracture mechanics and approaches for exploring the impact of cracks on engineering structures. Topics will be chosen from a range of mathematical techniques, applied mechanics, and materials science, e.g. theoretical strength, stress concentration, linear and nonlinear fracture mechanics, stress singularity, fracture modes, energy methods, stable and unstable crack growth thermal cracks, crack tip plastic zone, Dugdale and Irwin models, the R-curve, power-law materials, and the J-integral. Students should have a good understanding of the principles of strengths of materials and be able to apply these principles to the solution of problems in solid mechanics. The associated knowledge in complex variables and partial differential equations will be reviewed as needed.

**MECH.7410 Master's Thesis - Mechanical Engineering (Formerly 22.741) - Credits: 1**

**MECH.7420 Master's Thesis - Mechanical Engineering (Formerly 22.742) - Credits: 2**

**MECH.7430 Master's Thesis - ME (Formerly 22.743) - Credits: 3**

**MS Thesis Research**

**MECH.7460 Master's Thesis - ME (Formerly 22.746) - Credits: 6**

**MS Thesis Research**

**MECH.7490 Master's Thesis - Mechanical Engineering (Formerly 22.749) - Credits: 9**

**MS Thesis Research**

**MECH.7510 Adv Projects In Mechanical Engineering (Formerly 22.751) - Credits: 1-3**

**MECH.7530 Doctoral Dissertation/Mechanical Engineering (Formerly 22.753) - Credits: 1-3**

**Doctoral Dissertation Research**

**MECH.7560 Doctoral Dissertation/Mechanical Engineering (Formerly 22.756) - Credits: 6**

**Doctoral Dissertation Research**

**MECH.7590 Doctoral Dissertation/Mechanical Engineering (Formerly 22.759) - Credits: 9**

Masters and doctoral students who have attained the required number of thesis credits may enroll in:

**MECH.7610 Continued Grad Research (Formerly 22.761) - Credits: 1**
Continued Grad Research

**MECH.7630** Continued Graduate Research (Formerly 22.763) - Credits: 3

Continuing Graduate Research

**MECH.7660** Continued Graduate Research (Formerly 22.766) - Credits: 6

Continuing Graduate Research

**MECH.7690** Continued Graduate Research (Formerly 22.769) - Credits: 9

Continuing Graduate Research

**MECH.7710** Systems Analysis I (Formerly 22.771) - Credits: 3

Study of the key areas in multiple engineering disciplines including Mechanical, Electrical, Software, Systems and Optical. Students are introduced to weekly topics and then work in multidiscipline teams to solve technical assignments. Topics covered include: Concept of Operations and Requirements development, integration, test and verification, vibration/shock analysis, thermal analysis, power supply design, digital electronics &FPGA, intro to optical engineering, SCRUM planning, continuous integration and UML/SW design. Content may vary year to year. This course is part of the Engineering Leadership Development Program (ELDP) and team taught by industry experts at BAE Systems.

**MECH.7720** Systems Analysis II (Formerly 22.772) - Credits: 3

Introduction and analysis of complex systems aligned with the key product lines of BAE Systems. Students are introduced to multiple types of systems and then work in multidiscipline teams to solve technical assignments. The systems covered include but are limited to: Electronic Warfare (EW), Communications Electronic Attack (Comms EA), Wide Area Airborne Surveillance (WAAS), Signal Intelligence (SIGINT), RADAR Navigation, Radio Communications, and Infrared Countermeasures (IRCM). Content may vary year to year. This course is part of the Engineering Leadership Development Program (ELDP) and team taught by industry experts at BAE Systems.

**MECH.7730** Systems Analysis III (Formerly 22.773) - Credits: 3

Study of project management concepts, product development methods, transition to operations and new business capture. Topics covered include but are not limited to risks and opportunities management, earned value management, lean product development, business strategy, design for manufacturability/maintainability (DFM$^2$), and request for information (RFI) response. Content may vary year to year. This course is part of the Engineering Leadership Development Program (ELDP) and team taught by industry experts at BAE Systems.
Plastics Engineering

Department of Plastics Engineering

The UMass Lowell Department of Plastics Engineering offers the following Graduate Programs:

- **Doctor of Philosophy (Ph.D.)** Plastics Engineering Option
- **Doctor Engineering (D.Eng.)** Plastics Engineering Option
- **Polymer Science/Plastics Engineering Option** ([http://www.uml.edu/Catalog/Graduate/Sciences/Chemistry/Doctoral-Program.aspx](http://www.uml.edu/Catalog/Graduate/Sciences/Chemistry/Doctoral-Program.aspx)) (This joint program is offered through the Chemistry Department. It is a good fit for students interested in polymer synthesis and polymer characterization.)
- **Master of Science in Engineering (M.S.E.)**
- **Bachelor's-Master's (BS/MS) Program**

Co-op Option in Engineering

The Department of Plastics Engineering participates in the Graduate Master's Co-op Option in Engineering. For detailed information about the Co-op Program and curriculum requirements, please see the [Graduate Catalog Engineering Co-op page](https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).

About the Plastics Engineering Department

The Plastics Engineering Department at UMass Lowell is an internationally recognized leader in plastics engineering research and education. Founded in 1954 as the first of its kind, it continues to offer the only accredited Plastics Engineering program in the U.S. Over 3,000 graduates are working in leadership positions the plastics industry worldwide. The department offers a number of degree programs in Plastics Engineering, ranging from a Bachelor of Science (B.S.) to a Doctor of Philosophy (Ph.D.), as well as a number of other options, in order to fit a wide variety of career goals.

The department is staffed by 20 full-time faculty who conduct research in areas as diverse as nanomanufacturing and green polymeric materials. Close faculty connections to industry ensure that students develop an understanding of current issues in the field, while working relationships with other departments emphasize the increasingly interdisciplinary nature of modern scientific research. The Plastics Engineering Department at UMass Lowell maintains 20,000 square feet of dedicated laboratory space where students have an opportunity to work with and conduct research using the latest manufacturing, design, materials formulation and testing technologies.

The Plastics Engineering Department at UMass Lowell - over 50 years of academic and research excellence!

Master's Program - Thesis and Non-thesis Options

**Master of Science in Engineering Degree Programs (MS Eng)**

The Department of Plastics Engineering has recently restructured its MSE Degree Program. Plastics Engineering MSE graduate students accepted into the program beginning in the Fall of 2005 must follow either the "Thesis Option" Curriculum or the "Non-thesis Option" Curriculum described in the following sections.

Graduate students enrolled in the Thesis Option MSE Program prior to the Fall of 2005 may elect to follow either the new "thesis" or "non-thesis" program requirements described below, or those in effect at the time they were accepted into the degree program. Most MSE Plastics Engineering students opt for the 30 credit hour thesis option MSE degree program. The 33 credit hour non-thesis MSE degree program is intended for part-time graduate students working full-time jobs as practicing engineers.

**Thesis Option**

- Admission Requirements and Prerequisites
- Graduate Student Advising

**Non-thesis Option**

- Admission Requirements and Prerequisites
- Graduate Student Advising

Co-op Option in Engineering

The Department of Plastics Engineering participates in the Graduate Master's Co-op Option in Engineering. For detailed information about the Co-op Program and curriculum requirements, please see the [Graduate Catalog Engineering Co-op page](https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf).

**Thesis Option**

**Non-thesis Option**
This graduate program offers professional training at the master’s level designed to provide the opportunity for the study of more advanced theory and practice in plastics materials, design and processing. The department also offers graduate training in the areas of rubber and elastomer technology and medical plastics. The graduate programs are also designed to broaden the background of experienced members of the profession to help them keep up with the latest fundamental developments in these fields.

The Department of Plastics Engineering offers a Master of Science in Engineering (M.S.E.) in Plastics Engineering. More than 800 graduate students have received Plastics Engineering degrees since the graduate program was established in 1968. Most M.S.E. Plastics Engineering students opt to enroll in the 30 credit hour research oriented thesis option M.S.E. program. A smaller percentage elect to enroll in the 33 credit hour non-thesis M.S.E. option. Students who have enrolled in the thesis option Plastics Engineering M.S.E. program must complete at least 24 course credits and 6 thesis credits as outlined in the program requirements section below. Students may transfer as many as 12 science or engineering graduate course credits from other universities or from courses completed when in non-degree status at UMass Lowell provided they are approved by the Plastics Engineering Department’s M.S.E. program coordinators. (For University regulations regarding transfer credit and other regulations, see Graduate Polices in the on-line catalog.) The thesis option M.S.E. degree will be awarded upon the satisfactory completion of 30 credit hours of study as outlined below.

Graduate students enrolled in the Thesis Option M.S.E. Program prior to the Fall of 2005 may elect to follow the either the new program requirements (thesis or non-thesis program) described below, or those in effect at the time they were accepted into the degree program. The new thesis option M.S.E. program requirements are:

**Requirement 1** Complete the cluster of "core course" requirements as described in the detailed program description that follows.

The following courses (9 credit hours) are required for all students.

- PLAS.5440 Advanced Plastics Materials 3 credits
- PLAS.5780 Advanced Plastics Processing 3 credits
- PLAS.xxxx Current Topics Plastics Seminars (1) 1 credit
- PLAS.5740 Physical Properties Laboratory 1 credit
- PLAS.5720 Plastics Processing Laboratory 1 credit

Total 9 credits

Special notes for students having a Plastics Engineering B.S. Degree:

Students who have a B.S. Degree in Plastics Engineering from UMass Lowell are not required to take the Physical Properties Lab (PLAS.5740) and Plastics Processing Lab (PLAS.5720). However, these students must still meet the 24 course credit hour program requirement by substituting other Plastics Engineering Graduate Courses.

Students who have a B.S. Degree in Plastics Engineering from UMass Lowell or an equivalent program may elect to test out of Advanced Plastics Materials (PLAS.5440) and Advanced Plastics Processing (PLAS.5780). However, these students must still meet the 24 course credit hour program requirement by substituting other Plastics Engineering Graduate Courses.

**Requirement 2** Complete the course requirements for one or more of the department’s graduate “Certificates” as an "area of specialization.” Some of the certificate course requirements may also be core requirements. The course requirements for each graduate certificate are also outlined below.

[Note: The Graduate Certificate in Plastics Engineering Fundamentals does not satisfy Requirement 2 for the thesis option M.S.E. Plastics Engineering Program.]

(a.) Graduate Certificate in "Plastics Design"

**Required Courses:**

- PLAS.5030 Mechanical Behavior of Polymers
- PLAS.5180 Plastics Product Design

**Elective Courses (any two of the following):**

- PLAS.5060 Polymer Structure, Properties, and Applications
- PLAS.5230 Screw Design Principles
- PLAS.5410 Computer Applications in Plastics
- PLAS.5490 Design with Elastomers
- PLAS.5510 Computer Aided Extrusion Die Design
- PLAS.5520 Design of Polymer Processing Machinery
- PLAS.5760 Advanced Mold Design
- PLAS.5850 Computer Aided Engineering and Design I
- PLAS.5860 Computer Aided Engineering and Design II

(b.) Graduate Certificate in "Plastics Materials"

**Required Courses:**

- PLAS.5440 Advanced Plastics Materials
- PLAS.5060 Polymer Structure, Properties, and Applications
Elective Courses (any two of the following):

- PLAS.5050 Polymer Structure II
- PLAS.5110 Polymer Blends and Multiphase Systems
- PLAS.5120 Porous Polymers
- PLAS.5130 New Plastics Materials
- PLAS.5400 Commercial Development of Polymeric Systems
- PLAS.5530 Medical Device Design I
- PLAS.5590 Elements of Packaging
- PLAS.5650 Engineering Thermosetting Resins
- PLAS.5660 Polymeric Material Systems Selection
- PLAS.5800 Polymer Science I
- PLAS.5960 Plastics, Elastomers and Additives from Renewable Resources

(c.) Graduate Certificate in "Plastics Processing"

Required Courses:

- PLAS.5780 Advanced Plastics Process Engineering
- PLAS.5090 Plastics Processing Theory I

Elective Courses (any two of the following):

- PLAS.5060 Polymer Structure, Properties, and Applications
- PLAS.5100 Plastics Processing Theory II
- PLAS.5180 Plastics Product Design
- PLAS.5210 Lean Plastics Manufacturing
- PLAS.5230 Screw Design Principles
- PLAS.5240 Process Analysis, Instrumentation, and Control
- PLAS.5260 Nanoscale Plastics Processing
- PLAS.5500 Processing with Elastomers
- PLAS.5510 Computer Aided Extrusion Die Design
- PLAS.5520 Design of Polymer Processing Machinery
- PLAS.5850 Computer Aided Engineering and Design I
- PLAS.5880 Injection Molding

(d.) Graduate Certificate in "Medical Plastics Design and Manufacturing"

Required Courses:

- PLAS.5530 Medical Device Design I
- PLAS.5750 Biomaterials

Elective Courses (any two of the following):

- PLAS.5540 Medical Device Design II
- PLAS.5790 Problems in Biomaterials - Directed Study
- PLAS.6020 Medical Device Development Regulation
- PLAS.6750 Biomaterials II
- CHEN.5550 Biopharmaceutical GMP and Licensing *
  * Offered by the Chemical Engineering Department
- BMBT.5000 Introduction to Biomedical Engineering &Biotechnology **
  ** Offered by the Biomedical Engineering Department

(e.) Graduate Certificate in "Elastomeric Materials"

Required Courses:

- PLAS.5350 Rubber Technology
- PLAS.5950 Thermoplastic Elastomers

Elective Courses (any two of the following):

- PLAS.5490 Design with Elastomers
- PLAS.5500 Processing with Elastomers
- PLAS.5060 Polymer Structure, Properties, and Applications
- PLAS.5960 Plastics, Elastomers and Additives from Renewable Resources

Requirement 3 Complete the requirements for an additional number of Elective Plastics Engineering Graduate Courses such that the "total" course credit hours is at least 24 credit hours (not counting thesis credits).

Core Courses + Non-Core Certificate Courses + Electives Courses = 24 Credits.

Up to two elective courses from other engineering departments may be substituted for Plastics Engineering courses if approved by the graduate coordinator.

Requirement 4 Complete the mandatory 6 Credit Hour Thesis requirement. The thesis research is conducted under the supervision of a three member advisory committee (see "Thesis Committee" below). Upon completion of the thesis research work, the student must prepare the written thesis manuscript and defend the work in an oral presentation such that all three committee members approve of the work.
Thesis Committee

As soon as a student has chosen an area of research, a Thesis Committee is selected by the student and his or her research advisor in accordance with the policy of the department. The Thesis Committee shall consist of at least three members, at least two of whom shall be from the student's major department. One member of the committee shall be the student’s thesis advisor. An outside expert, such as the supervisor of a research project conducted at an industrial setting or a faculty member from another institution, may be a member of the committee, but that individual must possess academic credentials which would qualify him or her to serve as a member of the University of Massachusetts Lowell faculty.

24 Course Credit Hours + 6 Thesis Credits = 30 Credit Hours Total

(Requirements 1, 2, 3) (Requirement 4)

The M.S.E. degree, and the appropriate Graduate Certificate (the area of specialization), will be awarded upon satisfactory completion of 30 credit hours of study as outlined. More detailed descriptions of the "Thesis Option" requirements are given below.

Admission Requirements and Prerequisites:

Admission to the program is open to candidates with a B.S. in Plastics Engineering or a related engineering or science field. The pre-requisite math requirements include Calculus II and Differential Equations. Applicants must also take the Graduate Record Examination (GRE), provide three Letters of Reference, an Official Transcript, and a Statement of Purpose as per the UMass Lowell Graduate Admissions Policy. You can apply online at www.uml.edu/grad. (https://www.uml.edu/Grad/default.aspx)

The foundation "Plastics" courses required in previous years are no longer required. Students who have taken these foundation graduate courses in the past can receive some graduate course credit for these courses as outlined above.

The Plastics Engineering Department makes every attempt to offer as many of these courses as possible during the evening so that students having full time jobs can complete the degree program. A listing of evening graduate courses for the next few semesters is given on http://plastics.uml.edu. (https://www.uml.edu/Engineering/Plastics/default.aspx)

Non-matriculated students (with an appropriate B.S. Degree) may begin taking courses without application to the M.S.E. Plastics Engineering Program. However, it is recommended that students apply to the M.S.E. Program as soon as possible (i.e. prior to taking too many course credits) since there is no guarantee of acceptance into the M.S.E. Program. In addition, no more than 12 credit hours taken as a non-matriculated student can be transferred into the M.S.E. Program upon acceptance.

Graduate Student Advising:

One of the graduate coordinators will be the academic advisor for students enrolled in the non-thesis M.S.E. Plastics Engineering Degree Program. The advisor will help the student remedy deficiencies in prerequisites, select electives of most value, and plan the overall study program efficiently. The thesis advisor will be the chairperson of the thesis advisory committee that will guide the student in the thesis research and supervise the completion of the thesis requirement. Once an advisor is selected, the student and advisor should complete the Departmental Advising Form, indicating the thesis topic. Both the student and advisor must sign this form before the student can register for thesis credits. This form is available in the Plastics Engineering Department Office (B204) and should be submitted to the graduate program coordinator.

Non-thesis Option

This graduate program offers professional training at the master's level designed to provide the opportunity for the study of more advanced theory and practice in plastics materials, design and processing. The department also offers graduate training in the areas of rubber and elastomer technology and medical plastics. The graduate programs are also designed to broaden the background of experienced members of the profession to help them keep up with the latest fundamental developments in these fields.

The Department of Plastics Engineering offers a Master of Science in Engineering (M.S.E.) in Plastics Engineering. Most M.S.E. Plastics Engineering students enroll in the thesis option program. However, some students, especially those students working full time days elect to enroll in the non-thesis M.S.E. option. This option was established in the Fall of 2004. Students enrolled in the non-thesis M.S. Plastics Engineering option must complete a total of 33 course credits as outlined in the course requirements section below. Students may transfer as many as 12 science or engineering graduate course credits from other universities or from courses completed when in non-degree status at UMass Lowell provided they are approved by the Plastics Engineering Department’s M.S.E. program coordinators. (For University regulations regarding transfer credit and other regulations, see the Graduate Policies in the online catalog.) The non-thesis option M.S.E. degree will be awarded upon the satisfactory completion of 33 credit hours of study as outlined. More detailed descriptions of the "Non-thesis Option" requirements are given below.

Requirement 1 Complete the "core course" requirements listed below.

The following courses (18 credit hours) are required for all students.
PLAS.5030 - Mechanical Behavior of Polymers 3 credits
PLAS.5440 - Advanced Plastics Materials 3 credits
PLAS.5780 - Advanced Plastics Processing 3 credits
PLAS.5060 - Polymer Structure Properties and Applications 3 credits
PLAS.5180 - Plastics Product Design 3 credits
PLAS.xxxx - Current Topics Plastics Seminars (Materials, Design, etc.) 1 credit
PLAS.5740 - Physical Properties Laboratory 1 credit
PLAS.5720 - Plastics Processing Laboratory 1 credit
Total 18 credits

Special notes for students having a Plastics Engineering B.S. Degree:

Students who have a B.S. Degree in Plastics Engineering from UMass Lowell are not required to take the Physical Properties Lab (PLAS.5740) and Plastics Processing Lab (PLAS.5720). However, these students must still meet the 33 credit hour program requirement by substituting other Plastics Engineering Graduate Courses.

Students who have a B.S. Degree in Plastics Engineering from UMass Lowell or an equivalent program may elect to test out of Advanced Plastics Materials (PLAS.5440) and Advanced Plastics Processing (PLAS.5780). However, these students must still meet the 33 credit hour program requirement by substituting other Plastics Engineering Graduate Courses.

Requirement 2: Complete the course requirements for one or more of the department's graduate "Certificates". Some of the certificate course requirements may also be core requirements. The course requirements for each graduate certificate are also outlined below.

Note: The Graduate Certificate in "Plastics Engineering Fundamentals" does not satisfy Requirement 2 for the thesis option M.S.E. Plastics Engineering Program. However, all courses of the Certificate transfer into the M.S. Plastics Engineering program should students wish to continue their education.

The Plastics Engineering Department offers the following graduate certificates:

(a.) Plastics Design
(b.) Plastics Materials
(c.) Plastics Processing
(d.) Medical Plastics Design and Manufacturing
(f.) Commercial Development for Plastics Engineering

(g.) Sustainable Polymeric Materials and Additives

Requirement 3: Complete the requirements for an additional number of elective plastics graduate courses such that the "total" credit hours (Core Courses + Certificate + Electives) is 33 credits. Up to two elective courses from other engineering departments may be substituted if approved by the graduate coordinator.

The M.S.E. degree, and the appropriate Graduate Certificate (the area of specialization), will be awarded upon satisfactory completion of 33 credit hours of study as specified above. This non-thesis M.S.E. degree is an alternative to the more traditional 30 credit thesis option M.S.E. degree.

Admission Requirements and Prerequisites:

Admission to the program is open to candidates with a B.S. in Plastics Engineering or a related engineering or science field. The pre-requisite math requirements include Calculus II and Differential Equations. Applicants must also take the Graduate Record Examination (GRE), provide three Letters of Reference, an Official Transcript, and a Statement of Purpose as per the UMass Lowell Graduate Admissions Policy. The GRE Requirement is waived for any student who has completed any one of the Plastics Engineering Graduate Certificates and have maintained a 3.5 GPA for this Certificate. You can apply online at www.uml.edu/grad.

The foundation "Plastics" courses required in previous years are no longer required. Students who have taken these foundation graduate courses in the past can receive some graduate course credit for these courses as outlined above.

The Plastics Engineering Department makes every attempt to offer as many of these courses as possible during the evening so that students having full time jobs can complete the degree program. Return to the home page for a listing of evening graduate courses for the next few semesters.

Non-matriculated students (with an appropriate B.S. Degree) may begin taking courses without application to the M.S.E. Plastics Engineering Program. However, it is recommended that students apply to the M.S.E. Program as soon as possible (i.e. prior to taking too many course credits) since there is no guarantee of acceptance into the M.S.E. Program. In addition, no more than 12 credit hours taken as a non-matriculated student can be transferred into the M.S.E. Program upon acceptance.

Graduate Student Advising:

One of the graduate coordinators will be the academic advisor for students enrolled in the non-thesis M.S.E. Plastics Engineering Degree Program. The advisor will help the student remedy deficiencies in prerequisites, select electives of most value, and plan the overall study program efficiently.
Full Time vs. Part Time Status

Both the Thesis and Non-thesis Option M.S.E. Plastics Engineering Programs are open to full time and part time students. Many of the courses required for these programs are offered at night so that engineers working at local companies can take advantage of the programs. Students taking fewer than 9 credits in a semester are considered part time, while those taking 9 or more credits are considered full time students. Graduate students must maintain full time student status in order to be eligible for teaching assistant (T.A.) or research assistant positions (R.A.).

Funding Policy - Plastics Engineering Graduate Students

Teaching Assistant Positions:

The Department of Plastics Engineering has a limited number of "Teaching Assistant Positions" (T.A.) and "Research Assistant" Positions (R.A.) available for full time Masters and Doctoral Plastics Engineering Graduate Students. Only those students who have applied and have been accepted into the respective programs will be considered for such a position.

Most of the T.A. positions awarded by the department are "half" T.A. positions which provide a 9 credit tuition waiver and 9 credit fee waiver for in-state students, along with a stipend. Out-of-state students receive the 9 credit tuition waiver, a fee reduction and a stipend. A departmental committee selects the T.A.’s during the spring semester for the following September. It is recommended that interested candidates should visit the campus and meet with a Graduate Coordinator prior to June 1. T.A. applications are available in Ball 204 or at http://plastics.uml.edu. (https://www.uml.edu/Engineering/Plastics/default.aspx)

Research Assistant Positions:

Unlike T.A. positions that are awarded by the Plastics Engineering Department, R.A. positions, either "full time" or "half time", are awarded by individual faculty who conduct funded research. Accepted students must correspond with the individual faculty to inquire about R.A. positions. Faculty research interests are listed in the Faculty section of the department web site. It is recommended that applicants interested in obtaining R.A. funding should send a letter and resume to those faculty having similar research interests.

Many of the full time graduate students enrolled in the Department of Plastics Engineering do not receive T.A. or R.A. funding, especially during their first year of study. Many students are able to arrange funding during their second year after completing much of their coursework and after having time to interact with the various faculty members; however, there is no guarantee of funding.

- Bachelor’s-Master’s Program

Doctoral Programs

Doctoral Programs in Plastics Engineering

The UMass Lowell Department of Plastics Engineering offers two doctoral degree options:

- **Doctor of Engineering (D.Eng.)** Plastics Engineering Option
- **Doctor of Philosophy (Ph.D.)** Plastics Engineering Option

In addition the Plastics Engineering Department has a joint program with the Chemistry Department. It offers a joint Polymer Science/Plastics Engineering Ph.D. degree. The degree is awarded by the Chemistry Department, not the Department of Plastics Engineering. This degree option is a good fit for students interested in polymer synthesis and polymer characterization.

Plastics Engineering Doctoral Programs

The two Doctoral Plastics Engineering programs have equivalent admission requirements and differ primarily in their course requirements.

Ph.D. in Engineering, Plastics Engineering Option

The Ph.D. degree program is designed to produce qualified professionals for technical and research positions in the plastics industry, for technical positions in government, and for teaching careers in colleges and universities. This degree is awarded by the College of Engineering. The goal of the Ph.D. program is to develop decision-making engineers with sound theoretical and technical research knowledge in the areas of plastics materials, design, and processing research and development.

The Doctor of Engineering in Plastics Engineering

The D.Eng. Plastics Engineering degree program is designed to produce qualified professionals for technical and management positions in the plastics industry, as well as for technical or administrative positions in government and for teaching careers in colleges and universities. The goal of the Doctor of Engineering program is to develop decision-making engineers with sound theoretical and technical research knowledge who are design and development oriented and who also have a firm background in engineering management. This degree has a management component that is not required for the Ph.D., with fewer technical courses. This interdisciplinary program encompasses study in materials, design, processing, mathematics, computer science, and management.

Admission Requirements

Graduates with a B.S. in Engineering (e.g. Plastics, Mechanical, Chemical, Materials...) and high academic standing may apply
for admission to either of the doctoral programs. Technical graduates who do not have a B.S. in “Engineering” but have a science degree may request admission to the program with the understanding that they will also be required to take and pass the “Fundamentals of Engineering Exam” given by the National Council of Examiners for Engineering and Surveying. Admission to the program will be based on review by the Graduate Admissions Office and by the Admissions Committee of the Plastics Engineering Department.

**Plan of the Doctoral Programs**

Each student entering the program must develop a plan of study in consultation with his or her advisory committee. After taking at least one year of graduate courses, the student will take a qualifying examination covering all the basic elements of plastics engineering. A student who performs well on this examination will be reviewed by the Admissions Committee of the Plastics Engineering Department and admitted to degree candidacy. He or she will then complete the remaining course work, seminars and labs, do a research proposal, conduct research and prepare a written dissertation, and present an oral defense of the research before the dissertation committee.

**Qualifying Examination**

The qualifying examination for both doctoral programs will be administered in September (and in January if there is sufficient demand for a second exam). It will be administered as two (2) four hour long examinations, covering the following topics: plastics processing, plastics design, plastics properties, and plastics materials with a total of four questions in each subject area for a total of 16 questions. One of the two exams is open book and one is closed book. In order to pass the exams, students must pass at least two of the four questions in each subject area, and pass at least eleven questions. Any changes to the format will be indicated by the doctoral coordinator when the specific examination date is announced. The student will receive an overall exam grade of pass or fail based on the stated criteria. A student who fails the exam on a marginal basis may make a second attempt the next time the exam is administered. All decisions of the Plastics Engineering Department regarding passing of the qualifying exam are final.

**Dissertation Proposal**

Once the student has passed the qualifying exam, he or she will submit a dissertation proposal and defend the proposal before the Doctoral Committee. Upon approval, the student’s name will be submitted to the College Doctoral Committee and the Registrar’s Office as a candidate for the Doctor of Engineering or the Doctor of Philosophy degree.

**Transfer Credit**

Up to 24 credits in graduate engineering courses are transferable to either the Doctor of Engineering or Doctor of Philosophy programs upon approval by the department’s Doctoral Committee.

**Course Requirements for the D.Eng. Plastics Engineering Degree**

The following courses are required for the D.Eng. degree:

- PLAS.5440 Advanced Plastics Materials (3 credits)
- PLAS.5780 Advanced Plastics Processing (3 credits)
- PLAS.5740 Physical Properties Laboratory (1 credit)
- PLAS.5720 Plastics Processing Laboratory (1 credit)
- PLAS.5030 Mechanical Behavior of Polymers (3 credits)
- PLAS.5060 Polymer Structure, Properties and Applications (3 credits)
- PLAS.5090 Plastics Processing Theory I (3 credits)
- PLAS.5180 Plastics Product Design (3 credits)
- PLAS.5480 Numerical and Analytical Methods (3 credits)
- PLAS.5850 Computer Aided Engineering and Design (3 credits)
- PLAS.XXXX Current Topics Plastics Seminar (1 credit)
- PLAS.XXXX Engineering Elective (3 credits)
- PLAS.XXXX Engineering Elective (3 credits)
- Engineering Management Courses (9 credits)
- Doctoral Research Dissertation (21 credits)

**TOTAL: 63 credits**

**Engineering Management Courses for the D.Eng. Program**

Doctor of Engineering students are required to take 9 credits of graduate engineering management courses from the College of Management or from the list of courses immediately below offered within the College of Engineering.

- PLAS.5070 Plastics Industry Organization (3 credits)
- PLAS.5160 Six Sigma (3 credits)
- PLAS.5210 Lean Plastics Manufacturing (3 credits)
- PLAS.5370 Business Law for Engineers (3 credits)
- PLAS.5400 Commercial Development of Polymeric Systems (3 credits)
- PLAS.5900 Survey of Intellectual Property (3 credits)
- MECH.5760 Engineering Project Management (3 credits)

Approved management graduate courses from the College of Management for D.Eng. students. These courses run for a duration of 8 weeks.
Course Requirements for the Ph.D. in Engineering, Plastics Engineering Option

(A) Students with a B.S. Plastics Engineering degree from UMass Lowell will be required to take a placement test on the following subjects:

- PLAS.5440 Advanced Plastics Materials
- PLAS.5780 Advanced Plastics Processing

If they failed in the test or do not take the test, they will be required to take these courses and can be counted as electives. Students whose UMass Lowell undergraduate GPA is higher than 3.0 can waive the above two courses.

In addition the following courses are required for the Ph.D. degree:

- PLAS.6420 Characterization of polymers and plastics (3 credits)
- PLAS.6820 Physical Polymer Science (3 credits)
- PLAS.6780 New Development in Polymer Manufacturing (3 credits)
- PLAS.6180 Structure Product Design (3 credits)
- PLAS.5090 Plastics Processing Theory I (3 credits)
- PLAS.5480 Numerical and Analytical Methods (3 credits)
- PLAS.5780 Advanced Plastics Processing
- PLAS.XXXX Current Topics Plastics Seminar (1 credit)
- PLAS.XXXX Engineering Elective (8 - 20 credits)
- Doctoral Research Dissertation (21 - 33 credits)

TOTAL: 63 credits

(B) The following courses are required for a Ph.D. degree for students with a M.S. Plastics Engineering Degree from UMass Lowell:

- PLAS.5030 Mechanical Behavior of Polymers
- PLAS.5060 Polymer Structure, Properties and Applications
- PLAS.5180 Plastics Product Design
- PLAS.5780 Advanced Plastics Processing
- PLAS.5440 Advanced Plastics Materials

If the failed in the test or do not take the test, they will be required to take these courses and can be counted as electives.

In addition, the following courses are required for the Ph.D. degree:

- PLAS.6420 Characterization of polymers and plastics (3 credits)
- PLAS.6820 Physical Polymer Science (3 credits)
- PLAS.6780 New Development in Polymer Manufacturing (3 credits)
- PLAS.6180 Structure Product Design (3 credits)
- PLAS.5090 Plastics Processing Theory I (3 credits)
- PLAS.5480 Numerical and Analytical Methods (3 credits)
- PLAS.5850/PLAS.5760 Computer Aided Engineering or Advanced Mold Design (3 credits)

TOTAL: 63 credits

(C) Students with B.S. degree in engineering or other disciplines from UML or other schools will be required to take a placement test on the following subjects:

- PLAS.5030 Mechanical Behavior of Polymers
- PLAS.5060 Polymer Structure, Properties and Applications
- PLAS.5180 Plastics Product Design
- PLAS.5780 Advanced Plastics Processing
- PLAS.5440 Advanced Plastics Materials

If the failed in the test or do not take the test, they will be required to take these courses and can be counted as electives.

In addition, the following courses are required for the Ph.D. degree:

- PLAS.6420 Characterization of polymers and plastics (3 credits)
- PLAS.6820 Physical Polymer Science (3 credits)
- PLAS.6780 New Development in Polymer Manufacturing (3 credits)
- PLAS.6180 Structure Product Design (3 credits)
- PLAS.5090 Plastics Processing Theory I (3 credits)
- PLAS.5480 Numerical and Analytical Methods (3 credits)
- PLAS.5850/PLAS.5760 Computer Aided Engineering or Advanced Mold Design (3 credits)
• PLAS.5720 Plastics Processing Laboratory (1 credit)
• PLAS.5740 Physical Property Laboratory (1 credit)
• PLAS.xxxx Current Topics Plastics Seminar (1 credit)
• PLAS.xxxx Engineering Elective (9 - 18 credits)
• Doctoral Research Dissertation (21 - 33 credits)

TOTAL: 63 credits

**Ph.D. Polymer Science/Plastics Engineering Option**

A doctoral program in Chemistry with an option in Polymer Science/Plastics Engineering is offered jointly with the Polymer Science group in the Department of Chemistry. This program is designed to provide the student with a background in advanced course work and laboratory techniques which will prepare him or her to carry out, under the guidance of experienced scientists, an original, independent investigation leading to an acceptable contribution to the body of contemporary knowledge. Further details of the program are described in the Chemistry section of this catalog.

**Certificate Programs**

**Graduate Certificates in Plastics Engineering**

The UMass Lowell Department of Plastics Engineering offers eight graduate certificates in a wide variety of topics.

- Commercial Development for Plastics Engineers
- Medical Plastics Design and Manufacturing
- Plastics Design
- Plastics Engineering Fundamentals
- Plastics Materials
- Plastics Processing

**About Graduate Certificates**

All Plastics Engineering graduate certificates are comprised of four courses (12 graduate credits) designed to provide specific knowledge and expertise vital to today’s changing and complex needs in the workplace. In all cases courses may be applied toward a degree program provided they meet transfer credit requirements.

Note: Courses used as credit towards one Plastics Engineering Certificate may not count towards another Plastics Engineering Certificate.

**Requirements to Complete a Graduate Certificate**

The four courses must be completed within a five year period with a minimum 3.0 grade point average, and with no more than 3 credits below a B. Courses completed for one certificate may not be used for another certificate, but can be used for the graduate degrees.

**Certificate Application Process**

Individuals must complete a simplified application, provide an official undergraduate transcript indicating that a baccalaureate degree has been awarded, and submit a nominal application fee. GRE is are not required.

**Download Graduate Certificate Application Form (pdf)**

You will need Adobe Acrobat Reader to view any pdf files. It can be downloaded for free from the Adobe website.

**For more information visit the Plastics Engineering Department website**

**Department of Plastics Engineering**

**Contact:**

Bridgette M. Budhlall, Ph.D.

Email: bridgette_budhlall@uml.edu

Phone#: 978-934-3414

Admission to this 12 credit program is open to candidates with a B.S. in Engineering or a related field.

Courses previously used for another Plastics Engineering Certificate may not be used for a second Plastics Engineering certificate. Students who wish to continue with their education may apply all of these courses to any one of the Plastics Engineering Graduate M.S. Degree Programs or our D.Eng. Degree Program.

**Required Courses (Six credits):**

- PLAS.5140 Statistics for Six Sigma
- PLAS.5370 Business Law for Engineers

**Elective Courses** (any two of the following courses - total of six credits):

- PLAS.5150 Lean Plastics Manufacturing
- PLAS.5400 Commercial Development of Polymeric
Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information (https://www.uml.edu/gainful-employment/Commercial%20Development%20for%20Plastics%20Engineers%20-%2014.3201-Gedt.html).

Medical Plastics Design and Manufacturing
Department of Plastics Engineering

Contact:
Bridgette M. Budhlall, Ph.D.
Email: bridgette_budhlall@uml.edu
Phone#: 978-934-3414

The use of plastics in medical products and medical devices is rapidly increasing. The Plastics Engineering Department at UMass Lowell is continuing its leadership role in Plastics Engineering Education by responding to industry’s need for Medical Plastics training. This 12 credit program will provide knowledge needed for the development of new "engineering intensive" medical products which combine complex material compositions, designs, and manufacturing processes. The certificate program is intended for medical professionals, engineers and technologists working in the medical products industry.

Required Courses (Six credits):
- PLAS.5530 Medical Device Design I
- PLAS.5750 Biomaterials

Elective Courses (choose two - total of six credits):
- PLAS.5540 Medical Device Design II
- PLAS.5790 Problems in Biomaterials (Directed Study)
- PLAS.6750 Biomaterials II
- CHEN.5550 Biopharmaceutical GMP and Licensing (Offered by the Chemical Engineering Department)
- BMBT.5000 Introduction to Biomedical Engineering & Biotechnology (Offered by the Biomedical Engineering program)
- PLAS.5030 Mechanical Behavior of Polymers
- PLAS.5180 Plastics Product Design
- PLAS.6020 Medical Device Development and Regulation

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Medical%20Plastics%20Design%20and%20Manufacturing%20-%2015.0607-Gedt.html)

Plastics Design
Plastics Engineering Department

Contact:
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Email: bridgette_budhlall@uml.edu
Phone#: 978-934-3414

The certificate program is designed for students who have attained a bachelor’s degree and need more plastics design background. The Plastics Engineering Department makes every attempt to offer many of these courses during the evening to accommodate the schedules of working professionals. Graduates who have already completed these course requirements can receive a retroactive certificate.

Required Courses (Six credits):
- PLAS.5030 Mechanical Behavior of Polymers
- PLAS.5180 Plastics Product Design

Elective Courses (choose two - total of six credits):
- PLAS.5060 Polymer Structure, Properties, and Applications
- PLAS.5410 Computer Applications in Plastics
- PLAS.5490 Design with Elastomers
- PLAS.5510 Computer Aided Extrusion Die Design
- PLAS.5520 Design of Polymer Processing Machinery
- PLAS.5530 Medical Device Design I
- PLAS.5540 Medical Device Design II
Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information (https://www.uml.edu/gainful-employment/PlasticsDesign-20-%20Fundamentals-2014.3201-Gedt.html).

Plastics Materials

Plastics Engineering Department

Contact:

Bridgette M. Budhlall, Ph.D.

Email: bridgette_budhlall@uml.edu

Phone#: 978-934-3414

This 12 credit certificate program is designed for students who have attained a Bachelor’s degree and need more plastics materials background. The Plastics Engineering Department makes every attempt to offer many of these courses during the evening to accommodate the schedules of working professionals. Graduates who have already completed these course requirements can receive a retroactive certificate.

Required Courses (Six credits):

- PLAS.5440 Advanced Plastics Materials
- PLAS.5060 Polymer Structure, Properties, and Applications

Elective Courses (choose two - total of six credits):

- PLAS.5030 Mechanical Behavior of Polymers
- PLAS.5130 New Plastics Materials
- PLAS.5320 Adhesives and Adhesion
- PLAS.5330 Coatings Science and Technology
- PLAS.5400 Commercial Development of Polymeric Systems
- PLAS.5350 Rubber Technology
- PLAS.5340 Polymer Blends and Multiphase Systems
- PLAS.5470 Materials for Renewable Energy and Sustainability
- PLAS.5650 Engineering Thermosetting Resins
- PLAS.5660 Polymeric Material Systems Selection
Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Plastics%20Materials%20-%20-%2015.0607-Gedt.html.html)

Plastics Processing

Plastics Engineering Department

Contact:

Bridgette M. Budhlall, Ph.D.

Email: bridgette_budhlall@uml.edu

Phone#: 978-934-3414

This 12-credit certificate program is designed for students who have attained a bachelor's degree and need more plastics processing background. The Plastics Engineering Department makes every attempt to offer many of these courses during the evening to accommodate the schedules of working professionals. Graduates who have already completed these course requirements can receive a retroactive certificate.

Required Courses (Six credits):

- PLAS.5780 Advanced Plastics Process Engineering
- PLAS.5180 Plastics Product Design

Elective Courses (choose two - total of six credits):

- PLAS.5060 Polymer Structure, Properties, and Applications
- PLAS.5090 Plastics Processing Theory I
- PLAS.5150 Lean Plastics Manufacturing
- PLAS.5230 Screw Design Principles
- PLAS.5240 Process Analysis, Instrumentation, and Control
- PLAS.5260 Nanoscale Plastics Processing
- PLAS.5500 Processing with Elastomers
- PLAS.5510 Computer Aided Extrusion Die Design
- PLAS.5520 Design of Polymer Processing Machinery
- PLAS.5850 Computer Aided Engineering and Design I
- PLAS.5880 Injection Molding
- PLAS.6780 New Developments in Polymer Manufacturing.

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Plastics%20Processing%20-%20-%2015.0607-Gedt.html.html)
PLAS.5000 Advanced Project In Plastics I (Formerly 26.500) - Credits: 1
A laboratory course for advanced projects in the areas of plastics materials, design, processing, elastomers, coatings, adhesives, or medical plastics.

PLAS.5010 Advanced Project In Plastics II (Formerly 26.501) - Credits: 3
Continuation of 26.500.

PLAS.5060 Polymer Structure Properties & Applications (Formerly 26.506) - Credits: 3
Relationships between polymer structure (chemical composition, molecular weight and flexibility, intermolecular order and bonding, supramolecular structure) and practical properties (processability, mechanical, acoustic, thermal, electrical, optical, and chemical) and applications.

PLAS.5090 Plastics Processing Theory I (Formerly 26.509) - Credits: 3
Principles of Rheology and continuum mechanics involved in the processing of plastics, and their applications in plastics process engineering including flows in standard geometries and extrusion applications.

PLAS.5100 Plastics Processing Theory II (Formerly 26.510) - Credits: 3
A continuation of Theory I using the transport phenomena approach to analyze and describe plastics conversion processes, including roll processing blown film extrusion, injection molding, and mixing.

PLAS.5110 Polymer Blends (Formerly 26.511) - Credits: 3
Physical, mechanical, and thermal properties, preparation, and testing of polymer blends, alloys, and multiphase systems. Thermodynamic theories and experimental determination of miscibility of polymer blends. Structure property relationships for multiphase systems and interpenetrating networks.

PLAS.5120 Porous Polymers (Formerly 26.512) - Credits: 3
Preparation, structure, and properties of porous polymers. Includes both practical systems in development and production and novel techniques of more fundamental interest and/or aimed at more specialized applications. Existing and potential applications for these materials will also be discussed, and related back to their structure and properties.

PLAS.5130 New Plastics Materials (Formerly 26.513) - Credits: 3
Critical examination of the new plastics appearing in the research literature and being field-tested for commercialization in the plastics industry.

PLAS.5140 Statistics for Six Sigma (Formerly 26.514) - Credits: 3
A review of statistical techniques for Six Sigma with Applications specifically designed for the plastics processing industry. Those completing the course should be at the Six Sigma green belt level or better.

PLAS.5150 Lean Plastics Manufacturing (Formerly 26.515) - Credits: 3
Methods of analysis and operation of plastics manufacturing facilities. Topics include: performance measurement, inventory control, forecasting, production planning, scheduling, resource management, supply chains, various technologies for improved productivity.

PLAS.5180 Plastics Product Design (Formerly 26.518) - Credits: 3
This course reviews the theoretical principles and the engineering practice associated with the development of new plastic products. The course focuses on design practices for products that will be produced by conventional and advanced injection molding processes. Topics include design methodology, plastic materials selection, design for manufacturing, computer aided engineering, mechanical behavior of plastics, structural design of plastic parts, prototyping techniques, experimental stress analysis, and assembly techniques for plastic parts.

PLAS.5220 Advanced Project in Plastics IV (Formerly 26.522) - Credits: 3
PLAS.5240 Process Analysis Instrument and Control (Formerly 26.524) - Credits: 3
PLAS.5250 Synthetic Fibers: Processing-Structure-Properties (Last Term 1997 Fall)(Formerly 26.525) - Credits: 3

An introduction to processing-structure-properties of fibers and its significance to modern advanced materials. This course covers both traditional and emerging fiber spinning methods (ex. solution spinning, melt extrusion, gel-spinning, and electrospinning), post-processing techniques (ex. yarns, weaving), and the resulting multi-scale structures and properties. The unique physical and chemical properties of fibers and its application as past and emerging advanced materials will be discussed.

PLAS.5280 Plastics Information Data Bases (Formerly 26.528) - Credits: 1

Review of procedures for literature searching, databases, etc.

PLAS.5300 Selected Topics (Formerly 26.530) - Credits: 1-3

Topics in various fields of Plastics Engineering. Content may vary from year to year so that students may, by repeated enrollment, acquire a broad knowledge of contemporary Plastics Engineering.

PLAS.5320 Adhesives and Adhesion (Formerly 26.532) - Credits: 3

Adhesive joining of engineering materials. Surface chemistry, theories of adhesion and cohesion, joint design, surface preparation, commercial adhesives, Rheology, equipment, testing, service life, and reliability.

PLAS.5330 Coatings Science and Technology I (Formerly 26.533) - Credits: 3

This course reviews the basic principles of design and formulation of waterborne, high-solids, powder resins used for the development of solvent-less "green" coatings and the use of bio-derived resins, mostly based on soybean oil and other renewable raw materials. The mechanisms and methods of curing and of polymerization for polymers used as coatings will also be covered.

PLAS.5340 Coatings Science and Technology II (Formerly 26.534) - Credits: 3

A continuation of 26.533. This graduate course reviews the basic principles of design and formulation of waterborne, high-solids, powder resins that meet current manufacturing regulations. Rheology of polymer and pigment dispersion, and their application to coatings, inks and adhesives will be included here.

PLAS.5350 Rubber Technology (Formerly 26.535) - Credits: 3

Polymerization and compounding of the commercial elastomers. Properties and test methods. Leading applications and methods of processing.

PLAS.5360 Rheology of Polymers (Formerly 26.536) - Credits: 3

Rheology of polymer melts, solutions, latexes, and pigment dispersions, and their application to coatings and adhesives.

PLAS.5370 Business Law for Engineers (Formerly 26.537) - Credits: 3

Business legal issues engineers encounter in practice, including contractual, products liability, and intellectual property issues. Business torts relating to product design, manufacturing and inadequate warning defects. Unreasonably dangerous products and strict liability.

PLAS.5400 Commercial Development of Plastics (Formerly 26.540) - Credits: 3

The concepts of industrial marketing will be reviewed for research, pricing strategies, and product planning for market segmentation, place (distribution)-promotional activities. Topics will include creating a demand, selling, and servicing base resins and additives.

PLAS.5410 Computer Applications in Plastics (Formerly 26.541) - Credits: 3

Problem solving in plastics engineering has been dramatically influenced by the computer and innovative software packages. This graduate course will focus on the application and development of software packages for engineering analyses of plastics processes. Specially, the course will cover the basic CAD programs, Pro/ENGINEER, SOLIDWORKS, followed by basic Pre-and-Post processor software, FEMAP, meshing program HYPERMESH, FEMLAB multiphysics, and MATHEMATICA.

PLAS.5420 Colloidal Nanoscience and Nanoscale Engineering (Formerly 10.542/26.542) - Credits: 3

This course will cover the fundamentals of nanoscale colloidal processes, intermolecular forces and electrostatic phenomena at
interfaces, boundary tensions and films at interfaces, electrostatic and London forces in disperse systems, interactions and self-assembly of polymer colloids, nanoparticles, surfactants and biomolecules. Applications include microfluidics; lab-on-a-chip; nano-biocolloids, vesicles, colloidosomes, polymersomes and polymer hydrogel microcapsules for drug delivery and nanostructured materials and devices.

PLAS.5440 Advanced Plastics Materials (Formerly 26.544) - Credits: 3

This course reviews the historical developments of polymeric material systems, commodity, engineering, biodegradable, and high performance thermoplastics. Topics include their synthesis, structure, properties, and applications and there is also an overview of typical additives that are used to modify the properties of plastics. Knowledge of general and/or organic chemistry is recommended as a prerequisite for this course.

PLAS.5450 Additives for Polymer Materials (Formerly 26.545) - Credits: 3

Additives incorporated into polymers to modify processing and end-use properties: reinforcements, plasticizers, stabilizers, flame retardants, colorants, biostats, blowing agents, anti-stats, impact modifiers, and processing aids.

PLAS.5470 Materials for Renewable Energy and Sustainability (Formerly 26.547) - Credits: 3

This course reviews the selection and design of materials for use in energy generation and conservation applications. Both traditional and renewable technologies for energy generation are reviewed, and the differences in materials needs for generation, storage and transmission highlighted. Particular emphasis is placed on organic and polymeric materials technological challenges in solar, wind and hydro/geothermal energy and future transportation fuel production. The concept of life cycle assessment is introduced for the optimization of systems from a materials science perspective. The impacts of global economics, ethics and efficiency are also addressed. The course approaches sustainability as an open-ended, complex engineering problem and introduces students to the broad range of career opportunities for materials engineers in renewable energy.

PLAS.5480 Analytical and Numerical Methods in Plastics Processing (Formerly 26.548) - Credits: 3

This course covers the use of analytical and numerical methods related to engineering. Topics include ordinary differential equations, linear second order differential equations, matrices, vectors, linear systems of equations, partial differential equations. Use of numerical methods to differential equations, linear algebra, regression, interpolation, data analysis, and partial differential equations.

PLAS.5490 Product Design for Elastomers (Formerly 26.549) - Credits: 3

This course covers the basics of thermoset and thermoplastic elastomer product design. Topics include mechanical behavior, large deformation structural analysis, design for manufacturability, performance limitations, and end use applications for elastomers and assembly considerations.

PLAS.5500 Processing with Elastomers (Formerly 26.550) - Credits: 3

This course covers the basics of elastomer processing. Topics include mixing, Rheology, extrusion, injection molding, compressing molding, and curing as it applies to elastomers.

PLAS.5510 Extrusion Die Design (Formerly 26.551) - Credits: 3

This is a project-oriented course which utilizes current CAE programs to design extruder dies. This course will study the basic principles of extrusion die design and apply these principles in designing extrusion dies. A review of the extrusion process and the flow behavior of various polymers will be studied.

PLAS.5520 Machine Design (Formerly 26.552) - Credits: 3

Hydraulics, machine logic, drives, pumps, motors, heaters, barrel and screw combinations, mechanical design. Hydraulic and electrical control circuits development. A semester project is required.

PLAS.5530 Medical Device Design I (Formerly 26.553) - Credits: 3

A systematic approach to inventing new medical devices. The course details the process of validating medical needs including market assessment and the evaluation of existing technologies; basics of regulatory (FDA) and reimbursement planning; brainstorming and early prototyping for concept creation. Course format includes expert guest lecturers and interactive practical discussions with faculty. Students will prepare a medical device proposal and presentation.

PLAS.5540 Medical Device Design II (Formerly 26.554) - Credits: 3
This course focuses on how to take a medical device invention forward from early concept to technology translation and implementation planning. Topics include technology research & development; patent strategies; techniques for analyzing intellectual property; advanced planning for reimbursement and FDA approval; choosing translation strategies (licensing vs. start-up); ethical issues including conflict of interest; fundraising approaches and cash requirements; essentials of writing a business or research plan; strategies for assembling a development team. Students will prepare a final medical device proposal and presentation.

PLAS.5630 Current Topics in Plastics Materials I  
(Formerly 26.563) - Credits: 1

Individual research and presentation in the field of plastics materials.

PLAS.5640 Current Topics in Plastics Materials II  
(Formerly 26.564) - Credits: 1

Individual research and presentation in the field of plastics materials.

PLAS.5650 Thermosets  (Formerly 26.565) - Credits: 3

Provides an in-depth review of the major families of engineering thermosetting resins: phenolics, aminos, polyesters, epoxies, silicones, and various polyurethanes systems. Emphasis is on the basic chemistry, inherent physical properties and processability, and the effect of polymer modifiers (additives) on the functional properties of molding compounds. Typical market sectors served and related processing/fabrication technologies used in reinforced plastics/composites are reviewed.

PLAS.5660 Polymer Materials Systems Solution  
(Formerly 26.566) - Credits: 3

This course investigates the selection processes to be followed in screening material candidates, and specifying a material of record. Emphasis is placed on prioritizing performance requirements, contrasting potential candidates, reviewing processing demands, and post-fabrication schemes. The course will be based on actual case studies.

PLAS.5680 Dynamic Mechanical Properties II  
(Formerly 26.568) - Credits: 3

Practical review of theoretical concepts of rheological measurements with practical applications of experimental techniques. Emphasis will be on the viscoelastic properties of polymer solutions, melts, and solids with correlation with theoretical dynamic mechanical behavior.

PLAS.5690 Current Topics in Plastics Design I  
(Formerly 26.569) - Credits: 1

Individual research and presentation in the field of plastics design.

PLAS.5700 Current Topics in Plastics Processing I  
(Formerly 26.570) - Credits: 1

Individual research and presentation in the field of plastics processing.

PLAS.5710 Plastics Processing Engineering Laboratory I  
(Formerly 26.571) - Credits: 1

Laboratory study of the interaction between process variables and materials in extrusion, injection molding, blow molding, thermoforming, compounding and mixing.

PLAS.5720 Advanced Plastics Processing Engineering Laboratory  
(Formerly 26.572) - Credits: 1

PLAS.5740 Advance Physical Properties Lab  
(Formerly 26.574) - Credits: 1

Measurement of mechanical properties in tension, compression, shear, and flexure; dielectric constant and dissipation factor; thermal behavior under stress; melt rheology.

PLAS.5750 Biomaterials I  (Formerly 26.575) - Credits: 3

A comprehensive study of the history, current and future rents within biomedical devices and their applications. Students will be introduced to research techniques used to analyze the different classes of biomaterials. An overview of typical host reactions such as inflammatory response and their evaluation will be touched upon.

PLAS.5760 Advanced Mold Design  (Formerly 26.576) - Credits: 3

This course provides an integrated approach to mold engineering which includes the interrelationships of polymeric materials, engineering principles, processing, and plastics product design. Major topics include cost estimation, mold layout and feed system design, cooling systems, structural design considerations, and ejector system design. Analytical treatment of the subject matter is given based on the relevant rheology, thermodynamics, heat transfer, fluid flow and
The first course in a two semester sequence to study the fundamental principles of polymer processing, i.e., the conversion of the polymeric materials into useful articles. The course will first study the properties of polymers (bulk and rheological and thermal properties) and why they are important to understanding polymer processing. This course will emphasize the fundamental principles of the extrusion process and examine the correlation between elements of the extruder, polymer properties, and processing variables and why they all must be considered when studying and understanding a plastics processing technique.

This course reviews the common plastics manufacturing processes, including extrusion, injection molding, blow molding, thermoforming, and rotational molding. After the review, the course focus shifts to the impacts of screw design and processing parameters on the conveyance, melting, devolatilization, and mixing with single screws and compounding with twin screw extruders. This course also includes an overview of die designs, multi-shot and gas assist injection molding, film stretching and methods for heating and cooling in plastics processing.

Selection of a current biomaterial problem of interest by the individual student, examination of pertinent literature to determine present knowledge in the area, formulation of an approach to resolve or clarify the issues involved, and (time permitting) work towards the solution of the selected problem.

Individual research and presentation in the field of plastics product or tooling design.

A systematic evaluation of the techniques used in efficient research and development. Experimental data are analyzed and plotted using a mathematical approach. Creative thinking, problem solving, and student presentation of data are stressed. Extensive reading of research papers, analysis of such, and defense of the analysis required.

This course provides a fundamental approach to computer-aided engineering for plastics processing. Emphasis is upon the theory and techniques of computer aided engineering as applied to plastics processing problems, allowing students to understand the various assumptions and methods used to create the programs.

This course deals with the preparation, characterization, behavior and properties of polymer nanocomposites, with an emphasis on the most commercially relevant systems to date, as well as new developments in the field. The major preparation routes to these materials are discussed, with an emphasis on the importance not only of dispersion but of true thermodynamic compatibility in these systems. From there, the focus shifts to describe the consequences of nanocomposite structure in terms of both molecular behavior and macroscopic properties, as informed by the most up-to-date research literature available. Case studies of specific systems will serve as opportunities to gain deeper understanding, and the safety issues surrounding nanoparticle handling will also be presented. Finally, current research by invited lecturers working in the field will be presented as time permits.

A review of patents, trademarks, copyrights and their application for protection of technology in the plastics industry. Other topics to be considered will be employee rights/non-competition agreements, foreign protection, and technology licensing. (in the Plastics Industry)

Enables graduate students to work part-time to compliment academic studies with practical industrial experience and acquire/enhance expertise in their research as well as thesis investigation.

Enables graduate students to work full time to gain practical industrial experience for one semester while on reduced course load.
PLAS.5950 Thermoplastic Elastomers (Formerly 26.595) - Credits: 3

A comprehensive review of thermoplastic elastomer (TPE) technology. Physical and chemical nature of the various classes of TPE’s will be considered with emphasis on mechanical and rheological properties relevant to engineering applications.

PLAS.5960 Plastics, Elastomers and Additives from Renewable Resources (Formerly 26.596) - Credits: 3

This course will provide an introduction to plastics, elastomers and additives obtained from renewable resources. Processes that involve conversion (chemically/enzymatically) of naturally occurring precursors (monomers) obtained from renewable resources to plastics and elastomers will be reviewed. Brief discussion of processing, degradation and recycling of these materials will also be included.

PLAS.5970 Plastics & Environment (Last Term 1993 Fall) (Formerly 26.597) - Credits: 3

This course investigates the waste management solutions for different types of plastics. Both traditional and emerging recycling methods will be highlighted. Accumulation of plastic waste in the natural environment and the toxicology of plastics as well as their additives will be discussed. Further, analysis methods and instrumentation to characterize recycled plastics, and the differences in virgin polymers and recycled polymers will be introduced. Potential degradable, biodegradable or biobased alternatives will be reviewed along with the concepts of life cycle assessment and Green Chemistry for designing the most sustainable plastic materials.

PLAS.6010 Graduate Industrial Coop Education I (Formerly 26.601) - Credits: 1-3

Graduate students interested in developing a practical industrial experience component to complement their academic training may register for this course with advisor’s approval. This credit is not applicable to the mandated degree credit hours.

PLAS.6060 Plastics Manufacturing Systems Engineering (Formerly 26.606) - Credits: 3

The course provides guidance about plastics manufacturing as an integrated system with broadly applicable analysis in three areas: 1) machinery, 2) controls, and 3) operations. The machinery topics include heating/cooling, hydraulics/pneumatics, electric drives, and sensors. The controls topics include signal conditioning, data acquisition, machine controllers, and related control laws. The operations topics include process characterization, process optimization, quality control, and automation. The course is developed to support plastics processing engineers and others involved with plastics manufacturing who are performing process development, research, and machine design.

PLAS.6070 Supply Chain Management for Engineers (Formerly 26.607) - Credits: 3

This course focuses on design, development, and planning supply chain networks while examining the product’s life cycle with an emphasis of the manufacturing processes. Throughout the course, global supply chain management, supply chain drivers, distribution networks, network design under uncertainty, supply-demand cycle, demand forecasting, inventory management, supply chain performance, end-of-life, cradle-grave and cradle-cradle products, along with supply chain decision-making topics will be covered. These topics will be demonstrated with the implementation of examples, and case studies.

PLAS.6100 Plastics Industry Development (Formerly 26.610) - Credits: 3

The goals of this course are numerous. In the large sense, the primary focus of this course will be to review many of the major technological developments and discoveries that have helped make the plastics industry what it is today. Having a thorough understanding of how these developments were implemented commercially can help us implement modern day technologies in a more efficient and productive manner.

PLAS.6110 Coloration of Engineering Thermoplastics - Credits: 3

A comprehensive approach to all elements of Color Technology focused on needs for future plastics engineers. The course includes theory of color vision, instrumental color measurement and tolerancing, chemistry and processes of commercial dyes and pigments, their testing in polymers, failure modes and elements of industrial color matching. Special attention will be given to weatherability of color formulations.
PLAS.6180 Structural Product Design (Formerly 26.618) - Credits: 3
Design of plastic and composite products to meet structural requirements including strength, stiffness, impact, fatigue, and creep while remaining low weight, low cost, and easy to manufacture. The course will include an overview of structural properties of polymeric materials as well as application of finite element analysis to homework and project assignments.

PLAS.6420 Characterization of Polymers and Plastics (Formerly 26.642) - Credits: 3
This course provides an in-depth review of the various means by which important properties of polymers and plastics are determined. Lectures will cover analysis of composition and structure (including deformation techniques) as well as measurements of common physical, mechanical, thermal, barrier, fire and optical properties. Coverage will include both the fundamental basis for the techniques and their practical applications, strengths and weaknesses. Time and resources allowing, selected techniques will be demonstrated in the lab as well.

PLAS.6500 Nanoscale Transport Phenomena for Manufacturing Nanodevices (Formerly 26.650) - Credits: 3
An interdisciplinary course taught by faculty from the Chemical, Mechanical and Plastics Engineering Department, who have special knowledge in nanoscale fluid mechanics and heat transfer. The course on nanoscale transport phenomena constitutes a bridge between existing fluid and heat transfer courses in multiple disciplines and emerging nanoscale science and engineering concepts to reflect the forefront of nanomanufacturing. The course is designed to incorporate recent advances in manufacturing polymer based nanodevices. Key issues of the implementation and maintenance cost for fabrication will be addressed. Hands-on laboratory experiments will be performed to complement the lectures with the ultimate goal of designing and building a complete nanodevice at the end of the course. The course will prepare graduates for employment focused on designing and manufacturing nano/microfluidic systems, lab on ship devices, electronic devices, medical devices and other emerging technologies.

PLAS.6750 Biomaterials II (Formerly 26.675) - Credits: 3
The degradation of biomaterials in the biological environment for applications such as sutures, orthopedic implants, dental implants, etc. will be reviewed. Students will analyze issues unique to the field of implants, devices and biomaterials. While reviewing new products and standards, the prospective and possibilities of biomaterials will be studied.

PLAS.6780 New Developments in Polymer Manufacturing - Credits: 3
This course explores advanced concepts and new developments in polymer manufacturing. It is designed for students with prior courses and/or experience in polymer processing.

PLAS.6820 Physical Polymer Science - Credits: 3
Comprehensive course covering physical polymer science and engineering. The role of molecular conformation and configuration in determining the physical behavior of polymers. The amorphous and crystalline states of polymers; polymer/polymer phase diagrams; glass-rubber transition and polymer viscoelastic behavior.

PLAS.7410 Master’s Thesis - Plastics Engineering (Formerly 26.741) - Credits: 1
PLAS.7430 Masters Thesis Plastics Engineering (Formerly 26.743) - Credits: 3
Individual research projects in plastics.

PLAS.7460 Master’s Thesis - Plastics Engineering (Formerly 26.746) - Credits: 6
Individual research projects in plastics.

PLAS.7490 M S Grad Res Plastics (Formerly 26.749) - Credits: 9
Individual research projects in plastics.

PLAS.7510 Doctoral Thesis Research (Formerly 26.751) - Credits: 1
PLAS.7520 Doctoral Thesis Research (Formerly 26.752) - Credits: 2
PLAS.7530 Doctoral Dissertation/Plastics Engineering (Formerly 26.753) - Credits: 3
Individual research projects in plastics.

PLAS.7560 Doctoral Dissertation/Plastics Engineering (Formerly 26.756) - Credits: 6
Individual research projects in plastics.
PLAS.7590 Doctoral Dissertation/Plastics Engineering (Formerly 26.759) - Credits: 9
Individual research projects in plastics.

PLAS.7630 Continued Graduate Research (Formerly 26.763) - Credits: 3
Individual research projects in plastics.

PLAS.7660 Continued Graduate Research (Formerly 26.766) - Credits: 6
Individual research projects in plastics.

PLAS.7690 Continued Graduate Research (Formerly 26.769) - Credits: 9
Individual research projects in plastics.
College of Fine Arts, Humanities & Social Sciences

The College of Fine Arts, Humanities and Social Sciences, led by Luis Falcon (https://www.uml.edu/Academics/Provost-office/contact/Falcon-Luis.aspx), Ph.D., offers five programs of graduate study in Master of Arts and Master of Music. These degree programs are part of the University’s commitment to develop regional and national economies by providing state-of-the-art educational programs beyond the bachelor’s degree. A wide range of ongoing research and project opportunities exist within the various degree programs, and interdisciplinary study is emphasized. Graduates of these programs are heavily recruited both regionally and nationally by industry and governmental agencies.

Faculty in College of Fine Arts, Humanities and Social Sciences (https://www.uml.edu/docs/FAHSS%20Faculty%20List_tcm18-90422.pdf) (pdf)

Graduate Programs Offered

Doctor of Philosophy (Ph.D.)

- Applied Psychology and Prevention Science (http://www.uml.edu/Catalog/Graduate/FAHSS/Psychology/DoctoralAppliedPsychology.aspx)
- Criminal Justice (http://www.uml.edu/Catalog/Graduate/FAHSS/Criminal-Justice/PhD-Program.aspx)
- Global Studies (http://www.uml.edu/Catalog/Graduate/FAHSS/Global-Studies/default.aspx)

Master of Arts (MA) - degree awarded in the following fields:

- Community Social Psychology (http://www.uml.edu/Catalog/Graduate/FAHSS/Psychology/Masters-Program.aspx)
- Criminal Justice (http://www.uml.edu/Catalog/Graduate/FAHSS/Criminal-Justice/Masters-Program.aspx)
- History
- Peace and Conflict Studies (http://www.uml.edu/Catalog/Graduate/FAHSS/PACS/Default.aspx)

Master of Public Administration (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)

Master of Science (MS)

- Autism Studies (http://www.uml.edu/Catalog/Graduate/FAHSS/Masters-Program-in-Autism-Studies.aspx)

Master of Music (MM) - degree awarded in the following fields:

- Music Education (http://www.uml.edu/Catalog/Graduate/FAHSS/Music/Default.aspx)
- Sound Recording Technology (http://www.uml.edu/Catalog/Graduate/FAHSS/Music/Masters-Programs.aspx)

Current undergraduate students may be qualified for bachelor/master degree programs.
Economic & Social Development of Regions

Program

No Longer Accepting New Applicants in this Program!

Graduate programs offered:

- Master of Arts in Economic and Social Development of Regions
- Graduate Certificate: Economic & Social Development of Regions
- Bachelor’s-Master’s Program

Program Objectives

The College of Fine Arts, Humanities, and Social Sciences offers an interdisciplinary, advanced certificate and Masters programs to prepare students to understand, analyze, and intervene in the economic development of regions. By development, we mean strengthening people’s ability to meet their varied needs. This includes expanding the capacity to produce, but also includes strengthening the capacity to carry out constructive social activity (such as democratic decision-making) it is both economic and social. The regions involved can range from a single neighborhood to an entire continent.

The degree program has three main objectives. The first is to provide students with a profound and practical understanding of the dynamics of development processes. Second, the program trains students in research skills that are useful for analyzing and tackling development problems. Third, students learn practitioners’ tools for solving such development problems - tools that can be useful in a variety of settings including businesses, government agencies, and nonprofit organizations. The program offers students flexibility in choosing the appropriate mix of research and practitioner skills to meet their needs and interests.

This program is no longer accepted students.

Master’s Program

Master of Arts in Economic and Social Development of Regions

This program is no longer accepting students.

The Master of Arts in Economic and Social Development of Regions is designed to serve students from a variety of backgrounds. It attracts recent undergraduates from liberal arts fields such as social sciences (Economics, Sociology, Psychology, Political Science) and History, and also from practice-oriented fields such as Management, Education, and Engineering.

For those already working in public or private sector fields related to economic and social development, it can enhance skills and provide opportunities for career advancement. It is specifically designed to speak to the interests of international students as well as domestic ones.

Graduates of the program will be prepared to assume professional roles in local, state, and national government agencies (in the United States and abroad); in research, consulting, and planning aspects of business; and in non-profit organizations working on economic or social development. Students who choose to do so will also be prepared to go on to doctoral programs in social sciences, history, public policy, planning, and management.

In the Masters program, courses can be selected to address the student’s particular interests in one of six Focus Areas:

1. Policy at the National, State, and Local level
2. Global Development and International Policy
3. Community Development, Social Policy, and Non-Profit Management
4. Innovation, Technology, and Policy
5. Environment and Sustainability
6. Research Methods

Admissions Requirements

The Economic and Social Development of Regions Master’s program at the University of Massachusetts at Lowell is designed not only for recent college graduates, but also for older, non-traditional, and mid-career students with experience in a variety of work and community settings. The requirements for admission include:

1. Bachelor’s degree from an accredited institution college or university.
2. An undergraduate grade point average of 3.0 or better. Applicants must submit an official transcript from their undergraduate institution.
3. Acceptable scores on the Graduate Record Examination Aptitude Test. (Use of GMAT scores may be approved by the graduate coordinator.) Students for whom English is not a national language must also submit a score for the Test of English as a Foreign Language (TOEFL).
4. Three letters of reference from individuals familiar with the educational and/or professional performance of the applicant.
5. A personal letter including a statement about the applicant’s professional interests, educational and work qualifications, and future goals.
6. A curriculum vitae summarizing education and work experience.
7. An interview may be requested by the Graduate Admissions Committee.

Students may be admitted in one of the following categories:

1. Matriculated student. A fully accepted degree candidate who meets all criteria.
2. Matriculated with conditions. From time to time, a student may be accepted conditionally into the program. To become a fully matriculated student, the student must receive at least a 3.0 grade point average in nine credit hours of Economic and Social Development of Regions graduate level courses, while also completing any conditions established by the Graduate Admissions Committee. Conditional matriculation requires that students meet conditions 1 and 2 above.

Part-Time and Full-Time Study

MA students may attend either full-time or part-time. Most courses will be scheduled in the evening. Courses will be offered in fall and spring terms, and some courses may be available during the summer. Students taking a full-time load of 12 credits per semester can finish the program in three semesters. Students taking 9 or more credits in a semester will be considered full-time students.

Transfer Credit

Matriculated students in Economic and Social Development of Regions may transfer up to 12 credits of course work completed at other accredited universities, provided that such courses are within the content area of Regional Economic and Social Development, and do not involve credit for field experience or professional work. Such transfer credit is subject to the approval of the Department Graduate Curriculum Committee and the Registrar’s Office, and all University policies governing graduate transfer credit.

Degree Requirements

A total of 30 (for project) or 33 (for thesis) academic credits, at least 18 of which must be taken at the University of Massachusetts at Lowell with a grade average of B or better, is required for completion of the degree.

The course of study includes two compulsory core courses (six credits):

- 57.506 Research Methods in Economic and Social Development
- 57.513 Foundations of Comparative Regional Development

The course of study must also include three of the following six courses (9 credits):

- 57.503 Work, Technology, and Training
- 57.511 Dynamics of Power and Authority, Diversity, and Inequality
- 57.537 Developing Economies
- 57.592 Qualitative Research Methods
- 57.593 Advanced Quantitative Methods
- 57.598 Organizational Dynamics in Regional Development

Students are also required to complete an additional 12 credits of course credits, and either six credits of thesis or three credits of project. The 12 credits of additional course requirements can be satisfied in a wide variety of ways. Students are encouraged to take advantage of six focus areas that specify additional course work in particular areas. However, students are also encouraged to tailor their program to achieve their own learning and career goals, by combining courses, independent study, and practica as appropriate. Non-core course selections must be approved in advance by the student’s graduate advisor.

Thesis or Project

The capstone to the degree program is a thesis or project demonstrating the student’s mastery of the field. Typically, the thesis (6 credits) involves a substantial piece of research in economic and social development, whereas the project (3 credits) involves carrying out and documenting a professional problem-solving activity. In some cases, more in-depth problem-solving activities may qualify for thesis status. Thesis or project work is supervised on an ongoing basis by the student’s thesis/project supervisor.

Graduate Advisor

Each newly matriculated student in the program will be assigned to an academic advisor from among the faculty of the graduate program. The student will meet with his/her academic advisor.
advisor on a regular basis throughout the course of study to discuss course selections, planning for practica, and the development of the thesis or project. In particular, all non-core course selections require prior approval from the academic advisor. Each student will, in addition, select a faculty member to supervise his/her thesis or project. The student will retain his/her academic advisor to provide guidance on selection of remaining courses.

**BA/MA and BS/MA Options**

Undergraduate majors in related fields at the University of Massachusetts at Lowell may enroll in a BA/MA or BS/MA program that allows eligible students to complete both degrees in five years. Application for this program typically occurs in the junior year and applicants must meet all eligibility requirements, including a minimum 3.0 cumulative GPA. Additional information is available from the Graduate Coordinator.

**Graduate Certificate Program**

**No Longer Excepting New Students for This Program!**

**Economic & Social Development of Regions**

**Contact:**
Philip Moss (mailto:Philip_Moss@uml.edu)
978-935-2787

Robert Forrant (mailto:Robert_Forrant@uml.edu)
978-934-2904

The 12 credit certificate offers graduate level instruction to students interested in understanding, analyzing, and intervening to enhance the economic and social development of regions. It provides students with a strong grounding in the conceptual tools and the information needed to participate effectively in the development of neighborhoods, states, or nations.

**Required Courses (all students):**

- 57.513 Foundations of Comparative Regional Development (3 credits)

**Plus two of the following seven core courses (Total of six credits):**

- 57.503 Work, Technology, and Training (3 credits)
- 57.506 Research Methods in Economic and Social Development (3 credits)
- 57.511 Dynamics of Power and Authority, Diversity, and Inequality (3 credits)

- 57.537 Developing Economies
- 57.592 Qualitative Research Methods
- 57.593 Advanced Quantitative Methods
- 57.598 Organizational Dynamics in Regional Development

**AND One Approved Elective (3 credits)**

About Graduate Certificates (https://www.uml.edu/Grad/programs/about-certificates.aspx)

**Focus Areas**

**Master’s Program Focus Areas**

The Master of Arts in Economic and Social Development of Regions allows students to focus their elective courses in a particular topic or policy area of personal or professional interest. Students are not obligated to follow any of these focus areas but may take any elective courses he or she prefers and build their own curriculum. However concentrating on a specific focus area may better suit the students interests or better further their career or educational goals.

Below are the six focus areas in which students may direct their studies:

- Policy at the National, State, and Local Level
- Global Development and International Policy
- Community Development, Social Policy, and Non-Profit Management
- Innovation, Technology, and Policy
- Environment and Sustainability
- Research Methods

**Policy at the National, State, and Local Levels**

This area is largely focused on US policy. Courses in this area explore public policy in terms of labor, gender, social welfare, as well as sustainable housing, and municipal management.

**Suggested Courses:**

- 57.511 Dynamics of Power & Authority
- 57.515 Politics & Economics of Public Policy
- 57.520 Inequality & Organization
- 57.527 Sustainable Housing Development & Land Use
- 57.525 Gender, Work and Public Policy
- 57.545 Political Economy of Employment
- 57.507 Municipal Management

**Courses in other programs:**

PUBH.6250 Health Policy
CRIM.5730 Law and Public Policy
CRIM.5030 Administration of Criminal Justice
CRIM.5460 Mental Health & Criminal Justice

Global Development and International Policy

This focus area addresses globalization, links between local, regional and national policy issues and the impact of international politics, trade and development on domestic policy. Students study development strategies, migration, gender roles, poverty, patterns of trade, the major institutions that influence trade finance and development, and the changing international division of labor and capital.

Suggested Courses:
- 57.513 Foundation of Comp. Reg. Dev.
- 57.520 Inequality & Organization
- 57.537 Developing Economies
- 57.539 Justice & Trade in the Global Economy
- 57.540 China & India/GLOBAL Economy
- 57.552 Enterprise in Latin America
- 57.605 Social Movements

Courses in other programs:
- ECON.4100 Economic Growth and Development
- ECON.4030 Topics in International Economics and Trade
- PSYC.5270 Immigrant Psychology and Communities
- MGMT.5110 Global Enterprise and Competition (2 credits)
- PUBH.6530 Globalization, Work, and Health

Community Development, Social Policy, and Non-Profit Management

Understanding sustainable development strategies requires a deep comprehension of the dynamics of community economic development, community policies and community practice. Students who focus in this area address urban development strategies, sustainability, community inclusion in decision making, land use policy and planning, and management of non-profit organizations.

Suggested Courses:
- 57.503 Work and Technology
- 57.514 Community Mapping
- 57.545 Political Economy of Employment
- 57.520 Inequality & Organization
- 57.519 Science, Tech & Economy
- 57.540 China & India/Global Economy

Courses in other programs:
- ENTR.6500 Innovation & Emerging Technology
- MGMT.4800 Current Topics in Management: Business Ethics
- MGMT.5010 Organizational Behavior (2 credits)
- PUBH.5000 Analytic Context of Work Environment
- PUBH.6430 Healthy Work Organization
- PSYC.5260 Workplace Diversity

Innovation, Technology, and Policy

Students who focus in this area study the sources of competitive leadership among countries and within industries. They become skilled at industry studies that involve the theory and sources of innovation, the path of technology design, competitive strategies, the role of financial strategies and skill development strategies in the innovative trajectory of industries and firms, and the impact of offshoring and global relocation on employment and on particular regions.

Suggested Courses:
- 57.503 Work and Technology
- 57.514 Community Mapping
- 57.545 Political Economy of Employment
- 57.520 Inequality & Organization
- 57.519 Science, Tech & Economy
- 57.540 China & India/Global Economy

Courses in other programs:
- ENTR.6500 Innovation & Emerging Technology
- MGMT.4800 Current Topics in Management: Business Ethics
- MGMT.5010 Organizational Behavior (2 credits)
- PUBH.5000 Analytic Context of Work Environment
- PUBH.6430 Healthy Work Organization
- PSYC.5260 Workplace Diversity

Environment and Sustainability

Environmental issues are some of the most important challenges facing communities at the local, national, and global level. This focus area introduces students to some of the most significant issues arising from the connections of economic activity and economic development to the quality and...
sustainability of the environment. Students learn skills in the economic and political analyses relevant to the design and implementation of policy alternatives that have emerged domestically and globally over the last 40 years or so. From global climate change to brownfields, concern about environmental damage has created a rich legacy of economic and political analysis, policy, and politics to which students are exposed through the courses in the focus area.

**Suggested Courses:**

- 57.518 Politics of Climate Change
- 57.567 Introduction to Environmental and Natural Resource Economics
- 57.527 Sustainable Housing and Land Use
- 57.515 Politics and Economics of Public Policy

**Courses in other programs:**

- PUBH.5000 Analytic Context of the Work Environment
- PUBH.5500 Environmental Law & Policy
- PUBH.6510 Work Environment Policy and Practice
- PUBH.5500 Environmental Law & Policy
- PUBH.6160 Law and Ethics in Healthcare
- CRIM.5470 Economic Crime
- ENVI.5040 Geographic Information Systems
- ENVI.5720 Energy and the Environment

**Research Methods**

Student can put together a set of courses that will develop qualitative or quantitative skills to support jobs or further education that is oriented to research.

**Suggested Courses:**

- 57.506 Research Methods
- 57.592 Qualitative Research Methods
- 57.522 Research Ethics with Underserved Groups
- 57.546 Grant Writing
- 57.515 Politics and Economics of Public Policy
- 57.514 Community Mapping with GIS

**Courses in other programs:**

- PUBH.6800 Intro to SAS
- PUBH.6740 Applied Biostatistical Methods
- PUBH.6890 Advanced Regression Modeling
- PSYC.5120 Applied Research Methods
- POLI.6110 Program Evaluation
- MATH.5700 Probability and Statistics
- MATH.5910 Statistical Modeling and Linear Regression Analysis
- MATH.5930 Experimental Design
ECON.5130 Foundations Of Comparative Regional Development (Formerly 57.513)(Formerly POLI.5130) - Credits: 3

This course offers an initial grounding in economic, historical, political, and sociological methodologies and introduces discipline-based and interdisciplinary approaches to regional development. It introduces students to: identifying and assessing structural factors influencing regional development, defining regional development challenges, and generating problem-solving strategies and public policies. The course highlights the relationship between theory and application, and looks at development at the community, national, and international levels. It makes extensive use of case materials on regional development, including a unit on the development of the Massachusetts economy. Students will learn how to find, prepare and analyze data on regional economies and will learn several basic quantitative tools for regional analysis.

ECON.5140 Researching Industries and Companies in the Global Economy - Credits: 3

The Internet revolution gives us access to vast amounts of information on economics, industries, and companies. This course provides students with a framework, rooted in Prof. Lazonick’s "theory of innovative enterprise," for the integration of facts and logic in conducting research. Students learn where to find and how to make use of relevant information available as e-resources. Through the study of Lazonick’s research, the course enables students to take a deep dive into the theoretical approaches and sources of information that he has used to analyze economies, industries, and companies in global perspective. During the course, students work in teams to produce e-resource-based research reports on innovation, competition, and globalization in selected industrial sectors.

ECON.5150 Politics and Economics of Public Policy (Formerly 57.515)(Formerly POLI.5150) - Credits: 3

The course will provide students with both a set of analytical frameworks to understand how and why specific public policies develop, and a set of normative perspectives to assess what makes for good public policy. Our treatment will be interdisciplinary drawing from areas of economics and political science. Following some grounding in the political economy of the role of government and policy making in a market based economy such as the United States, we will do case studies to understand and to evaluate policies from a variety of current areas of interest to the students and professors. Students will be introduced to basic ideas of cost benefit analysis, program evaluation, and implementation analysis.

ECON.5930 Econometrics (Formerly 49.593) - Credits: 3

This course is a continuation of Econometrics II; the focus will be on the more advanced techniques used in estimation and inference problems in social science research. Possible topics include nonlinear models, the generalized method of moments, limited dependent variable and sample selection problems,
multi-equations models, time-series models, and panel data analysis. Statistical packages will be utilized for a hands-on approach to the techniques.
ENGL.5060 Writing in the Community (Formerly 42.506) - Credits: 3

Students learn advanced writing techniques in the classroom and apply them to real writing tasks in the community. Assignments include a writing project designed to meet the needs of a local organization, along with research and reflective pieces.

ENGL.5200 Experiencing Poetry: Sound and Sense (Formerly 42.520) - Credits: 3

The class offers seminar-style discussions on specific aspects of poetry, considering a range of excellent poems from various eras. Through hands-on writing exercises, we will examine the art from the vantage point of the practitioner, using imitation and exploration of technique as a kind of close reading. Assignments include analytical essays as well as creative work.

ENGL.5400 Modernist Literature (Formerly 42.540) - Credits: 3

Much of the influential literature produced during the modernist period, roughly 1900-1950, was considered radical in its time. This course will focus on the experimental, avant-garde impulse that manifests itself in the themes and techniques of key modernist texts, relating that impulse to questions about the nature of identity, the role of gender and class in constituting the modernist subject, and the sociocultural functions of literature itself. Readings will primarily include Virginia Woolf’s Mrs. Dalloway, Zora Neale Hurston’s Their Eyes Were Watching God, T.S. Eliot’s poetry, and James Joyce’s Portrait of the Artist as a Young Man, as well as theoretical texts. We will explore this period by examining these exemplary texts, historical and social events, and films.
Ph.D. in Global Studies

The Ph.D. in Global Studies is an interdisciplinary program offered through the College of Fine Arts, Humanities and Social Sciences, administered by the Department of Political Science, with an interdisciplinary faculty group representing a range of disciplines, including Economics, Education, Sociology, Philosophy, History, Psychology, Criminal Justice and Political Science.

This is an interdisciplinary, research-oriented degree, designed for students and practitioners who seek advanced interdisciplinary education to develop their ability to analysis problems, policies and programs and to facilitate a sophisticated understanding of the crucial challenges facing the world today. Our innovative interdisciplinary program trains students in social scientific methods and inquiry, while offering a strong foundation in humanities-based theory and knowledge. The Program has three areas of study:

1. Conflict, Cooperation, Security and Human Rights
2. International Political Economy, Trade and Development
3. Theory in Global Studies

For More Information, Please visit the Global Studies Doctoral Program page.

Graduates of this program will be able to:

1. Utilize qualitative and/or quantitative methods to conduct research on major issues related to globalization.
2. Assess the effectiveness of organizations and programs.
3. Publicize best practices and innovative findings through teaching, presentations, and publications in various formats.

Graduates of the program will also demonstrate the following knowledge competencies:

1. Globally shared political, social, economic and security issues.
2. Current academic research in the fields covered by two of the program areas of study (Conflict, Cooperation, Security and Human Rights; International Political Economy, Trade and Development; or Theory in Global Studies) as well as a broad familiarity with key topics in all three areas.
3. An understanding of the key concepts, theories, and methodology in the new and emerging field of Global Studies.
4. An understanding of the diverse aspects of global civil society--such as political economy, security, human rights, religion, ethical and historical perspectives--that affect our contemporary world in significant ways.
5. A working knowledge of the organizations, institutions and global systems having important roles in the development and maintenance of global civil society, human rights and social justice and economic growth and stability.
6. Advanced quantitative and qualitative research methods.

Admissions Requirements:

1. Applicants must show official evidence of having earned a baccalaureate degree or its U.S. equivalent from an accredited college or university. Complete and official undergraduate and graduate (if applicable) academic transcripts from all previously attended institutions must be provided. A Master’s degree is not required.
2. If an international transcript does not adequately
demonstrate that an applicant has the equivalent of an American bachelor’s, the applicant must obtain such verification by an independent service such as the Center for Educational Documentation, Boston, MA (617-338-7171).

3. All prior degrees must have been earned with a satisfactory scholastic average to demonstrate that the applicant has adequate preparation for the field in which doctoral studies are undertaken.

4. Applicants must have achieved satisfactory Verbal and Quantitative scores on the Graduate Record Exam (GRE). In some instances, GMAT or LSAT scores may be substituted. The official score report must be submitted; a photocopy of the examiner’s report is acceptable.

5. Three (3) letters of reference must be provided from individuals familiar with the educational [two letters minimum] and/or professional performance [maximum of one letter] of the applicant.

6. Applicants must submit a personal statement which indicates why the applicant wishes to pursue a doctoral degree in Global Studies. An interview may also be requested by the Graduate Admissions Committee.

7. **Your personal statement should address the following:** Describe your personal, professional and academic background, and what has led you to apply for admission to the UMass Lowell doctoral program in Global Studies at this point in your personal and professional journey. Describe a global problem or challenge that is of particular interest to you, and why? Indicate which 2 of the 3 tracks you are most interested in, and why? Indicate in your statement (and on the application form) whether you intend to enroll full-time or part-time in this program.

8. A current CV/resume is required.

9. International applicants (whose native language is not English and who have not earned a university degree where English was the primary language of instruction, must also provide official test score of the Test of English as a Foreign Language (TOEFL). A waiver may be given to candidates who have completed at least two semesters of full-time college/university work in the United States by the date of submission of this application.

**Application Materials:**

1. Application form
2. Proof of an earned baccalaureate degree from an accredited college or university.
3. Undergraduate and graduate academic transcripts from all previously attended institutions.
4. Official GRE scores (in some instances GMAT or LSAT scores may be substituted).
5. Current CV/resume
6. Personal statement
7. Letters (3) of reference from individuals familiar with your educational [two letters minimum] and/or professional performance [maximum of one letter].
8. Official TOEFL or IELTS scores. (Required for international students whose native language is not English and who have not earned a university degree where English was the primary language of instruction.)

Optional, but applicants are strongly encouraged to also submit:

1. Evidence of bilingual or multilingual skills and level of proficiency (oral and written)
2. Evidence of research and reasoning skills

Each application will be carefully evaluated by an admissions committee comprised of faculty participating in the Global Studies program. All of the items mentioned above will inform their deliberations - thus, an incomplete application will not be considered.

**Deadline on Admissions Decisions:**

Decisions for admission into the Ph.D. in Global Studies program are made for the fall semester only. This program has an application deadline of February 1. Applications will be reviewed by an admissions committee during the first half of the spring semester.

Applicants will be notified of the Admissions decision on or around April 1.

**Transfer Credit for the Ph.D. in Global Studies:**

The faculty committee for the Ph.D. in Global Studies can...
accept transfer credit for graduate courses from an accredited university with a grade of "B" or better which meet the university policy for graduate transfer credit. Transfer credit can be awarded for up to 21 credit hours from a completed Masters. Transfer credit will only be awarded for courses that are substantially similar to those offered at UMass Lowell and are consistent with the UMass Lowell's Global Studies curriculum. Applicants are required to submit Course Descriptions and Course Syllabus for each course to be considered for transfer credit.

Degree Requirements:

The Ph.D. program in Global Studies offers three areas of concentration to meet the specific research interests of students: Conflict, Cooperation, Security and Human Rights; International Political Economy, Trade and Development; Theory in Global Studies.

All students are required to take 9 credits of core coursework, 12 credits of research methods courses, 39 credits of elective courses (a maximum of 21 credits of which can be transferred from a MA/MS degree program director approval), and a minimum of 15 dissertation credits.

Core Courses (9 credits) - REQUIRED

- GLST.7010 Contemporary Global Studies (3 credits)
- GLST.7012 Conflict, Cooperation, Security and Human Rights (3 credits)
- GLST.7170 International Political Economy, Trade and Development (3 credits)

Research Methods Courses (12 credits)

- GLST.7030 Comparative and International Research (3 credits)
- 1 quantitative methods course focusing on econometric techniques (ECON.7310, ECON.7330 or ECON.7340, depending on student’s previous course work) (3 credits)
- 2 advanced research methods & data analysis electives (6 credits); choices include: EDUCA.6423 Program Evaluation, EDUCA.6600 Ethnographic Inquiry, EDUCA.7040 Qualitative Research Methods, EDUCA.7050 Survey Research, PUBH.6800 Intro to SAS, PUBH.6740 Applied Biostatistical Methods, PUBH.6890 Advanced Regression Modeling

Elective Courses (39 credits)

A minimum of 39 credits of elective coursework is required. To meet the requirement for the remaining electives, courses (3 credits each) are chosen from the list provided below. Please note these courses are subject to change and not be offered every semester. A student’s selection of electives is based on consultation with their faculty advisors. The Global Studies Program offers 3 areas of study:

1. Theory in Global Studies;
2. Conflict, Cooperation, Security and Human Rights;

Though students are encouraged to take courses in all three areas, students must select 2 of these 3 areas in which to focus, and take at least 2 (3 credit) electives in each focus area. After meeting the methodology course requirement (described above), students can take additional advanced research methods courses as electives.

Conflict, Cooperation, Security and Human Rights:

Drawing primarily from the departments of Political Science, Economics, Sociology and Criminal Justice, topics for research and study in this area include major transnational security threats such as terrorism, criminal networks, human trafficking, weapons of mass destruction proliferation, energy security, maritime security, environmental security, and the global trafficking of drugs, small arms and light weapons and other contraband. Study includes the critical importance of political regime legitimacy, criminal justice systems and the rule of law in order to understand how governments and
multinational organizations respond to these and other kinds of security threats.

Elective courses include:

- GLST.6600 International Perspectives on Crime & Justice
- GLST.6610 Comparative Criminal Justice
- GLST.6620 Global Issues an Human Rights and Justice
- GLST.6630 Prisons: A Global Perspective on Punishment & Rehabilitation
- GLST.6640 Weapons of Mass Destruction
- GLST.6650 Seminar on Global Trafficking and Criminal Networks
- GLST.6660 Terrorist Networks: Al Qaida and Affiliated Groups
- GLST.6670 Seminar on Security Studies
- GLST.6680 Scientific and Technological Dimensions of National Security
- GLST.7100 Directed Study
- GLST.7280 Organizational Theory

**International Political Economy, Trade and Development:** This area is designed to enhance understanding of economic, political and social development around the globe. Globalization is enhanced by international trade foreign investments, world financial markets, migration movements, and technological transfer. All of these factors affect countries growth potential as well as their income distribution. This leads to changes in their citizens’ health, education, poverty, literacy, environment, and sustainability.

Elective courses include:

- ECON.7300 Microeconomics
- ECON.7330 Econometrics I
- ECON.7340 Econometrics II
- GLST.6530 Globalization, Work and Health
- GLST.7100 Directed Study
- GLST.7110 The World of Things: Consumer Culture in Historical Perspective
- GLST.7150 International Migration
- GLST.7170 Development Economics
- GLST.7180 International Economics
- GLST.7190 Human Capital and Employment in a Global Economy
- GLST.7200 The Role of Government in a Global Economy
- GLST.7280 Organizational Theory
- GLST.7300 Microeconomics
- GLST.7310 Seminar on Global Environmental Issues
- GLST.7320 Seminar on Poverty, Discrimination and Public Theory in Global Studies:

This area of study will provide students a deep understanding of the theoretical underpinnings and rapidly emerging new paradigms of global studies. Globalization has exposed some of the shortcomings of traditional theories of international relation, economic development, and political an social philosophy. By promoting a critical approach to traditional theory in this field and by embracing theoretical contributions from feminism, ecology, anthropology, cultural studies and international political economy, students will be able to comprehend the intellectual contribution of a wide range of disciplines to understanding the impact of globalization on citizens and societies. This area of study provides a through background in traditional theoretical approaches to understanding global society while exposing students to innovative new approaches and arenas of study. The area of study is designed to move students from theory to practice and to encourage examination of current events through the lens of theories both traditional and new, and by assessing their explanatory power and implications for domestic and international study.

Elective courses include:

- GLST.7020 Theoretical Paradigms in Global Studies
- GLST.7140 Globalization, Feminism, & Liberalism
- GLST.7160 Advanced Seminar in Global History, Politics and Theory
- GLST.7100 Directed Exam

**Doctoral Qualifying Exam:**

Following the accumulation of at least 27 credits at the doctoral level (i.e., credits transferred from a Master’s program do not count), students will register to take their comprehensive doctoral exam, which must be passed prior to students’ enrollment in dissertation credits. Students will test in their two areas of study and each section of the test will incorporate a methods component. Students will be given access to a computer (with no internet connection, notes, etc.) and will have three hours to answer each part of the exam. A two-hour break will be provided between part 1 and part 2. Altogether, the exam and breaks will last 8 hours.

The qualifying exam will be offered in November and May of each year. Students wishing to take the qualifying exam must announce their intent to sit by the deadline set in the semester.
prior to the examination on the form provided by the Program.

**Dissertation:**

Upon successfully passing the Comprehensive Qualifying Exam, a student can begin his/her dissertation research. The major requirements remaining at this stage are:

- successful oral defense of a dissertation proposal; and
- successful oral defense of a complete dissertation and submission of the final written document.

**Doctoral Dissertation:**

The minimum number of dissertation credits is 15. During each semester of the dissertation stage, students will register for 1, 3, 6, or 9 credits of direct supervision (GLST.7530 / 7560 / 7590 Dissertation Supervision) with their dissertation advisor. Students must successfully pass oral defenses of both the dissertation proposal and the completed dissertation. Dissertation committee must consist of three members, and must be chaired by a tenured UML faculty member.

**Language Requirement:**

Students must demonstrate sufficient competency in a second language or advanced statistics.

**Curriculum Summary:**

- Core Credits: 9
- Methods and Data Analyst Credits: 12
- Elective Credits (including up to 21 transferred credits): 39
- Dissertation Credits: 15
- Total Credits: 75
GLST.7010 Global Studies I (Formerly GLS.701) - Credits: 3

The focus of this course is the intersection of theory and practice in Global Studies. Students will be acquainted with the three fields of study that structure the Ph.D. Global Studies curriculum: Comparative Cultures, Security and Human Rights, and Socio-Economic Development and the interdependence of these fields.

GLST.7012 Conflict, Cooperation, Security and Human Rights - Credits: 3

This is an interdisciplinary course for the Global Studies PhD Program. Drawing from political science, this course investigates the major global threats to human security, including poverty, public health crises, environmental deterioration, terrorism, mass killings and war. These threats to human security can also be framed as violations of human rights. Drawing from economics, the class will explore the interactions that lead to these violations and security threats with a game theoretic approach. Employing game theory, the study of interdependent decision-making, will enable students to analyze and gain an understanding of the strategies that lead to violations of human rights, with the aim of developing policies to mediate these threats to human security.

GLST.7017 International Political Economy, Trade and Development - Credits: 3

Since the end of the cold war it seems that analysts of international relations have changed their focus from the politics of preserving the peace to the politics of the international economy. Reading any international newspaper one is now less likely to see a story on the arms reduction talks between states on the front page than seeing an article on the trade relations between states. The economic crisis of 2007-8, the European debt crisis and the rise of China has brought more attention to the relationship between global politics and economics. This course is intended to give an introduction to international political economy (IPE) and security economic relations. Students will study the theoretical perspectives that are used by analysts, the history of IPE, and some important issues currently confronting the economic and trade relations of states in an era of globalization.

GLST.7020 Global Studies II (Formerly GLS.702) - Credits: 3

This course elaborates on the topics introduced in GLS 701 Global Studies I. It familiarizes students with specific knowledge competencies in the three fields of study that structure the Ph.D. Global Studies curriculum: Comparative Cultures, Security and Human Rights, and Socio-Economic Development and the interdependence of these fields. Emphasis includes geography, history, economics, and cultural studies.

GLST.7030 Global Research and Data Analysis (Formerly GLS.703) - Credits: 3

This course is designed to cultivate and further develop students’ understanding and skills in research methods and data analysis as they become practitioners of qualitative and quantitative research addressing a range of global studies issues and problems. Through the use of applied analysis projects students will explore multiple methods of data analysis, critique and evaluate existing research studies and reports, and develop skills in critical thinking.

GLST.7110 The World of Things: Consumer Culture in Historical Perspective. (Formerly GLS.711) - Credits: 3

This course examines the emergence and historical impact of consumer cultures in the modern world, for the mid nineteenth century through the present. Focusing mainly on the cases of France, the United States and Japan, it will trace the broad shift from elite luxury consumption to popular, and eventually global consumer culture over this period.

GLST.7120 Media and Global Culture (Formerly GLS.712) - Credits: 3

In this course students will examine the development and increasing interrelatedness of the media industries from the early twentieth century to the present and the range of theoretical and critical approaches taken toward media industries. The emerging field of "Media industry studies" that emphasizes the importance of integrating analysis of media structures with consideration of cultural, global and textual matters will be explored.

GLST.7130 Seminar on Global Trafficking. (Formerly GLS.713) - Credits: 3

This course will examine the threat that global trafficking poses to a nation’s security, political stability, economic development, and social fabric. Illicit economic activities are a global phenomenon with local impact.

GLST.7140 Globalization, Feminism, and Liberalism (Formerly GLS.714) - Credits: 3

This course provides students with opportunities to gain an understanding of the issues necessary to consider whether, and to what extent, liberalism and feminism are compatible in a global context. The importance of critical thinking and communication are emphasized.
GLST.7150 International Migration in the Global World (Formerly GLS.715) - Credits: 3
This course offers a holistic view of the migration process from multiple disciplinary perspectives with multiple levels of analysis and aspects of the world. The course further reflects the need to examine migration as a general social process as well as a personal/individual experience that can be both liberating and limiting.

GLST.7160 Advanced Seminar in Global History, Politics and Theory (Formerly GLS.716) - Credits: 0
This seminar provides an overview of the history, politics and theories that underpin Global Studies. Particular emphasis is on identifying the main points of debate and contrasting research traditions within the field, developing the critical analytic skills necessary to evaluate the contrasting arguments made within the field, and grounding individual empirical interests within the context of the broader theoretical and methodological issues.

GLST.7170 Developing Economies (Formerly GLS.717) - Credits: 3
The emphasis of this course is an examination of globalization and whether it can be made a human-centered process, to historically examine the interrelatedness of the world economy to determine how policies shaped by industrialized countries impact developing countries, and to define key terms including poverty, sustainable development, market, informal economy, and civil society.

GLST.7200 Special Topics Seminar in Comparative Cultures (Formerly GLS.720) - Credits: 3
This special topics seminar engages students in humanistic and artistic approaches to cultural inquiry. An awareness and understanding of cultures, especially through literature, language, media and the arts are viewed as essential to a holistic understanding of global systems. This seminar applies techniques of intercultural inquiry at the intersection of culture, creativity, and technology through applied fieldwork projects.

GLST.7210 Curricular Practical Training - Credits: 1
An internship, practicum or other type of employment that is either required by the student’s academic program or an experience for which a student receives academic credit. To be eligible the student must be in legal F-1 status and have been enrolled full-time for one academic year. CPT work experience must be in the student’s field of study and contain a curricular component. Contact the Global Studies Program Director for additional details.

GLST.7530 Doctoral Dissertation/Global Studies (Formerly GLS 753) - Credits: 3
Doctoral Dissertation Research.

GLST.7560 Doctoral Dissertation/Global Studies (Formerly GLS 756) - Credits: 6
Doctoral Dissertation Research.

GLST.7590 Doctoral Dissertation/Global Studies (Formerly GLS 759) - Credits: 9
Doctoral Dissertation Research.

GLST.7610 Dissertation Review/Global Studies (Formerly GLS 761) - Credits: 1
Dissertation Review.

GLST.7910 Global Studies Directed Studies (Formerly GLS.791) - Credits: 3
Global Studies Directed Studies
Master of Arts in History

- Admissions
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The Master of Arts (M.A.) in History is designed for those who teach in local schools, those who wish to prepare for a Ph.D. program and those who seek the additional intellectual challenge of graduate work in History.

The Master of Arts (M.A.) in History, with concentrations in U.S. History and Global Comparative History, requires thirty credits of coursework. The U.S. History concentration includes standard topics in American history as well as more specialized courses in local history, public history and industrial history. The Global Comparative History concentration allows students to choose from an array of courses covering a broad geographical and temporal range.

Students may be full or part-time. A full-time student could complete the M.A. degree in one and a half full academic years (summer attendance included).

Admissions

Students of all backgrounds are encouraged to apply. There is no application deadline; applications are accepted on a rolling basis.

Application Requirements:

1. Graduate Application and Application Fee, To apply online: Graduate Admissions. (http://www.uml.edu/grad/)
2. Bachelor’s degree from an accredited college or university.
3. An undergraduate grade point average of 3.0 or better. At the discretion of the department’s Graduate Admissions Committee, students may be admitted with a grade point average below 3.0 if they substantive work experience in the field, including successful classroom teaching.
4. Acceptable scores on the Graduate Record Examination. There is no minimum GRE Score. However, we recommend a Verbal Score in the 55th percentile or better and a Analytical Essay score of at least 4.5. GRE’s are waived for: UMass Lowell B.A./M.A. applicants UMass Lowell alumni who graduated in the last five years with a 3.0 GPA or higher. Applicants who earned a graduate certificate from UMass Lowell with a 3.5 GPA or higher. Applicants with an earned Master’s degree from an accredited college or university in the United States.
5. Students for whom English is not a national language must also submit a score for the test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS). The minimum acceptable score on the TOEFL is 570 for the paper test and for the new Internet-based test the aggregate minimum is 79. The minimum IELTS score is 6.5.
7. A personal Statement
8. A curriculum vitae summarizing education and work experience.
9. In addition, the Department’s Graduate Admissions Committee may request an interview.

B.A. / M.A. Candidates

UMass Lowell undergraduates who wish to be B.A. / M.A. candidates may apply to the program and waive the GRE test and application fee. To apply to the B.A. / M.A. program, a student must have a minimum cumulative GPA of 3.0 for all previous course work. Application is typically submitted during the student’s second semester of their junior year but may be submitted through senior year.

B.A. / M.A. application requirements:

2. An overall GPA of 3.0 or better
3. Two Letters of recommendation from UMass Lowell History Department faculty.
4. A personal statement that describes the student’s interest in a History Master’s degree

Additional B.A. / M.A. Information:

1. Students admitted to the B.A. / M.A. program are
accepted on a conditional basis with the requirement that students receive their bachelor’s degree at the end of their senior year and graduate with a minimum cumulative GPA of 3.0. If students do not meet this requirement, their master’s degree candidacy will be voided and they would be required to re-apply via the traditional application process.

2. B.A. / M.A. students must complete their bachelor’s degree first before graduate admissions can change their status to that of a fully matriculated graduate student.

3. B.A. / M.A. students may defer their graduate matriculation for up to one year following their graduation for the bachelor’s degree. A request for deferral must be made to the Graduate Admissions Office in writing. After one year of deferral, failure to register for graduate classes will invalidate their acceptance into the master’s program.

Curriculum

Program requirements include thirty credits of coursework which may be completed in one of three ways:

1. Ten three-credit graduate courses;
2. Nine three-credit graduate courses and a three-credit project or internship with an area historical society or organization;
3. Eight three-credit graduate courses and a six-credit thesis.

Required Courses:

- HIST.5010 The Practice of History
- 5000 Level History Research Seminar as approved by Graduate Coordinator.

Electives:

Students completing a thesis take six electives and those doing a project or internship take 7 electives. Students not doing a thesis or project/internship take 8 electives.

- HIST.5020 Introduction to Archives
- HIST.5100 Modern Revolutions in a Global Context
- HIST.5110 History of College, 1100-1900
- HIST.5120 Athenian Democracy and Political Culture
- HIST.5130 World History: Theory and Practice
- HIST.5160 Consumer Cultures in Historical Perspective
- HIST.5350 Immigration History
- HIST.5360 Readings on the Great Depression and the New Deal
- HIST.5400 Law, Politics and Society in Early America
- HIST.5450 Native People of the Northern Woodlands
- HIST.5460 Topics in African American History
- HIST.5470 History of the U.S. South
- HIST.5500 Graduate Reading Seminar: Imperial Japan, 1894-1952
- HIST.5510 Reading Seminar on Modern China
- HIST.5520 Enterprise in Latin America
- HIST.5590 Reconstructing America: Upheaval, Immigration and Reform
- HIST.5900 Topics in History
- HIST.5910 Directed Study

With the approval of the Graduate Coordinator, students may count up to two graduate-level courses (6 credits) outside of the History Department as electives.

Transfer Credit

Matriculated students are allowed to transfer up to 12 credits of graduate course work completed with a grade of B or better taken in other departments at UMass Lowell or at other accredited college or universities in the United States or Canada, provided that the courses are within a relevant content area and do not involve credit for field experience or professional work. Such transfer credit is subject to the approval of the Graduate Coordinator and the Registrar’s Office.

Advising and Support

Each entering student will be assigned to an adviser from among the History Department’s full-time faculty. The student will meet with his/her adviser on a regular basis throughout their years of study to discuss course selection and academic progress. It is our expectation that faculty advisers and student advisees will meet at least once each semester.

Learning Outcomes

Students in the M.A. program will develop a thorough grounding in the historical process and a greater empathy and special perspective for viewing human thought and action through a broad exposure to the complexities that shape the forces of civilization. Graduates will recognize the distinctiveness of people and societies of the past and acknowledge the threads that connect the experiences of these people over time. Learning outcome include:
1. How to think historically, that is, a heightened ability to understand and explain change over time, utilizing multiple sources.
2. Demonstrate a thorough grounding in the historical process and a variety of perspectives through which to view human thought and action.
3. Demonstrate an understanding of the distinctiveness of people and societies of the past, as well as the threads that connect the experiences of all peoples over time.
4. How to critically evaluate and work with a wide range of primary source materials.
5. Effective oral and written communication skills so as to be able to present reading and research findings effectively in written and in spoken presentations; to be able to tell the story well.
6. Demonstrate an understanding of interpretations developed by different historians.
7. Greater Understanding of linked global histories.

Contact

For more information about the program or to contact the coordinator, please visit the History Department website (http://www.uml.edu/FAHSS/History/graduate.aspx).
HIST.5010 The Practice of History (Formerly 43.501) - Credits: 3

This course surveys the range of methodology and philosophy associated with various approaches to historical study. It includes a general introduction to the discipline as well as topical sections dealing with Historical Materialism, the Annales School, Postmodernism, Gender History, Post-Colonial Studies, and Public History, wrapping up with a focused reflection on the material as a whole.

HIST.5020 Introduction to Archives (Formerly 43.502) - Credits: 3

How should we remember and document the past? This course introduces students to the goals and operation of archives, which play a crucial role in the preservation of historical sources. The course considers archival administration, funding, management, record-keeping (both paper and digital), and security. Field trips to university, municipal, and national archives are expected, as well as occasional guest speakers from the world of archives. Students will complete a variety of different writing assignments as well as brief oral presentations.

HIST.5100 Modern Revolutions in a Global Context (Formerly 43.510) - Credits: 3

Course is an introduction to the historical study of revolutions and revolutionary movements. We will define revolution and examine competing theories about its causes, outcomes, and processes through the study of several revolutions, upheavals, coups, and rebellions from around the world. We will read about and discuss the origins of the modern idea of revolution and a few leading theorists and theories along with our historical analyses. Over the course of the semester, we will identify the elements of a revolution and the specific historical, social, and political contexts that create them.

HIST.5110 History of College, 1100-1900 (Formerly 43.511) - Credits: 3

The foundation of universities in late medieval Europe also ushered in the earliest colleges, intended primarily to house students but also to provide tutoring, social support, and financial assistance. The earliest colleges arose in Paris but soon spread to Bologna, Oxford, and other university towns. This course traces the history of colleges from late medieval Europe to nineteenth-century America. It considers the various models of colleges that developed in northern and southern Europe, and how those models were transferred across the Atlantic. Some colleges remained primarily residences, while others expanded to offer a full graduate and undergraduate curriculum. We will also consider topics like student life, financial arrangements, admissions, alumni, and academic requirements.

HIST.5120 Athenian Democracy and Political Culture (Formerly 43.512) - Credits: 3

The Athenian democracy serves as a key reference point in the history of democratic governance and is one of the best documented periods and institutions in ancient Greek history. We will undertake a detailed examination of the ways in which the workings of the Athenian democracy and state evolved throughout antiquity and the ways in which the workings of the Athenian democracy and state evolved throughout antiquity and the ways in which this form of radical democracy was viewed and critiqued during the period itself. The course will provide both an overview of Athenian institutional and social histories as well as a methodological survey of the variety of source material used by historians of ancient Athens. We will also look at broader issues including the connection between democracy and empire in the fifth century, social class, and the critique of democracy.

HIST.5130 World History: Theory and Practice (Formerly 43.513) - Credits: 3

In an increasingly globalized and diverse age, world history has become a growing teaching field at the secondary and the college level in the United States. The overarching purpose of this class is to prepare students as teachers and practitioners of world history. This course will introduce the field and concepts of world history. It will familiarize students with available materials such as textbooks, readers, primary documents, academic books and articles, websites, and podcasts. This course also exposes students to the global processes that have shaped our world since roughly the year 1400. Taking a global comparative perspective, this course will help students to develop a topical, chronological, and geographical understanding of global history and cultures.

HIST.5150 Contemporary Global Issues in Historical Perspective - Credits: 3

In a period of intensifying globalization a basic understanding of our world is increasingly important. By looking at various contemporary issues, such as the revolutions in the Muslim world, atrocious war, gender, corruption, religion vs. secularism, immigration, and global economic issues, this course will provide historically grounded perspectives of contemporary issues around the world.

HIST.5160 Consumer Cultures in Historical Perspective (Formerly 43.516) - Credits: 3

This course examines the emergence and historical impact of consumer cultures in the modern world, from the mid
Moving between Europe, North America, Asia and Africa, it will trace the broad shift from elite luxury consumption to popular, and eventually global consumer culture over this period. Individual classes will focus on issues such as the emergence of new retailing practices and spaces of consumption; changing attitudes towards material life; the construction of modern social identities of class, gender, generation and race through consumption; and political struggles over consumption. Our approach will be an interdisciplinary one, involving multiple tools of analysis and a great variety of both written and visual historical materials.

**HIST.5170 Post-Colonial Europe, 1945 to the Present - Credits: 3**

This course considers recent European history through a postcolonial optic, with particular focus on ongoing European dilemmas of immigration, assimilation and multiculturalism. Its approach will be interdisciplinary, beginning a critical reflection upon salient examples of postcolonial theory, and then moving through three different thematic units. The first will be immigration and immigration politics, as those came to the very fore of European concern from the 1960s forward. The final unit adopts a cultural approach, using film, fiction, memoir, music and other sources to explore the textures of individual and community life among those of immigrant decent within contemporary Europe.

**HIST.5350 Immigration History (Formerly 43.535) - Credits: 3**

The course focuses on the experiences of women, men, and children who came to the U.S. from the colonial era through the 21st century. Their emigrations will be examined in a global context. Irish migration, the mass European migrations during the last 19th / early 20th centuries, and post-Second World War immigration particularly from Asian and African countries are discussed. The Lawrence, Lowell, and Boston immigration stories are extensively considered. Students will acquire an understanding of U.S. Immigration History - Both the experiences of immigrants and reactions to that immigration over time, including the frequent passage of federal legislation to block or impede immigration. Students will utilize area immigration archives to produce original research on the topic.

**HIST.5360 Readings on the Great Depression and the New Deal (Formerly 43.536) - Credits: 3**

This course examines a turbulent period in American history: the era of the great economic boom and cultural revolution of the 1920s, the Great Depression and the New Deal, and World War II. This course critically examines the growth of a consumer economy in the 1920s, the cause of the Depression, and how the New Deal response affected the lives of ordinary Americans. We take a close look at the Great Migration of African Americans out of the South and how it affected race relations and the impact of the Great Depression and the New Deal on women. Finally, we consider how the country shook off its isolationism and emerged at the end of the Second World War as the world’s hegemonic superpower. Throughout, we consider the period’s larger lessons for other disjunctions in history.

**HIST.5400 Law, Politics and Society in Early America (Formerly 43.540) - Credits: 3**

This class closely examines the colonies of Virginia, Maryland, Massachusetts, Maine, New Netherland/New York, Rhode Island and the Carolinas from the early seventeenth century through the mid-eighteenth century. The class focuses particularly on the wide range of legal, political and social systems present in British North America which made it possible for certain colonies to survive and thrive, while other colonies foundered and failed. Students will master a wide range of primary and secondary sources during the semester and will finish by conducting their own research on one of these seven colonies.

**HIST.5410 The American Revolution in the World - Credits: 3**

The American Revolution began as a North American conflict between the newly formed United States and Great Britain over the question of whether the thirteen colonies could become an independent nation. The entrance of France, the Netherlands and Spain into the war in the late 1770s made the Revolution a conflict which could be fought anywhere these five countries shared borders, whether in North America, Europe or Asia. The class will also examine the experiences of both Native Americans and African Americans in the Atlantic World as they experienced the war in far ranging ways. The class will use both primary and secondary sources and culminate in a research paper of topics chosen by individual students.

**HIST.5430 The North During the Civil War - Credits: 3**

Many classes about the Civil War era (1848-1877) focus on the changes brought about in southern society, especially the overthrow of slavery and the transformation of race relations. This course will analyze the dramatic changes that northern society experienced during this period. The North saw important transformations in its economy, government, and society. This course will explore changes in the North’s economy, work cultures, politics, gender system, and race relations, as well as how those developments both brought about the war and were accelerated by the Civil War. By the end of the semester, we will have a fuller understanding of the inter-relationships between the Industrial Revolution,
capitalism, and U.S. victory in 1865.

HIST.5450 Native Peoples of the Northern Eastern Woodlands (Formerly 43.545) - Credits: 3

Students will analyze and research the history of the Native peoples of the northern Eastern Woodlands - an area encompassing the northeastern U.S., southeastern Canada, and the North American Great Lakes region. The course provides coverage from pre-contact to the present. It emphasizes contributions of the first peoples to the broader course of the history of the northern Eastern Woodland region. The course offers a framework for understanding indigenous Americans and their historical experiences by exploring the forces of continuity and change that have shaped Native Americans' lives through time and space. This view will stress the ongoing presence of American Indian peoples and their efforts to preserve the integrity and viability of their dynamic and self-directed societies.

HIST.5460 Topics in African-American History (Formerly 43.546) - Credits: 3

This graduate-level course examines important ideas and events in African-American history as well as debates among historians about how to interpret these ideas and events. We will examine slavery and its demise, the labor system that emerged after slavery, violence against and intimidation of blacks, the relocation of millions of African Americans from the rural South to the urban North, and the struggle for civil rights, among other topics. A theme that runs through the course is how African Americans were able to build a rich and vibrant culture as well as strong networks of kinship even as masters, landlords, and others sought to control their labor and deny them political and other rights.

HIST.5470 History of the U.S. South (Formerly 43.547) - Credits: 3

This graduate course examines selected topics in the history of the United States South from the seventeenth century through the present. Topics include the development of plantation slavery, the Civil War and Reconstruction, industrialization and the "New South," segregation and disenfranchisement, the Civil Rights Movement, and conservatism. A theme that runs through the course is the question of how "new" the "New South" was - that is, to what extent Southerners left behind antebellum patterns of labor relations and social hierarchies as they remade their region after the Civil War.

HIST.5500 Graduate Reading Seminar: Imperial Japan, 1894-1952 (Formerly 43.550) - Credits: 3

This course is a reading and writing intensive study of the political, social, cultural, and economic history of Imperial Japan, from the First Sino-Japanese War (1894-1895) through the end of the American occupation after the Pacific War (1952).

HIST.5510 Reading Seminar on Modern China (Formerly 43.551) - Credits: 3

The course explores the intersection of tradition and revolution in modern Chinese history. It is a seminar where students do assigned readings and come to class prepared to discuss the readings. The objective of the course is to gain a critical understanding of China's modernization process - the traditional and radical forces that shaped the process, the impact of the process on everyday life, and the blending of what is traditionally Chinese and what is modern or borrowed from the outside.

HIST.5511 Transformation of Rural China - Credits: 3

A reading seminar exploring political, economic, and cultural changes in rural China since the 1920s. Special emphases are given to the Western impact on traditional China, the Land Reform, the collective period, and the post-1978 economic reforms. Students will read investigative reports, anthropological field work, scholarly analysis, and memoirs on China's rural transformation, engage in seminar-style discussions, write analytical and critical papers of assigned topics, and produce a final research paper on a topic of his/her own choice.

HIST.5515 Topics in Middle East History: Environmental History of the Middle East and North Africa - Credits: 3

This course is designed to introduce students to the intensive study of a particular aspect of Middle East History. In this course, with a focus on environmental factors, we will consider various historical perspectives on colonialism, nationalism, capitalism, gender and sexuality, empire, race, and class. What are some of the benefits of these interpretations? Are there also drawbacks? Students will explore this history through reading both primary and secondary sources. They will also pursue their own research project on a topic of their choosing in Middle East environmental history.

HIST.5520 Enterprise in Latin America (Formerly 43.552) - Credits: 3

This M.A.-level course introduces students to the history of enterprise in Latin America through four case studies and a research project. No prior knowledge of Latin American history is required or expected. Each of the case studies, including the students’ own research projects on an enterprise
in Latin America, will consider the wide range of factors that impact a business. These include infrastructure, government regulations and policy, labor, markets, and environmental concerns, among others. The case studies and readings may change from semester to semester, but will be representative of different time periods and regions within Latin America.

Throughout the semester, the class will also consider the historical legacies of each enterprise and how it continues to affect the region’s economic and political development today.

HIST.5590 Reconstructing America: Upheaval, Immigration, and Reform (Formerly 43.559) - Credits: 3

The second year of the Teaching American History Project, involving UMass Lowell and eight school districts in the Greater Boston Area, will include a week-long Summer Institute, title "reconstructing America: Upheaval, Immigration, and Reform". The institute’s seminars, readings, and field trip will focus on several topics tied to immigration, internal migration, social and economic struggle, and reform. This encompasses a history of the major immigrant groups in late 19th and early 20th century America; settlement, acculturation and resistance; Jim Crow and the Great Migration in the early 20th century; and post World War II immigration and refugee settlement. The Summer Institute will offer a blend of U.S. history and local history, namely Lowell and Lawrence, Massachusetts, with readings tied to recent scholarship in African-American, Latino, and Euro-American immigrant history.

HIST.5910 Directed Study (Formerly 43.491/591) - Credits: 1-4

Directed study offers the student the opportunity to engage in an independent study or research project under the supervision of a department member. Working closely with the instructor, students define and investigate a research topic in an area of special interest and present the results of their investigation in a significant paper. Juniors and seniors only.

HIST.5990 Thesis in History - Credits: 3-6

For History graduate students actively engaged in research leading toward the submission of a written thesis for completion of their degree. A program of supervised study will be arranged between the student and a faculty supervisor.
LGST.5140 Engineering Law (Formerly 41.514) -
Credits: 3
Music

Department of Music

Graduate Programs Offered:
- Master of Music in Music Education
- Master of Music in Sound Recording Technology
- Bachelor’s-Master’s Program

Objectives of the Graduate Programs in Music

The graduate programs in Music are committed to the development of innovative, creative and technologically savvy professional musicians. The specific objectives of the various degree programs are listed under the individual program descriptions.

General Requirements for Admission

Applicants for admission to the Master of Music degree program must possess a bachelor’s degree or its equivalent with a major in music. Those holding degrees in other disciplines will be expected to take prerequisite undergraduate courses for no graduate credit to bring their skills to a level commensurate with that attained by an undergraduate music major in the area of the application. Some prerequisites may be waived at the discretion of the Department of Music through distinguished results on placement examinations and/or professional experiences and achievement.

All applicants are expected to present an undergraduate record of sufficient quality to assure a reasonable expectation of successful graduate achievement. Candidates for admission must submit the required Graduate School application forms, GRE scores, and official transcripts of previous post-secondary education. Applicants for admission to the Master of Music in Sound Recording Technology must also provide a production portfolio demonstrating technical and artistic capabilities indicative of graduate level work. Applicants for admission to the Master of Music Education and the Master of Music in Music Education (Research Thesis/Project Track) must have passed the Massachusetts Tests for Educator Licensure (MTEL) test in Music within the last five years and must submit the results of this test. Each program requires additional materials or examinations which must be completed or filed by the applicant. Please review the materials for information on individual programs.

Advising

Successful candidates for admission will be assigned a faculty advisor and notified of registration dates and other pertinent information.

General Program Requirements

All Master of Music programs require a minimum of 30 credits. Each program has a required capstone component. Depending on the program, this will be apprentice teaching, a thesis, a recording project, a research project, or an internship. Specific requirements are listed under the individual program descriptions.

Master’s Programs in Music

The Music Department offers the following graduate degrees:
- Master of Music in Music Education (Research Thesis/Project Track) This does not lead to licensure.
- Master of Music in Music Education (Community Music Option) This does not lead to licensure.
- Master of Music Education (leads to certification)
- Master of Music in Sound Recording Technology

Master of Music in Music Education (Research Thesis/Project Track OR Community Music Option)

Program Objectives

The Master of Music in Music Education (Research Thesis/Project Track OR community Music Option) at UMass Lowell provide advanced study of music teaching and learning and professional preparation for those engaged in or aspiring to a career as a music educator.

The Master of Music in Music Education has two non-certification options consisting of the research-based Research Thesis/Project track for fully-certified music teachers who are seeking professionalization and the Community Music option which serves to broaden the definition of music education to include other venues beyond public school teaching such as community outreach programs, arts organizations and educational media.

All of our programs are designed to facilitate students’ growth and development as leaders in the profession of music education; as creative problem solvers and innovative thinkers; as individuals who love music and the arts and utilize their knowledge of and enthusiasm for music to inspire students; and as contributors, through research, to the profession and discipline of music education.

The Music Education curriculum is based on the belief that music educators must have comprehensive knowledge of the subject matter of music, an awareness of current theory and practice in music education, and an understanding of recent curriculum development and contemporary issues in general
education.

**Admission Requirements**

In addition to the admission requirements for all applicants to the Master of Music programs, applicants to the music education program must submit:

1. Resume

For the thesis option:

1. verification of initial certification in music and/or proof of music teaching experience
2. a sample of your scholarly writing about music or music education. This may be a term paper or research paper written in any baccalaureate level music class, providing evidence of writing skills and potential for writing at the level of a graduate thesis.

For the certification option:

1. verification of appropriate MTEL passing scores and/or provisional certification.
2. an essay of at least three typewritten pages addressing the following: The applicant’s purpose and specific objectives in pursuing graduate study in music education; the applicant’s philosophy of education in general and arts education in particular.

**Program Requirements - Certification Option**

**Pedagogy 6-9 Credits**

- MUED.6010* Seminar in Music Education - Socio-Cultural Influences
- MUED.5100* Foundation of Music Education
- MUED.5150 Curriculum Design in Music Education

**Research - 3 credits**

- MUED.6500* Research in Music Education

**General Education - 3 - 6 Credits**

- EDUC.5010 Teaching Diverse Populations
- EDUC.5020 Adolescent Development & Behavior

**Music Theory/History - 3 Credits**

- MUTH.6100* Structure, Context and Style

**Graduate Performance Ensembles - 3 credits**

**Teaching Practicum**

- MUED.5950* Practicum & Analysis

**Program Requirements - Research/Thesis/Project Option**

**Pedagogy 6-9 Credits**

- MUED.6010* Seminar in Music Education - Socio-Cultural Influences
- Music Ed Electives - 6 credits

**Research - 3 credits**

- MUED.6500* Research in Music Education

**Music Core - 9 Credits**

- MUTH.6100* Structure, Context and Style
- Non-Music Ed Electives - 6 credits
- Performance Ensembles - 2 credits
- Applied Music - 4 credits
- Project or Thesis - 3 credits

**Master of Music in Sound Recording Technology**

**Concentrations:**

- Technical
- Production

**Program Objectives**

The Master of Music in Sound Recording Technology (MM:SRT) program enhances the musical and technical capabilities of the graduate through deep studies of the area, science and practice in this ever-advancing field. Significant hands-on, in-studio project work, using the newest technologies and a broad collection of time-proven vintage equipment, enables the student to apply their acquired knowledge toward artistic and research projects throughout the two years of study. Technology is always studied in the context of the relevant aesthetics - for music, picture or games: in live performance or in the studio.

Graduates of the program find meaningful careers in music production and engineering, sound design, music performance, technical support, research and development, product
management, test and measurement, system design, education and more.

The program prepares graduates to be lifelong learners in a changing, high tech field through foundational studies and experiences with a music technology core, informed by advanced critical listening, empowered by problem solving and critical thinking, challenged by leading edge innovation and guided by deep knowledge of the associated arts.

Admission Requirements

In addition to the admission requirements for all applicants to the Master of Music programs, applicants to the sound recording technology program must submit

1. Transcripts demonstrating completion of an undergraduate degree in an area related to the audio industry. We seek applicants whose undergraduate studies included in-depth studies across the disciplines of audio, music, and science. Students whose undergraduate studies do not include all of the programs three main disciplines are expected to demonstrate compensating excellence in at least two of them, plus documented threshold capabilities in the third. This will be done through the portfolio, college transcripts, and/or documented professional experience.

2. A Production Portfolio demonstrating suitable production skill and experience, with detailed documentation. We request three example projects -- either audio-only productions where the applicant was the primary engineer, or video/film projects for which the applicant provided audio post-production work. All media (USB drives, CD, DVD, Blue Ray) must be clearly and fully labeled. We understand that projects are often a collaboration among a number of people. Applicant should choose recordings in which they made a significant contribution, clearly defining their role in the project [e.g., producer, recording engineer (all tracks), sound designer, synthesis, composer, recording engineer (drums and vocals only), mix engineer, etc.]. Each project should be accompanied by document, (digital preferred) of no less than three pages (and it may run to several more) documenting performers, location, technology, techniques, and the exact nature of the applicants contributions. Information on equipment and techniques used is especially important. Copies of original session documentation (Track Sheets, Set-up Sheets, Recall Sheets) and/or a complete list and description of the equipment used in the creation of each submitted recording are strongly desired. Photos showing instrument placement within the room and microphone placement around instruments are welcome. Finally, include a discussion of your creative goals on each project and how it influenced your technical approach to the making of the recording. The Production Portfolio is designed to be open-ended enough for you to express yourself creatively, demonstrate success in any related discipline, and show attention to detail.

3. Demonstrated proficiency in college-level math and science through relevant course work or standardized tests or college transcripts.

4. A Statement of Career Objectives and Interests showing the applicants specific goals and motivations for graduate study in sound recording technology.

5. Three letters of recommendation which evidence the students preparedness for graduate study in the MM: SRT program.

6. All other requirements for Graduate Admission by UMass Lowell (see admissions requirements)

Program Concentrations

MM:SRT offers two concentrations. The Technical Concentration is for students with a strong math and science background, leading to publication of a research thesis in the sound recording technology field. The Production Concentrations capstone effort is the Masters Recording Project, for students focused on the art and practice of sound recording.

The Technical Concentration

The Technical Concentration requires the student to complete the SRT masters thesis and at least one technical elective course that is approved in advance by the student’s faculty advisor.

Major Field (15 credits)
MUSR.5200 Recording Analysis (3)
MUSR.6300 Technologies of Audio (3)
MUSR.6400 Production Practicum (3)
MUSR.7430 SRT Masters Thesis (6)

**Music Core (9 credits)**
- MUTH.6100 Structure, Context, and Style (3)
- MUSR.6500 Research in SRT (3)
- MUEN.xxxx Ensemble Participation (3) (Multiple Course Options Available)

**Electives (6 credits)**
Technical elective (one from below)
- MUSR.5900 Advanced Acoustics for Audio (3)
- MUSR.6100 Digital Media (3)
- MUSR.6600 Seminar in Audio (3)
- MUSR.5450 Advanced Mix Techniques (3)
- Free elective [approved by the faculty advisor] (3)

**The Production Concentration**
The Production Concentration requires the student to complete the masters recording project and at least one production elective related to their capstone project.

**Major Field (15 credits)**
- MUSR.5200 Recording Analysis (3)
- MUSR.6300 Technologies of Audio (3)
- MUSR.6400 Production Practicum (3)
- MUSR.7400 Masters Recording Project (6)

**Music Core (9 credits)**
- MUTH.6100 Structure, Context, and Style (3)
- MUSR.6500 Research in SRT (3)
- MUEN.xxxx Ensemble Participation (3) (Multiple Course Options Available)

**Electives (6 credits)**
Production elective (one from below)
- MUSR.4410 Advanced Multitrack Recording (3)
- MUSR.4600 Audio for Visuals (3)
- MUSR.4300 Computer Applications in Music (3)
- MUSR.5500 Advanced Video Production (3)
- MUSR.5450 Advanced Mix Techniques (3)
- Free elective [approved by the faculty advisor] (3)

**Master of Music in Music Education (Teaching Certification)**

**Objectives of the Master of Music in Music Education (Teaching Certification)**
The Master of Music in Music Education (Teaching Certification) is for music teachers who are in the process of earning their initial teacher certification in Massachusetts.

The Master of Music in Music Education (Teaching Certification) is also the graduate segment of the music teacher preparation/certification program at the university for Graduates of our Music Studies program. Upon successful completion of the Massachusetts Tests for Educator Licensure (MTEL), Music Studies graduates may apply directly for the Master of Music in Music Education (Teaching Certification) degree. Upon completion of this degree program, through our Graduate School of Education, students may file an application to the Massachusetts Department of Education for initial licensure and become fully certified teachers in Massachusetts.

**Admission Requirements**
1. Applicants must possess a bachelor’s degree or its equivalent with a major in music. Applicants who possess an undergraduate degree in music education will not be considered for admission to the Master of Music in Music Education (Teaching Certification), as these students will have completed their student teaching and obtained initial teacher certification. Those applicants will be considered for admission to the Master of Music in Music Education non-licensure tracks.
2. Applicants for the Master of Music in Music Education (Teaching Certification) program must present evidence of having passed all parts of the Massachusetts Teachers’ Test.
3. Official transcripts from each undergraduate and graduate school previously attended must be submitted directly to the Graduate Admissions Office.
4. An official copy of the applicant’s scores obtained on the Graduate Record Examination must be mailed directly to the Graduate Admissions Office.
5. Three letters of recommendation from persons who are
qualified to evaluate the applicant’s academic and professional abilities.

6. Applicants must have taken course work equivalent to the University of Massachusetts Lowell Bachelor of Music in Music Studies degree.

Program Requirements - Certification Option Pedagogy 6 - 9 Credits

- MUED.6010* Seminar in Music Education - Socio-Cultural Influences
- MUED.5100* Foundations of Music Education
- MUED.5150 Curriculum Design in Music Education

Research - 3 Credits

- MUED.6100* Research in Music Education

General Education - 3 to 6 Credits

- EDUC.5010 Teaching Diverse Populations
- EDUC.5020 Adolescent Development & Behavior

Music Theory/History - 3 Credits

- MUTH.6100* Structure, Context and Style

Graduate Performance Ensembles - 3 Credits Teaching Practicum

- MUED.5950* Practicum &Analysis
MUHI.5940 Graduate Directed Study in Musicology  
(Formerly 74.594) - Credits: 3
MUHI.5950 Graduate Directed Study in Musicology  
(Formerly 74.595) - Credits: 3
MUTH.5950 Graduate Directed Study in Music Theory  
(Formerly 71.595) - Credits: 3
MUTH.6100 Structure, Context and Style  
(Formerly 71.610) - Credits: 3

This course will bring the student to a concept of music in its theoretical, historical and cultural contexts, building on the materials and techniques acquired in undergraduate studies. Required for all Master of Music Students.
MUBU.5040 Arts Administration and Marketing  
(Formerly 77.504) - Credits: 3

This course is designed to provide essential information regarding the structure and strategies for creating and maintaining a sustainable non-profit arts organization. Topics to be covered include: organizational structure; development; production; market research; and promotion.

MUBU.5250 Community Outreach Practicum 1  
(Formerly 77.525) - Credits: 1

The Community Outreach Practicum provides mentorship and initial hands-on training in the educational and arts management skills which will enable the student to build and direct community-based youth music programs.

MUBU.5260 Community Outreach Practicum 2  
(Formerly 77.526) - Credits: 1

The Community Outreach Practicum provides mentorship and initial hands-on training in the educational and arts management skills which will enable the student to build and direct community-based youth music programs.

MUBU.6250 Community Internship (Formerly 77.625) - Credits: 6

This course will provide students with the opportunity to gain real world experience in the administration of a Community Arts organization. Students will be required to undergo 300 hours of work under the direct supervision of the director of a Community Arts organization, in coordination with a University advisor. Students will conduct research into various arts organizations, revise resumes, and draft cover letters under the guidance of the course advisor in preparation for the internship application process. Students will be required to secure the internship pending approval of the course advisor.
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MUAP.5010</td>
<td>Graduate Applied Keyboard I (Formerly 72.501)</td>
<td>2</td>
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<tr>
<td>MUAP.5020</td>
<td>Graduate Applied Keyboard 2 (Formerly 72.502)</td>
<td>2</td>
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<tr>
<td>MUAP.5110</td>
<td>Graduate Applied Voice I (Formerly 72.511)</td>
<td>2</td>
</tr>
<tr>
<td>MUAP.5120</td>
<td>Graduate Applied Voice 2 (Formerly 72.512)</td>
<td>2</td>
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<tr>
<td>MUAP.5210</td>
<td>Graduate Applied Woodwinds 1 (Formerly 72.521)</td>
<td>2</td>
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<tr>
<td>MUAP.5220</td>
<td>Graduate Applied Woodwinds 2 (Formerly 72.522)</td>
<td>2</td>
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<tr>
<td>MUAP.5310</td>
<td>Graduate Applied Brass And Percussion 1</td>
<td>2</td>
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<tr>
<td>MUAP.5320</td>
<td>Graduate Applied Brass And Percussion 2</td>
<td>2</td>
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<tr>
<td>MUAP.5410</td>
<td>Graduate Applied Strings 1 (Formerly 72.541)</td>
<td>2</td>
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<tr>
<td>MUAP.5420</td>
<td>Graduate Applied Strings 2 (Formerly 72.542)</td>
<td>2</td>
</tr>
<tr>
<td>MUEN.5010</td>
<td>University Orchestra (Formerly 76.501)</td>
<td>1</td>
</tr>
<tr>
<td>MUEN.5020</td>
<td>Wind Ensemble (Formerly 76.502)</td>
<td>1</td>
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<tr>
<td>MUEN.5030</td>
<td>Chamber Singers (Formerly 76.503)</td>
<td>1</td>
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<tr>
<td>MUEN.5040</td>
<td>University Choir (Formerly 76.504)</td>
<td>1</td>
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Open to all students by audition. Includes the study and performance of a wide variety of choral compositions.

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<th>Credits</th>
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<tbody>
<tr>
<td>MUEN.5050</td>
<td>Concert Band (Formerly 76.505)</td>
<td>1</td>
</tr>
<tr>
<td>MUEN.5080</td>
<td>Studio Orchestra (Formerly 76.508)</td>
<td>1</td>
</tr>
<tr>
<td>MUEN.5510</td>
<td>Choral Union (Formerly 76.551)</td>
<td>1</td>
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</table>

A large chorus open to the campus and the community without audition. Performs larger works in the choral repertoire including oratorios, masses, motets and opera.

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<th>Credits</th>
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<tbody>
<tr>
<td>MUEN.5530</td>
<td>Percussion Ensemble (Formerly 76.553)</td>
<td>1</td>
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Open to all students by audition. Exploration of the growing body of literature for percussion ensemble. Public performance.

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<th>Credits</th>
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<tbody>
<tr>
<td>MUEN.5540</td>
<td>Classical Guitar Ensemble (Formerly 76.554)</td>
<td>1</td>
</tr>
<tr>
<td>MUEN.5550</td>
<td>Brass Ensemble (Formerly 76.555)</td>
<td>1</td>
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Open to all students by audition. Provides a wide range of performance experience through varied brass literature.

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<tbody>
<tr>
<td>MUEN.5560</td>
<td>Electric Guitar Ensemble (Formerly 76.556)</td>
<td>1</td>
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Open to all students by audition. Provides study and performance of literature for guitar, lute, etc. Required of all guitar majors each semester.

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<tbody>
<tr>
<td>MUEN.5580</td>
<td>Piano Ensemble (Formerly 76.558)</td>
<td>1</td>
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Open to all students by audition. Provides performance experiences through varied piano ensemble literature for one and two pianos.

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<th>Credits</th>
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<tbody>
<tr>
<td>MUEN.5590</td>
<td>Mixed Chamber Ensemble (Formerly 76.559)</td>
<td>1</td>
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</table>

Open to all students by audition. Offers a wide range of performance experience through a selection of literature for varying combinations of instruments.

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<th>Credits</th>
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<tbody>
<tr>
<td>MUEN.5600</td>
<td>String Ensemble (Formerly 76.560)</td>
<td>1</td>
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Open to all students by audition. Provides experience in the performance of string orchestra literature.

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<tr>
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<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MUEN.5610</td>
<td>Small Jazz Ensemble (Formerly 76.561)</td>
<td>1</td>
</tr>
</tbody>
</table>

Open to all students by audition. Provides experience in the performance of jazz literature for groups ranging from four to eight members.
MUEN.5620 Jazz Laboratory Ensemble (Formerly 76.562) - Credits: 1

Open to all students by audition. Provides students with a clear understanding of the skills, knowledge and attitudes necessary to satisfactory ensemble performance and practical experience in the application of such skills, knowledge and attitudes.

MUEN.5630 Recording Studio Ensemble (Formerly 76.563) - Credits: 1

This course introduces students to the music-making paradigm of the recording studio. Issues of musicianship and ensemble performance are addressed within the context of creating music recordings. Recording musicians must demonstrate music abilities in a range of spaces from live rooms to sound isolation booths, interacting with other musicians via microphones and headphones, contributing to music played live and previously recorded to a multitrack recorder by musicians at earlier recording sessions, collaborating with music producers and recording engineers. The ensemble includes a core rock/pop rhythm section of drums, electric bass, electric guitar, keyboards, and vocalists. Other musicians are welcome to contribute to the Studio ensemble as repertoire requires. Students will prepare representative recording studio works and original compositions. Students will complete several recordings by the end of the semester.

MUEN.5650 Jazz/Rock Big Band (Formerly 76.565) - Credits: 1

Open to all students by audition. Fusion big band covering a wide variety of contemporary jazz rock literature. Solo improvisational opportunities. Numerous performances.

MUEN.5700 Contemp Electronic Ensemble (Formerly 76.570) - Credits: 1

MUEN.6010 World Music Ensemble (Formerly 76.601) - Credits: 1

An immersion into the music of non-Western cultures, this course will provide instrumental and vocal instruction, as well as an introduction to the theory and cultural contexts that shape the practice of traditional music. The ensemble will meet weekly, with the goal of a public performance at the close of the semester.

MUEN.6020 Graduate Instrumental Ensemble (Formerly 76.602) - Credits: 2

MUEN.6250 Community Internship (Formerly 76.625) - Credits: 6
MUED.5000 Global Music for Classroom (Formerly 73.410/500) - Credits: 3
Focus on the music education profession’s response to multiculturalism in education as evidenced through the National Music Standards and an examination of resources and methodologies for teaching and understanding the music of diverse cultures, styles, and genres. As one of the core professional music education courses, the course includes the component of pre-practicum fieldwork. There will be an additional research project for Graduate Students enrolled in 73.500.

MUED.5010 Introduction To Brass Pedagogy 1 (Formerly 73.141/501) - Credits: 1
Intensive class instruction toward the development of basic performance proficiency on brass instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes.

MUED.5030 Introduction to Guitar Pedagogy (Formerly 73.143/503) - Credits: 1
Intensive class instruction toward the development of basic performance proficiency on the guitar and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes.

MUED.5040 Introduction to Woodwind Pedagogy I (Formerly 73.144/504) - Credits: 1
Intensive class instruction toward the development of basic performance proficiency on woodwind instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes.

MUED.5050 Introduction to Woodwind Pedagogy 2 (Formerly 73.145/505) - Credits: 1
A continuation of 73.144. Intensive class instruction toward the development of basic performance proficiency on woodwind instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes.

MUED.5060 Introduction to Percussion Pedagogy (Formerly 73.162/5060) - Credits: 1
Intensive class instruction toward the development of basic performance proficiency on percussion instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes.

MUED.5070 Introduction to Strings Pedagogy 1 (Formerly 73.241/507) - Credits: 1
Intensive class instruction toward the development of basic performance proficiency on string instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes.

MUED.5080 Introduction to String Pedagogy 2 (Formerly 73.242/508) - Credits: 1
Intensive class instruction toward the development of basic performance proficiency on string instruments and the development of pedagogical skills and techniques for beginning instruction and demonstration purposes.

MUED.5100 Foundations Of Music Education (Formerly 73.510) - Credits: 3
This course is intended for undergraduate students preparing for teacher certification in music. Course participants will explore the historical, psychological, and philosophical foundations upon which current practices in music education are built. Students will explore these concepts through readings, class discussions, individual and group presentations, and other dynamic and interactive processes.

MUED.5150 Special Topics in Music Education (Formerly 73.515) - Credits: 3
A variety of topics in Music Education will be explored such as children and the composition process, curriculum design, assessment and technology, which will vary from semester to semester.

MUED.5160 Introduction to Voice Pedagogy 1 (Formerly 73.244/516) - Credits: 1
Intended to cultivate the fundamental principles of singing. The psychology of singing and the psychology of the singing voice are considered as they apply to tone production and resonance.

MUED.5170 Introduction to Voice Pedagogy 2 (Formerly 73.245/517) - Credits: 1
A continuation of Voice Pedagogy 1. Intended to cultivate the fundamental principles of singing. The psychology of singing and the psychology of the singing voice are considered as they apply to tone production and resonance.

MUED.5220 Curriculum Design in Music Education (Formerly 73.522) - Credits: 3
This course will focus on how to design developmentally appropriate learner centered music curricula. We will explore what it is we are looking to achieve through the arts, what types of learning we are looking to develop and what are the instructional materials and methods needed to achieve these goals.

MUED.5440 General Music Methods 1 (Formerly 73.420/544) - Credits: 3

A course designed to present the basic fundamentals of general music pedagogy, including lesson planning and the writing of instructional objectives. The course discusses basic principles of curriculum and instruction, assessment, learning styles, and developmental psychology. These are related to state curriculum frameworks and National Music Standards 1-5. As one of the core professional music education courses, the course includes the component of pre-practicum fieldwork in selected settings.

MUED.5450 General Music Methods 2 (Formerly 73.430/545) - Credits: 3

Investigation of some of the most popular methods of teaching general music, including Orff, Kodaly, Dalcroze, and comprehensive musicianship. Discussion of contemporary issues including music in special education, multicultural music education, and National Music Standards 6-9. As one of the core professional music education courses, the course includes the component of fieldwork in selected settings.

MUED.5630 Choral Repertoire and Rehearsal Techniques (Formerly 73.563) - Credits: 3

Examination of appropriate choral repertoire for the secondary school level and effective choral rehearsal techniques. Covers auditioning, warmups, choral tone, diction, score preparation, and development of fundamental musicianship skills necessary for a successful choral ensemble. Serves as a choral laboratory setting for the practice of score preparation and rehearsal techniques.

MUED.5770 Instrumental Music Workshop (Formerly 73.577) - Credits: 1-3

This workshop is designed for music educators working with elementary, middle or high school instrumental ensembles, and for students seeking materials for practical application. Participants will explore band music through performance on instruments. Clinician will provide additional information as to technical facility and instrument specific rehearsal techniques.

MUED.5780 Music/Way of Knowing (Formerly 73.578) - Credits: 2

Nick Page presents a unique and practical fusion of ideas and skills, combining multiple intelligence and multicultural theories to create a powerful vision for music education. Using his book "Music as a Way of Knowing," Nick Page will show how music can come alive in a creative, positive environment with music as the center of a school’s curriculum - to teach history, culture, and science. Nick is a master song leader who has inspired music educators throughout North America. He is also the author of Sing and Shine On! An Innovative Guide to Leading Multicultural Song, and his choral music is published by Boosey & Hawkes and by World Music Press.

MUED.5830 Intro to Technology Applications for the Music Classroom (Formerly 73.583) - Credits: 2-3

Introduction to the role of computers and technology in music education programs. Course includes the development of computer literacy, including knowledge of word processing, database and spreadsheet applications as essential to educators, and explores MIDI, the Internet, music software, recording, multimedia and other technologies as educational tools.

MUED.5950 Practicum & Analysis (Formerly 73.595) - Credits: 9

This is the culminating experience in the Graduate Music Education Teaching Masters under the supervision of a public school supervising practitioner and a UMass Lowell Program Supervisor. Students are required to spend 8 weeks (minimum) teaching in an elementary placement and 8 weeks (minimum) in a secondary placement. Candidates are required to have passed both Communications and Literacy and Music portions of MTEL examinations and maintained an overall GPA of 3.0.

MUED.5960 Graduate Directed Study: Music Education (Formerly 73.596) - Credits: 3

Participants will develop a focused line of investigation with the supervision of a faculty member in Music Education. Approval of advisor is required.

MUED.6010 Seminar In Music Education (Formerly 73.601) - Credits: 3

This course examines the impact of popular culture on today's youth and its implications for the study of music. Students in this course will explore teaching strategies that link musical styles and conventions from other time periods to the present. Using music from various media as a springboard, there will be an emphasis on the development of technology rich teaching strategies for the K-12 music classroom.
MUED.6250 Community Internship (Formerly 73.625) - Credits: 6

This course will provide students with the opportunity to gain real world experience in the administration of a Community Arts organization. Students will be required to undergo 300 hours of work under the direct supervision of the director of a Community Arts organization, in coordination with a University advisor. Students will conduct research into various arts organizations, revise resumes, and draft cover letters under the guidance of the course advisor in preparation for the internship application process. Students will be required to secure the internship pending approval of the course advisor.

MUED.6500 Research in Music Education (Formerly 73.650) - Credits: 3

This is a required music graduate class that will highlight fundamental research techniques while focusing on multi-disciplinary aspects of writing about music. Relevant skills and practices: Students will learn how different project types are structured; students will discuss how research acts in the real world and its relevance to their field; The semester will be divided into writing the sections of a professional research paper, with students producing an article as their final project.

MUED.6950 Direct Study and Research (Formerly 73.695) - Credits: 3

Participants will develop a focused line of investigation with the supervision of a faculty member in Music Education. Approval of advisor is required.

MUED.6960 Project Report (Formerly 73.696) - Credits: 3

Original research through action research projects conducted in one's classroom. Students investigate learner-centered approaches to teaching, learning and evaluation. Written reports required.

MUED.7430 Master's Thesis, Music Education (Formerly 73.743) - Credits: 3

For graduate music education students actively engaged in research leading toward the submission of a written thesis. A program of supervised work will be arranged between the student and a faculty supervisor. Permission of the faculty member who will supervise the thesis is required.
Peace and Conflict Studies

Through the Peace and Conflict Studies Inter-disciplinary Program at UMass Lowell, undergraduate and graduate students explore the causes of violence, methods to resolve violence, and practices to build peace. We combine theoretical and experiential education to prepare students for success in graduate school and their careers.

The need for practitioners trained in conflict resolution, human rights advocacy, and violence prevention has never been greater. Peace and Conflict Studies graduates go into government, the business sector, and non-profit organizations in order to make a difference and apply their skills towards improving the world.

Undergraduate students can major or minor in Peace and Conflict Studies. UMass Lowell juniors and seniors can apply for the Accelerated BA to MA. Graduate Students can earn a Graduate Certificate or Master of Arts in Peace and Conflict Studies.

Other Links:
- Peace and Conflict Studies website (https://www.uml.edu/FAHSS/Peace-and-Conflict-Studies/default.aspx)
- Undergraduate Course of Study in Peace and Conflict Studies (https://www.uml.edu/catalog-AY18/pdf/Undergraduate.pdf)
- Graduate Course of Study in Peace and Conflict Studies
- Graduate Certificate Course of Study in Peace and Conflict Studies

Peace and Conflict Studies

Peace and Conflict Studies is an inter-disciplinary academic field that studies the causes and conditions which generate and sustain violent conflict, the mechanisms and models for the resolution of violent conflict and the norms, practices and institutions for building peace. Peace and Conflict Studies professionals engage in policy analysis, strategic peace-building, mediation, advocacy, and organizational leadership.

Curriculum Overview

The 30 credit M.A. program requirements include coursework in research methods, strategies for conflict transformation, and a two semester seminar that helps students integrate and synthesize their learning across disciplines. Students select electives within one of three professional options: Conflict Resolution, Organizational Leadership, or Policy Analysis. To complete the M.A., students choose a practicum at a local or international organization, a project, or a thesis.

Professional Options

The professional options are designed to help students advance their career trajectories within the broad field of peace studies. Each option offers core knowledge and skills relevant for work in the area.

- **The Conflict Resolution option** deepens student understanding of the nature and dynamics of conflict as well as strategies for managing and transforming conflict into more positive relationships, sustainable peace, and just societies. Students gain skills in identifying key factors and dilemmas in conflict settings and in fostering constructive change processes. Individuals in this option could pursue careers involving mediation and facilitation from the grassroots to the international level, restorative justice, and program development and training in conflict transformation.

- **The Organizational Leadership option** orients students for careers as professionals in peace-related local and international NGOs, governmental and intergovernmental agencies, and religious and other civil society organizations. Students gain a deeper understanding of the role of various kinds of organizations in peace-building and the challenges they face. Students reflect on what it means to be a leader in an organization, the ingredients of effective leadership, and their own leadership style. They also acquire skills and tools needed to manage
organizational peace-building efforts effectively.

- **In the Policy Analysis option**, students analyze policy formation, implementation, and evaluation designed to build sustainable peace. Students gain skills in developing policies as well as broader initiatives to promote normative and structural change. This option provides a strong background for pursuing careers in areas such as policy advising in government, in regional or global international organizations, or in NGO settings; political organizing and advocacy work; and human rights implementation, monitoring, and evaluation.

Admissions Requirements:

1. Bachelor’s degree from an accredited institution college or university.
2. An undergraduate grade point average of 3.0 or better. Applicants must submit an official transcript from the undergraduate institution that awarded their degree and an official transcript from any other undergraduate institution at which the applicant was awarded course credit. At the discretion of the Graduate Admissions Committee, students may be admitted with a grade point average below 3.0.
3. 18 credits of Peace and Conflict Studies related coursework. Courses dealing with the general themes of causes of conflict, resolution of conflict or the building of peace will be considered Peace and Conflict Studies coursework. Additionally, courses that are similar to the Peace and Conflict Studies elective courses will be considered as prior coursework. At the discretion of the Graduate Admissions Committee, a student may be admitted with fewer credits, especially in the case of a student with work experience in the field. The Graduate Admissions Committee is aware that while some of the applicants will have a Bachelors degree in Peace and Conflict Studies, many will be applying with degrees in related fields. This requirement will ensure that all incoming Masters students will have some familiarity with the key topics in the field. At the same time, this requirement is not expected to be prohibitive for applicants. In the event that a student does not have the necessary background credits in Peace and Conflict Studies and does not have relevant work experience in the field, the student may be admitted under the condition that they complete relevant courses during the summer prior to matriculation or during the first semester.
4. An application fee as set by the Office of Graduate Admissions.
5. Students for whom English is not a national language must also submit a score for the Test of English as a Foreign Language (TOEFL).
6. Three letters of reference from individuals familiar with the educational and/or professional performance of the applicant.
7. A personal statement about the applicant’s professional interests, educational and work qualifications, and future goals as related to the program.
8. A resume or curriculum vitae summarizing education and work experience.
9. An interview may be requested by the Graduate Admissions Committee.

Program Requirements: (30 credits total)

- **Required Core Courses** (9 credits): PCST.5010 Strategies for Conflict Transformation PCST.5060 Research Methods PCST.5500 Integrative Seminar

**Professional Option Requirement**

Students must select four courses (total of 12 credits) from one of the professional options listed below. (Some courses have relevance to multiple options and are therefore included in more than one option.)

**Conflict Resolution**

- PCST.5020 Seminar in Peace and Conflict Studies
- PCST.5080 Theories of Political and Criminal Violence
- PCST.5120 Community Conflict Resolution
- PCST.5270 Sustainable Housing Development & Land Use:
Conflict, Policy/Practice
- PCST.5230 Everyday Peace
- PCST.5450 Politics of Regression and Dissent
- PCST.5550 Mediation: Theory and Practice
- PCST.5580 Peace and Conflict Experience
- PSYC.5000 Introduction to Community Social Psychology
- PSYC.5020 Seminar in Community Social Psychology
- PSYC.5030 Applied Social Psychology
- PSYC.5220 Psychology of Diversity
- PSYC.5420 Working with Groups
- CRIM.5400 Community Profiling
- CRIM.5710 Domestic Terrorism and Hate Crimes
- CRIM.5720 Comparative Terrorism/Counter-Terrorism
- CRIM.5740 Overview of Homeland Security
- CRIM.6500 Violence in America
- EDUC.6520 Managing Change and Conflict
- PCST.5020 Seminar in Peace and Conflict Studies
- PCST.5120 Community Conflict Resolution
- PCST.5250 Gender, Work and Peace
- PCST.5450 Policies of Repression and Dissent
- PCST.5550 Mediation: Theory and Practice
- PCST.5580 Peace and Conflict Field Experience
- CRIM.5700 Crisis and Emergency Management
- PSYC.5000 Introduction to Community Social Psychology
- PSYC.5020 Seminar in Community Social Psychology
- PSYC.5030 Applied Social Psychology
- PSYC.5220 Psychology of Diversity
- PSYC.5420 Working with Groups
- PSYC.5450 Community and Organizational Change
- PSYC.5460 Grant Writing
- PSYC.6250 Advanced Community Dynamics
- PCST.5450 Policies of Repression and Dissent
- PCST.5500 Analyzing Peace, Violence & War
- PCST.5580 Peace and Conflict Studies Field Experience
- CRIM.5250 Domestic Terrorism and Hate Crimes
- CRIM.5720 Comparative Terrorism/Counter-Terrorism
- CRIM.5740 Overview of Homeland Security
- CRIM.5750 Contemporary Security Studies
- CRIM.6310 Intimate Partner Violence
- CRIM.6400 Criminal Mind Behavior
- CRIM.6500 Violence in America
- PSYC.5000 Introduction to Community Social Psychology
- PSYC.5020 Seminar in Community Social Psychology
- PSYC.5270 Immigrant Psychology and Communities
- POLI.5130 Foundations of Comparative Regional Development
- POLI.5150 Politics and Economics of Public Policy
- POLI.5500 Analyzing Peace, Violence & War
- POLI.5550 Analyzing Peace, Violence & War

Organizational Leadership
- PCST.5020 Seminar in Peace and Conflict Studies
- PCST.5120 Community Conflict Resolution
- PCST.5250 Gender, Work and Peace
- PCST.5450 Policies of Repression and Dissent
- PCST.5550 Mediation: Theory and Practice
- PCST.5580 Peace and Conflict Field Experience
- CRIM.5700 Crisis and Emergency Management
- PSYC.5000 Introduction to Community Social Psychology
- PSYC.5020 Seminar in Community Social Psychology
- PSYC.5030 Applied Social Psychology
- PSYC.5220 Psychology of Diversity
- PSYC.5420 Working with Groups
- PSYC.5450 Community and Organizational Change
- PSYC.5460 Grant Writing
- PSYC.6250 Advanced Community Dynamics
- PCST.5020 Seminar in Peace and Conflict Studies
- PCST.5120 Community Conflict Resolution
- PCST.5250 Gender, Work and Peace
- PCST.5450 Policies of Repression and Dissent
- PCST.5550 Mediation: Theory and Practice
- PCST.5580 Peace and Conflict Field Experience
- CRIM.5700 Crisis and Emergency Management
- PSYC.5000 Introduction to Community Social Psychology
- PSYC.5020 Seminar in Community Social Psychology
- PSYC.5030 Applied Social Psychology
- PSYC.5220 Psychology of Diversity
- PSYC.5420 Working with Groups
- PSYC.5450 Community and Organizational Change
- PSYC.5460 Grant Writing
- PSYC.6250 Advanced Community Dynamics

Policy Analysis
- PCST.5020 Seminar in Peace and Conflict
- PCST.5080 Theories of Political and Criminal Violence
- PCST.5250 Gender, Work and Peace
- PCST.5270 Sustainable Housing Development & Land Use:

Practicum, Project or Thesis: (three to six credits)

1. Thesis - six credits
2. Practicum - Three credits are earned for a one-semester practicum; six credits are earned for a two-semester practicum.
3. Project - Three credits are earned for a one-semester project; six credits are earned for a two-semester project.

Elective Requirement: (three or six credits, depending upon duration or practicum or project or whether the student has chosen to complete a thesis)

- Three credits of electives are required for students pursuing a six-credit thesis or two-semester (six credit) project or practicum.
- Six credits of electives are required for students completing a one-semester project or one-semester practicum.
- Elective courses may be chosen from within any of the courses listed under any of the professional options. This provides students the opportunity to take an elective course outside of their professional option.
Other Links:

- Peace and Conflict Studies website
  (https://www.uml.edu/FAHSS/Peace-and-Conflict-Studies/default.aspx)
- Undergraduate Course of Study in Peace and Conflict Studies
  (https://www.uml.edu/catalog-AY18/pdf/Undergraduate.pdf)
- Minor in Peace and Conflict Studies
  (https://www.uml.edu/catalog-AY18/pdf/Undergraduate.pdf)
- Graduate Certificate Course of Study in Peace and Conflict Studies

Graduate Certificate

Peace and Conflict Resolution Studies

Contact: David Turcotte, 978-934-4682,
David_turcotte@uml.edu (mailto:david_turcotte@uml.edu)

It is vitally important that we understand the causes of conflict, learn constructive ways to resolve them, and build peaceful relationships. Social injustice is a key source of conflict, and the dynamics of inequality and diversity are at the core of this program.

The certificate will be particularly valuable for:

- Those who have encountered conflict in their personal and/or professional lives.
- People working in very diverse fields, such as human services, law enforcement, health care, business, education and community organizing, who need skills in understanding and handling conflicts.
- Undergraduates interested in graduate studies.

This certificate program requires the completion of 12 credits comprised of one required course and three approved electives.

- Strategies of Conflict Transformation (PCST.5010 - 3 credits) - required core course
- Three Elective Courses (total of 9 credits)

Elective Courses

Some courses have relevance to multiple options and are therefore included in more than one option. Other courses may be added with the permission of the Graduate Coordinator.

Conflict Resolution

- PCST.5020 Seminar in Peace and Conflict Studies
- PCST.5080 Theories of Political and Criminal Violence
- PCST.5120 Community Conflict Resolution
- PCST.5270 Sustainable Housing Development &Land Use; Conflict, Policy / Practice
- PCST.5230 Everyday Peace
- PCST.5450 Politics of Repression and Dissent
- PCST.5550 Mediation: Theory and Practice
- PCST.5580 Peace and Conflict Field Experience
- PSYC.5000 Introduction to Community Social Psychology
- PSYC.5030 Applied Social Psychology
- PSYC.5220 Psychology of Diversity
- PSYC.5420 Working with Groups
- PSYC.6250 Advanced Community Dynamics: Lowell
- PCST.5120 Community Conflict Resolution
- EDUC.6520 Managing Change and Conflict

Organizational Leadership

- PCST.5020 Seminar in Peace and Conflict Studies
- PCST.5120 Community Conflict Resolution
- PCST.5250 Gender, Work and Peace
- PCST.5450 Politics of Repression and Dissent
- PCST.5550 Mediation, Theory and Practice
- PCST.5580 Peace and Conflict Field Experience

You will need Adobe Acrobat Reader
(https://get.adobe.com/reader/) to view any pdf files. It can be
download for free from the Adobe website
(https://get.adobe.com/reader/).
Policy Analysis

- PCST.5020 Seminar in Peace and Conflict Studies
- PCST.5080 Theories of Political and Criminal Violence
- PCST.5250 Gender, Work and Peace
- PCST.5270 Sustainable Housing Development & Land Use: Conflict Policy/Practice
- PCST.5450 Politics of Repression and Dissent
- PCST.5500 Analyzing Peace, Violence & War
- PCST.5580 Peace and Conflict Studies Field Experience
- CRIM.5260 Domestic Terrorism and Hate Crimes
- CRIM.5490 Terrorism and Counter Terrorism
- CRIM.5680 Contemporary Security Studies
- PSYC.5000 Introduction to Community Social Psychology
- PSYC.5270 Immigrant Psychology and Communities
- PSYC.5470 Community Mapping
- POLI.5150 Politics and Economics of Public Policy

Gainful Employment Disclosure Information


Other Links:

- Peace and Conflict Studies website (https://www.uml.edu/FAHSS/Peace-and-Conflict-Studies/default.aspx)
- Undergraduate Course of Study in Peace and Conflict Studies (https://www.uml.edu/catalog-AY18/pdf/Undergraduate.pdf)
PCST.5010 Strategies of Conflict Transformation (Formerly PCS 501) - Credits: 3

This course will examine the underlying connections between causes of conflict on the local, national and global levels and the processes that advance peaceful resolution. The course is designed to provide a cross-disciplinary approach to the relevant social, political, economic and cultural conditions leading to conflict and the variety of approaches to solve such conflict through both violent and nonviolent means. The beginning of the course will focus on issues of power and inequality related to class, race (and related divisions of ethnicity, religion, caste, nationality, immigration status) and gender. We will look at structures and system of power ranging from the family, to the community, the workplace and the national and international dimensions. The goal is to link theoretical analysis with the study of practical problem solving.

PCST.5020 Seminar in Peace and Conflict Studies (Formerly PCS 473/502) - Credits: 3

Offered from time to time to highlight specialized areas of faculty interest and to acquaint the student with new developments from a broad range of theory and research and how these developments might affect the field of Peace and Conflict Studies.

PCST.5030 Diplomacy and Cross Cultural Negotiations - Credits: 3

This course introduces the students to the breadth and depth of diplomatic historical practices, and theories. It will also introduce methods of negotiation and conflict resolution utilizing the different models focusing on cross-cultural negotiations. The role of cultural differences in the processes of negotiation and diplomatic practice and the multiple layers of public diplomacy will also be analyzed stressing the role of cultural differences in the processes of negotiation and diplomatic practice. The course will lastly examine democratic transition in conflicted countries and how to advocate for the transition as part and parcel of peace building.

PCST.5060 Research Methods (Formerly 57.506) - Credits: 3

This course is an applied survey of research methods appropriate for regional economic and social development. Students will learn data presentation and basic descriptive and inferential statistics, as well as the basics of researching data sources and primary data-gathering techniques (survey, case study, archival), and a framework for deciding when particular methods of data-gathering and analysis are appropriate. Students will apply the techniques as they learn them.

PCST.5080 Theories of Political and Criminal Violence - Credits: 3

The study of violence has been a central piece of debates in comparative politics that range from the causes of revolution to the analysis of civil wars. Since the 1990s, and as a result of the crucial changes the world experienced with the end of the Cold War, interest and research on civil wars increased notably, bringing in innovative theoretical insights. Yet, for the most part, research on political and criminal violence remains scattered across these different subfields, with research on civil war being the most active research field. This course aims to provide a broad overview of different bodies of research on violence and to analyze whether more dialogue between subfields could contribute to the accumulation of knowledge.

PCST.5120 Community Conflict Resolution (Formerly PCS 512) - Credits: 3

This course gives students an understanding of the main issues and solutions involved in community level conflict resolution; e.g., in neighborhoods, workplaces, and other institutions. It develops students' skills in practicing conflict resolution and/or evaluating programs in the field of dispute resolution. It is important to understand why conflict happens and how to resolve conflict.

PCST.5230 Everyday Peace: Community-based Approaches to Peace and Peacebuilding (Formerly PCS 523) - Credits: 3

This course will introduce students to a range of issues in community-based approaches to everyday conflict and peacebuilding. Premised on the idea that peace cannot be understood or studied in isolation of other of other social processes, the course will allow students to collectively engage with key conceptual, methodological and praxis related issues in peacebuilding drawing from community-based and critical perspectives in the social sciences, we will focus on developing the notion of 'everyday peace', that is, building community capacities and promoting social justice as an antidote to the normalized and endemic violence in society. The course will critically examine relevant empirical literature as well as ongoing peace initiatives that utilize community-based approaches.

PCST.5250 Gender, Work and Peace (Formerly PCS 525) - Credits: 3

"Gender, Work and Peace" will explore the relationship between human rights, gender and nonviolence in the 21st century. We will examine how current and future reality can be shaped by related policies, specifically those on the micro and macro level concerned with gender. Today we live in a period
of global transition comparable to the period that followed the Industrial Revolution. It presents us with enormous challenges and opportunities regarding factors we will address in class: economic globalization, government restructuring, work-family balancing, environmental safety at work, gender inequalities and the connection between human rights and dignity at work.

PCST.5270 Sustainable Housing Development and Land Use: Conflict, Policy, and Practice (Formerly PCS 527) - Credits: 3

Housing is fundamental to the quality of life in communities, and housing conflict, policy and practice shape the availability of this fundamental good. This course will examine the economic, environmental, social, and cultural factors that shape housing and its sustainability. The contentious nature of housing and land use policy in the United States will be summarized, with students learning how housing policy impacts communities, states, and regions. The course will then give students a detailed understanding of the conflictive process through which housing is developed and the role the market, government, funders, workers, and housing consumers play in influencing the creation and development of housing. The course will highlight ways in which current housing development policy and practices are not sustainable, and will examine more recent efforts to establish standards and practices that enhance consensus and sustainability. Students will learn how to manage conflict and take a housing project through the various stages, such as project conceptualization, market analysis, design, site acquisition, financing, construction, and occupancy. While the course focuses on the U.S. context, students will learn of international efforts to achieve greater sustainability in housing. The course will provide students with both practical and theoretical knowledge of housing and land use conflict, policy and development practices. Case studies of actual projects will be presented.

PCST.5390 Bridging Minds for Peace: Interfaith Perspectives and The Universal Moral System (Formerly PCS 539) - Credits: 3

There has been a consensus among the intellectuals and followers of religions that one of the major reasons for the accumulating political, economical, and environmental crises in the Middle East and around world is the absence of a grand vision that can guide the future and inspire humanity to create peace everywhere. The core premises of this theory are: Without peace among religions, there is no peace among nations; Without dialogue among religions, there is no peace among religions; Without a universal moral system, there is no dialogue among religions; A new model of international relations based on a set of morals universally accepted, can help human race to live in peace and justice; and the major religions have the set of morals that can be universally accepted by all, even the non-religious. This course will examine the possibilities and obstacles to bridging the religious divide through a universal, interfaith moral code.

PCST.5450 Politics of Repression and Dissent (Formerly PCS 545) - Credits: 3

A focus on the dark side of politics - political repression, including politically motivated imprisonment, torture, murder, and disappearance- and the struggle of critics to bring about change through non-violent and violent demonstrations, general strikes and armed resistance.

PCST.5500 Integrative Seminar in Peace and Conflict Studies I (Formerly PCS 550) - Credits: 0

The purpose of the integrative seminar is to assist students in developing a robust and mature understanding of the three PCS core questions as they relate to PCS coursework within and across the three Professional Options. With a strong evidence focus, students identify patterns, principles, questions, and dilemmas relevant to the core questions that emerge from multiple courses they have taken within the Professional options. Students develop a reflective journal, a series of essays, a portfolio of their accumulated work, and a culminating portfolio presentation. The course consists of six 2-hour sessions each semester for two semesters.

PCST.5530 Integrative Seminar in Peace and Conflict Studies (Formerly PCS 453/553) - Credits: 3

The purpose of the integrative seminar is to assist students in developing a robust and mature understanding of the three PCS core questions as they relate to PCS coursework. With a strong evidence focus, students identify patterns, principles, questions, and dilemmas relevant to the core questions emerge from multiple courses they have taken within the PCS program. Students develop a reflective journal, a series of essays, a portfolio of their accumulated work, and a culminating portfolio presentation. Meets Core Curriculum Essential Learning Outcome for Applied & Integrative Learning (AIL) and Written & Oral Communication (WOC).

PCST.5550 Mediation: Theory and Practice (Formerly PCS 455/555) - Credits: 3

Mediation is a form of dispute resolution in which a neutral person helps two or more parties discuss their conflict, explore wants and needs, generate options, and reach an agreement. Mediation has become more prevalent over the past few decades in the courts, community-setting, and schools because it empowers the disputing parties to reach a resolution that works for them. This course introduces mediation in the context of other forms of alternative dispute resolution, teaches the principles and theory behind mediation, and trains students
in the fundamentals of the mediation process. Interactive exercises and mediation role-plays will be used to provide experiential practice. Upon completion of the course, students will be connected to opportunities to practice mediation in the local courts or with community organizations.

PCST.5580 Peace and Conflict Field Experience (Formerly PCS 458/558) - Credits: 3

A program of practical experience in the field of Peace and Conflict. Students can work in a variety of areas related to Peace and Conflict Studies. Students meet regularly as a class on campus with the designated instructor to discuss their experiences and to learn more about the settings in which they practice and the challenges that they confront.

PCST.5910 Directed Study in Peace and Conflict Studies (Formerly PCS 591) - Credits: 1-3

Through frequent consultation with the instructor, the student carries out the investigation of a particularly specialized area of interest. This course may be repeated for up to a total of 6 credits.

PCST.6010 Peace and Conflict Studies Study Abroad I (Formerly PCS 601) - Credits: 3

Graduate study abroad in an institution with a University-approved Graduate-level exchange program. The specific course to be taken will be approved by the Graduate Coordinator.

PCST.6020 Peace and Conflict Studies Study Abroad II (Formerly PCS 602) - Credits: 3

Graduate study abroad in an institution with a University-approved graduate-level exchange program. The specific course to be taken will be approved by the Graduate Coordinator.

PCST.6030 Peace and Conflict Studies Study Abroad III (Formerly PCS 603) - Credits: 3

Graduate study abroad in an institution with a University-approved Graduate-level exchange program. The specific course to be taken will be approved by the Graduate Coordinator.

PCST.6310 Practicum in Peace and Conflict Studies I (Formerly PCS 631) - Credits: 3

The practicum allows students to intern at an organization related to the field of Peace and Conflict studies. The primary purpose of the Practicum is two-fold: 1) to allow students to apply, integrate, and evaluate the information and skills they have acquired in their masters-level academic course work; 2) to gain new understandings and competencies while contributing to a field setting. Students participate in placements for approximately 10 hours per week.

PCST.6320 Practicum in Peace and Conflict Studies II (Formerly PCS 632) - Credits: 3

The practicum allows students to intern at an organization related to the field of Peace and Conflict Studies. The primary purpose of the Practicum is two-fold: 1) to allow students to apply, integrate, and evaluate the information and skills they have acquired in their masters-level academic course work; 2) to gain new understandings and competencies while contributing to a field setting. Students participate in placements for approximately 10 hours per week.

PCST.7330 Project in Peace and Conflict Studies I (Formerly PCS 733) - Credits: 3

The project will consist of a scholarly investigation, such as a review, report, synthesis or design in the student’s field resulting in a written document.

PCST.7340 Project in Peace and Conflict Studies II (Formerly PCS 734) - Credits: 3

For a student who wants to complete a 2-semester project. The project will consist of a scholarly investigation, such as a review, report, synthesis or design in the student’s field resulting in a written document.

PCST.7430 Master’s Thesis in Peace and Conflict Studies (Formerly PCS 743) - Credits: 3

For graduate student actively engaged in research leading toward the submission of written thesis. A program of supervised study will be arranged between student and a faculty supervisor. This course may be repeated for credit, but only a total of 6 credits may be counted toward the Master’s Degree.

PCST.7460 Masters Thesis in Peace and Conflict Studies (Formerly PCS 746) - Credits: 6

For graduate students actively engaged in research leading toward the submission of a written thesis. A program of supervised study will be arranged between the student and a faculty supervisor.

PCST.7610 Continued Graduate Research (Formerly...
PCS 761) - Credits: 1
POLI.5001 Islam and Politics - Credits: 3

The relationship between Islam and Politics changed little since the rise of Islam. The surge in academic and public interest in the topic started in 1979 with the Iranian Revolution. This course will explain the role that Islam plays in everyday life, and will distinguish myth from fact about Islam and politics. Initially, the course will focus on the Muslim Brotherhood of Egypt as the prototype and first Islamic organization that was heavily involved in politics, will continue on to examine a range of issues including Jihad, woman’s rights, and related topics.

POLI.5002 Islamic Activists and Their Political Ideologies - Credits: 3

Islamic Activists have championed certain ideologies since the beginning of the twentieth century, the groups as well as their leading ideologues have changed over time. This course will explain the changes in political ideology, the causes of change and the group’s ability to appeal to a wide audience. Groups discussed in the class will include, the Muslim Brotherhood, the Jihad group in the 1980s, ISIS and other groups. The class will analyze the texts that the groups utilize to attract an audience as well as develop an understanding of the legitimization process of the group itself.

POLI.5110 Dynamics Power and Authority (Formerly 46.411/57.511) - Credits: 3

This course surveys theories of power, authority, participation, and politics. Building on these theories, students will examine changing social, political, and economic patterns of inequality based on class, race (and related divisions of ethnicity, religion, caste, nationality), and gender. Reviews various approaches to altering these dynamics (business strategy, public policy, community and social movements). Cuts across units of firm, community, region, and nation, along with corresponding governmental institutions, and links theoretical analysis with study of practical problem solving. Instructor-initiated cases drawn from a variety of national experiences. Students will learn techniques of power analysis and prepare a power analysis project.

POLI.5440 Advanced Research Methods (Formerly 46.544) - Credits: 3

The purpose of this course is to introduce students to the fundamentals of research while also conveying the need for skepticism as the foundation of scientific inquiry. Both quantitative and qualitative methods will be examined. Students will gain first-hand knowledge of the research process by formulating their own research questions, locating current literature to frame their topic, developing causal theories and then empirically testing these theories. With that in mind, the first goal of this course is for students to become critical consumers of research in general and peace and conflict research in particular. The second goal is for students to develop theories about peace and conflict and research designs to test those theories. Students are encouraged to use this course to develop their thesis or projects.
Psychology

Department of Psychology

The Department of Psychology offers a doctoral program in Applied Psychology & Prevention Science and master's programs in Autism Studies and Community Social Psychology and Graduate Certificate Programs in:

- Behavioral Intervention in Autism
- Diversity in the Workplace
- Domestic Violence Prevention (Interdisciplinary with the School of Criminology and Justice Studies)
- Family Studies

Ph.D. in Applied Psychology and Preventative Science

Philosophy and Program Objectives

The doctoral degree in Applied Psychology & Prevention Science at UMass Lowell is a psychology-based, research-oriented degree. The program is designed to provide a theoretically grounded and methodologically sophisticated education, and will train students and working professionals in the application of psychological knowledge for improving overall health and wellness at multiple levels, including health promotion and disease prevention. The curriculum of the APPS Ph.D. program is geared toward gaining new knowledge and skills through study, research, and experiential learning opportunities and to meeting the needs of public and private sectors that may serve as potential employers for the programs graduates.

Knowledge Competencies

- An understanding of the key concepts, theories, and methodology in the field of Applied Psychology and Prevention Science;
- Ability to assess the costs and benefits of intervention programs designed to prevent problematic behavior, promote health behaviors, and maximize individual and organizational potential and well-being;
- An understanding of and ability to work well with and empower diverse, underrepresented groups in real-world settings;
- A thorough grounding in the ethical conduct of research and practice in real-world settings

Skill Set

- Utilize quantitative and qualitative methods to conduct psychological research on major issues related to promoting healthy outcomes, preventing problematic behaviors, and/or intervening to diminish existing problems;
- Assess the effectiveness of organizations and programs;
- Analyze social problems and design appropriate interventions;
- Develop the ability to carry out systemic interventions on multiple levels.

The Department also offers a combined bachelor's-master's program for UMass Lowell undergraduates.

Philosophy and Objectives of the Autism Studies Program

Autism Spectrum Disorders (ASDs) are behavioral-neurological disorders, typically diagnosed before the age of three, that profoundly affect the young child's ability to communicate, develop language, form social relationships, and respond appropriately to environmental stimuli. Repetitive, stereotypical, and sometimes even self-injurious behaviors are a common part of the clinical picture. Recent estimates of prevalence report rates in the U.S. as high as 1 in every 91 children. Currently, there is a critical workforce shortage of professionals capable of meeting the challenges of those afflicted with this disorder. The M.S. program in Autism Studies provides students with the knowledge and skills needed to enhance the development of individuals diagnosed with an ASD, support their families and strengthen the ability of schools and hospitals to work with individuals diagnosed on the autism spectrum.

Through their course work and field training, students will gain mastery of skills in several critically important areas:

- definitions and characteristics of autism and other developmental psychopathologies;
- principles, processes, and concepts of Applied Behavior Analysis (ABA);
- methods of behavioral assessment and selection of intervention strategies;
- measurement of behavior and techniques for displaying and interpreting data;
- experimental evaluation of interventions;
- legal and ethical aspects of intervention;
- coordination of programs and services with families,
schools, and the community;
• training and supervision of direct service providers.

Graduates of this masters program will have met all the education and training requirements that will allow them to sit for the national certification exam to become Board Certified Behavior Analysts™. As BCBA’s, they will be able to work with schools and other agencies to design and implement effective interventions for children on the ASD spectrum and to supervise other direct service providers. They will also be able to conduct research that could lead to new and effective interventions.

Philosophy and Objectives of the Community Social Psychology Program

Community social psychologists study relationships between social and environmental forces and the psychological well-being of people. They seek to understand how individuals and groups are affected by such social influences as employment and educational opportunity, organization and delivery of public services, and the social systems within which people live and work. The M.A. program in Community Social Psychology provides students with a rich understanding of how communities and organizations influence behavior, adjustment, and growth. Students graduate knowing how to analyze and solve human problems in a wide variety of community and organizational settings. An emphasis on facts, methods, values, and especially practical skills creates a dynamic learning experience. This is one of the few M.A. programs of its kind in the Northeast.

By completing this program, students will gain:

• Knowledge about how social and environmental factors affect the individual;
• Proficiency in conducting applied research and performing data analysis;
• Increased awareness of multiculturalism, human diversity, and social justice issues;
• The ability to design, implement, and evaluate community programs.

This graduate program meets the needs of students from various academic and occupational backgrounds. It attracts recent undergraduates from such fields as Psychology, Sociology, Political Science, Health, and Education. For those already working, it enhances the skills and career development of human service workers, community developers, health care providers, teachers, government employees, human resource professionals, administrators, and managers in a wide variety of public and private sector positions. Employment opportunities for graduates of the program, both in the nonprofit and private sectors, have traditionally been very strong.

Master’s Program in Community Social Psychology

• Admissions
• Admissions Requirements
• Transfer Credit
• Part-Time Study with Non-Degree Status
• Graduate Advisor
• Degree Requirements: Credits
• Required Coursework
• Required Practicum
• Thesis Project Options
• Thesis
• Project
• Bachelor’s - Master’s (BA/MA) Program
• Application to BA/MA Program
• Additional Information from Graduate Admission for BA/MA Students
• Resources

Admissions

There is a Priority Application Deadline on March 15. Applicants who wish to meet the Priority Deadline should ensure that their applications, including external materials (e.g., GRE scores, letters of recommendation, etc.), are complete and ready for review by March 15. Review of applications by the program’s Admissions Committee will commence on that date. Applicants who meet the Priority Deadline will have their application fee waived and receive priority consideration for scholarships or assistantships.

Applications received after March 15 are reviewed on a rolling basis until all available spots are filled.

Students are encouraged to begin coursework in the fall semester because of the timing and sequence of required courses.

Admission Requirements

1. To apply online, please go to the Graduate Admissions (http://www.uml.edu/Grad/default.aspx) page.
2. Bachelor’s degree from an accredited college or university.
A foreign credential evaluation is required for degrees earned outside of the U.S. (see link: CED Evaluations (http://www.cedevaluations.com/)).

3. An undergraduate grade point average of 3.0 or better. At the discretion of the Graduate Admissions Committee, students may be admitted with a grade point average below 3.0 if they have substantive work experience in the field.

4. Academic background in psychology or a closely related field. We prefer to see at least 18 credits in psychology or a related field, including at least one course in research methods.

5. Graduate Record Examination (GRE) scores, on both verbal and quantitative, or scores from the Miller Analogies Test (MAT).

GRE / MAT scores may be waived if you meet any of the following conditions:

- a. Are a current UMass Lowell student qualifying for the BA/MA program.
- b. Earned a BA or BS with a cumulative GPA of 3.3 or greater at UMass Lowell, UMass Amherst, UMass Boston or UMass Dartmouth in the past 5 years.
- c. Earned a BA or BS with a cumulative GPA of 3.3 or greater from an accredited university in the United States or Canada in the past 5 years.
- d. Have taken 2 or more UMass Lowell graduate courses (as a matriculated or non-matriculated student) and earned at least a 3.5 cumulative GPA.
- e. Hold a graduate degree (Masters, Ph.D., J.D., etc.) from an accredited university in the United States or Canada.
- f. Have at least 3 years of full-time professional work experience (paid or unpaid) that is relevant to Community Social Psychology.

If you meet any of these criteria, you must complete the GRE/MAT Waiver Form (https://www.uml.edu/docs/CSP%20MA%20GRE%20Waiver%20Form_Revised%20012016_tcm18-229236.pdf) to apply for a waiver. For the form to work correctly, please download it and open it in Adobe Acrobat.

- Three letters of recommendation including at least one and preferably more than one, from recent or current professor.
- A personal statement. A 500-750 word personal statement explaining your interests in CSP and how you believe the degree will help you meet your career goals. Specifically, please include a description of your: Academic backgroundCareer aspirations and how completing a degree in community social psychology supports your career goalsRelevant experience including undergraduate campus involvement, community-based projects, research involvement and/or relevant paid work experiences that reflect your interest in social justice issues.
- A 250-300 word essay in which you identify and discuss a current social issue of interest to you.
- A resume summarizing education and work experience.
- Students from whom English is not a national language must also submit a score for the Test of English as a Foreign Language (TOEFL) or International English Language Testing System (IELTS). The minimum acceptable score on the TOEFL is 570 for the paper test and for the new Internet-based test the aggregate minimum is 79. The minimum IELTS score is 65.

To begin your Online Application, go to the Graduate Admissions (http://www.uml.edu/grad/) page and click on the application (https://sa-webapp-prd.erp.umasscs.net/psc/webapp/EMPLOYEE/HRMS/c/UM_WEBAPP_MENU.UM_ADM_APP_LOGIN.GBL?instituion=UMLOW&CareerGRAD&CenterGRAD%27%27&link).

Transfer Credit

Matriculated students in Community Social Psychology are allowed to transfer up to 12 credits of graduate course work completed with a grade of B or better taken in other departments at UMass Lowell or at other accredited universities, provided that such courses are within the content area of community social psychology and do not involve credit for field experience or professional work. Such transfer credit is subject to the approval of the Graduate Coordinator and the Registrar’s Office.
Part-time Study and Non-Degree Status

While the program in Community Social Psychology provides for full-time study, part-time students are encouraged to apply. Most courses are offered at late afternoon and evening hours to accommodate students who are employed. Students not pursuing an advanced degree or who wish to begin their graduate study without first applying for matriculated status are invited to register as non-degree students for specific graduate courses on a space-available basis.

If a non-degree student later applies for acceptance into the Masters program, his/her application will be treated equally with those of other new applicants, though performance in graduate courses taken on campus may be used as an additional admissions criterion. Non-degree students accepted as matriculated students may apply to transfer a maximum of 12 graduate credits earned at the University of Massachusetts Lowell with a grade of “B” or better toward the Masters degree (but students may be encouraged to formally apply to the program after completing 6 CSP credits).

Graduate Adviser

Each newly matriculated student in the program will be assigned to an adviser from among the faculty of the graduate program. The student will meet with his/her adviser on a regular basis throughout the years of study to discuss course selections, planning for practicum, and the development of the thesis or project (optional). Once a student selects a faculty supervisor for his/her thesis or project, this faculty member takes over as graduate academic adviser.

Degree Requirements: Credits

A total of 36 academic credits, at least 24 of which must be taken at the University of Massachusetts Lowell with a grade average of B or better, is required for the completion of the degree. The 36 credits for the Masters degree are divided as follows:

Required Coursework (3 courses, 9 credits total)
- PSYC.5000 Community Social Psychology
- PSYC.6250 Advanced Community Dynamics
- PSYC.5120 Applied Research Methods

Required Practicum (2-semester course sequence and placement: 6 credits)
- PSYC.6310 Practicum I
- PSYC.6320 Practicum II
(Must be taken over consecutive semester starting in the fall)

The remaining degree credits consist of elective courses. Students may select from over 15 elective courses in Community Social Psychology, most of which are offered at least once every two years. In their choice of electives, students have the option of completing a Master’s Project or Thesis (see below).

Total must equal 36 credits.

Thesis and Project Options

To earn the 36 credits needed for the Master’s degree, all matriculated students in Community Social Psychology have the option, in consultation with and with the consent of a faculty advisor, of completing either a Thesis or a Project. Both these options represent an integrative piece of significant independent scholarship. The Thesis will be larger in scope, more formal, and more rigorous than the Project, and it must involve a well-developed and systematically conducted research study. A brief summary is provided here:

Thesis
- Be completed over the course of two semesters (usually consecutive), counting for 6 credits toward the degree
- Involve a Thesis Committee of three faculty, chaired by a Psychology Faculty member and including at least one other Psychology faculty member.
- Be written in accordance with University guidelines
- Be defended by the student in front of the Thesis Committee at a public meeting.

The Thesis will always be a piece of quantitative and/or qualitative research, involving a review of literature, a clear statement of a research question, the design of an appropriate method for collecting data, and the analysis of results as the basis for drawing conclusions.

Project
- Typically be completed over the course of one academic semester, counting for 3 credits toward the degree
- Be carried out under the supervision of a CSP faculty member
- Be written in accordance with guidelines established by the graduate program
- Involve an appropriate form of public presentation
- The Project may also be a piece of research, though narrower in scope and more focused than a Thesis (e.g., a pilot study or a program evaluation). It may also involve the development, implementation and evaluation of an
action-oriented intervention.

Although many students will choose to earn all their credits through coursework, a Thesis might be a good choice for students interested in enhancing their research skills and/or who are thinking of going on to a doctoral program and a possible career in university teaching and research. A project might be a good choice for students interested in enhancing their program design, intervention and evaluation skills, and it might also benefit those students pursuing careers in human services and community development.

Detailed information may be found on the department website (https://www.uml.edu/FAHSS/Psychology/Programs/Graduate/default.aspx) and from the graduate program coordinator.

**Bachelor’s-Master’s (BA/MA) Program**

Undergraduate psychology majors at the University of Massachusetts Lowell who have a GPA of 3.0 or better are invited to apply to the BA/MA program, allowing students to begin graduate level coursework in our Community Social Psychology (CSP) Masters Program while still pursuing their bachelor’s degree. If a student is formally matriculated into the Master’s Program before earning her BA up to 9 credits of graduate (600 level or higher) courses completed with a B grade or better may be used by the student to count toward both the Bachelors and Master’s degrees.

**Application to the BA/MA Program**

Applications are typically submitted during the student’s second semester of their junior year to allow adequate time for the student to take maximum advantage of the opportunity to take graduate courses and double-count these graduate credits. Although it is highly recommended that students submit their application during their junior year, application materials can actually be submitted at any time prior to graduation. Students who are interested in the BA/MA option are strongly advised to consult with the Graduate Coordinator about undergraduate course selection. In order to complete the program as a “plus 1” option, students will need to carefully plan to take specific required graduate courses before they receive their BA.

**As additional advantages, students applying under the BA/MA option do not have to pay the standard application fee and do not have to take any of the standardized tests usually required of applicants. The decision to accept a BA/MA applicant is based on 3 factors:**

- A personal statement that clearly describes the student’s interest in our Community Social Psychology program and how it fits with the student’s educational and professional goals.

**Additional Information from Graduate Admissions for BA/MA Students**

1. Students admitted to our BA/MA program are accepted on a conditional basis with the requirement that students receive their bachelor’s degree at the end of their senior year and graduate with a minimum cumulative GPA of 3.0. If students do not meet this requirement, their masters degree candidacy will be voided and they would be required to re-apply via the traditional application process.
2. BA/MA students must complete their bachelor’s degree first before graduate admissions can change their status to that of a fully matriculated graduate student.
3. BA/MA students may defer their graduate matriculation for up to one year following their graduation for the bachelor’s degree. A request for deferral must be made to the Graduate Admissions Office (https://www.uml.edu/Grad/default.aspx) in writing. After one year of deferral, failure to register for graduate classes will invalidate their acceptance into the masters program.

**Additional information on the Bachelor’s/Master’s Program.**

**Resources**

- The Center for Family, Work and Community (https://www.uml.edu/Research/CCRE/default.aspx)

The Center for Community Research & Engagement promotes an facilitates community-based research and multidirectional learning as strategies to advance social justice, to enhance community well-being, and to galvanize the role of community-university partnerships as instrument so of positive change. We are committed to addressing community challenges collaboratively through high-quality research and scholarship, and through appropriate and creative applications of knowledge. We further believe that students engaged in community research and service learn how to work more collaboratively and effectively in a variety of different settings, and contribute more productively and respectfully to civic life in a diverse democratic society.
• Center for Women and Work
  (https://www.uml.edu/Research/CWW/default.aspx)

The Center for Women and Work is an interdisciplinary center at the University of Massachusetts Lowell. Since the Center is designed to support a wide range of projects, there are exciting opportunities for student involvement in both research and community-based action projects relevant to the theme of women and work.

• Laboratory for Autism and Spectrum Disorders
  (http://faculty.uml.edu/ahillier/)

The Laboratory for Autism Spectrum Disorders focuses on two main avenues of research involving adolescents and young adults on the autism spectrum. The first avenue seeks to further our understanding of the processing of emotional stimuli among those with ASD by examining physiological responses and memory for emotion provoking stimuli. The lab’s second main research avenue focuses on evaluating various intervention programs for those with ASD. We are currently focusing on a mentoring program for UMass Lowell students registered with Student Disability Services.

Laboratory for Children and Families
  (http://www.uml.edu/research_labs/child/default.html)

The Laboratory for Children and Families studies the development of children and youth in social contexts such as family and school, especially in how individual difference in areas like temperament and disability interact with aspects of the environment. Much of our research combines both qualitative and quantitative methods from self report, observation and the collection of psychophysiological data. Additional work involves secondary analysis of large existing data sets.

• Cultural and Immigrant Research Unit (CIRU)

CIRU is committed to research that investigates the impact of culture on the psychological, social and health development of ethnic minority immigrant individuals, families and communities. Both quantitative and qualitative methods and approaches are utilized to understand the immigrant experience. The ultimate aim of CIRU is to produce information that will be useful for the development of beneficial interventions in immigrant communities.

• Motivation and Performance Lab

This lab studies motivation and performance from cognitive and social perspectives. We examine performance in a variety of contexts, including academic, athletic and artistic. From the cognitive perspective, we take basic processes as a starting point, and investigate how to improve the accuracy of both memory performance and the judgments people make about their cognitive functions. From the social perspective, we look at how individual difference, the self, group stereotypes and situational factors influence people’s motivation and performance.

Master’s Program in Autism Studies
Master of Science in Autism Studies

• Admissions Requirements
• Transfer Credit
• Part-Time Study and Non-Degree Status
• Graduate Advisor
• Degree Requirements
• Thesis Option
• Bachelors to Master’s Program
• Resources

Admission Requirements

The Autism Studies graduate program at the University of Massachusetts Lowell is designed not only for recent college graduates, but also for students with experience in a variety of educational and work settings.

In addition to the requirements for graduate admission, requirements for the Autism Studies graduate program include these factors:

1. A Bachelors degree or its equivalent from an accredited college or university
2. A strong undergraduate academic record (a GPA of 3.0 or better is desirable).
3. A minimum of 4 courses in psychology and one course in statistics in your undergraduate coursework. Students should have some background in the psychology of child development, and we are especially interested in students with coursework in some of the foundational areas of psychology (e.g., developmental, learning, behavior analysis, biological bases of behavior, research methods, cognitive psychology, etc.).
4. Relevant experience and other activities outside of the classroom.
5. Official Graduate Record Examination (GRE) scores, on
both verbal and quantitative sections. Alternatively, you may submit scores from the Miller Analogies Test (MAT). The GRE/MAT requirement is waived for (1) applicants who graduated from UMass Lowell within the past five years with a cumulative GPA of 3.0 or better or (2) those who have successfully completed the Behavioral Intervention in Autism certificate.

6. At least three letters of recommendation. At least one, and preferably more than one, from recent or current instructors.

7. A personal statement. This detailed statement should describe your background, explain your interests in our program, and tell us how you believe our program will help you meet your own career goals.


These criteria may be applied or weighted differently for different students. For example, for students just receiving a Bachelor’s degree, greater attention will be paid to recent grades. For students out of school for some time, work background and experience will count relatively more. Please follow the procedures for application established by the UMass Lowell Graduate Admissions Office (http://www.uml.edu/Catalog/Graduate/Admissions/Application-Procedure.aspx#Application-Procedure).

Transfer Credit

Matriculated students in Autism Studies who come to UMass Lowell with prior graduate work at other schools may request a transfer of a maximum of 12 credit hours. An assessment will be conducted to determine how courses proposed for transfer map onto our courses with respect to BACB requirements. Such transfer credit is subject to the approval of the Graduate Coordinator and the Registrar’s Office and must meet the University’s Graduate Transfer Credit requirements. For students who have completed courses from the Behavioral Intervention in Autism Certificate Program:

- PSYC.5610
- PSYC.5620
- PSYC.5650
- PSYC.5660
- PSYC.5720
- PSYC.5680 up to 18 credits of those courses may be transferred.

Part-time Study and Non-Degree Status

While most Autism Studies students attend UMass Lowell for full-time study, part-time students are encouraged to apply. Many courses are offered online, while on-campus courses are usually offered at late afternoon and evening hours to accommodate students who are employed. Students not pursuing an advanced degree or who wish to begin their graduate study without first applying for matriculated status are invited to register as non-degree students for specific graduate courses on a space-available basis. Such students only need to meet the first two of the admissions requirements listed above.

If a non-degree student later applies for acceptance into the Masters program, his/her application will be treated equally with those of other new applicants, though performance in graduate courses taken on campus will be used as an additional admissions criterion. Non-degree students accepted as matriculated students may apply to transfer a maximum of 6 graduate credits earned at the University of Massachusetts Lowell with a grade of “B” or better toward the Masters degree. Students who are enrolled in a UMass Lowell certificate program may be able to transfer more than 6 credits.

Graduate Advisor

Each newly matriculated student in the program will be assigned a faculty advisor. The student will meet with his or her advisor on a regular basis to discuss course selection, planning for practicum, and the development of an optional thesis or project. Once a student selects a faculty supervisor for his or her thesis or project, that faculty member takes over as graduate academic advisor.

Degree Requirements

A total of 42 academic credits, is required for the completion of the degree. At least 30 of these credits must be taken at the University of Massachusetts Lowell. No more than two courses (6 credits) may have an earned grade of less than B (3.0). The 42 credits for the Masters degree are divided as follows:

Required Courses - 27 credits
Required Supervised Practicum - 9 credits
Electives or Thesis - 6 credits

Students may select from any the approved elective courses in Psychology, almost all of which are offered once every two years. Students may also, when appropriate, request permission to take related courses from other graduate programs at UMass Lowell. In their choice of electives, students have the option of completing a Master’s Thesis, which involves original empirical
research.

Total must equal 42 credits.

**Required Courses (27 credits total)**

**Foundations (9 credits)**

- PSYC.5710 Autism and Developmental Psychopathology
- PSYC.6630 Experimental Analysis of Behavior
- PSYC.5720 Legal and Ethical Issues in Professional Practice

**Methods (6 credits)**

- PSYC.5120 Applied Research Methods
- PSYC.5650 Measurement and Experimental Design in Behavioral Intervention

**Behavioral Interventions (12 credits)**

- PSYC.5610 Introduction to Behavioral Intervention in Autism
- PSYC.5620 Teaching and Positive Behavioral Support in Autism
- PSYC.5660 Functional Analysis and Treatment of Challenging Behaviors
- PSYC.5680 Behavioral Intervention Program Models in Autism

**Required Supervised Practicum (9 credits total)**

- PSYC.6710 Supervised Practicum in BIA I
- PSYC.6720 Supervised Practicum in BIA II
- PSYC.6730 Supervised Practicum in BIA III

**Electives or Thesis Option (6 credits total)**

**Elective Option (6 credits total; choose any two of the following):**

- PSYC.5000 Introductory to Community Social Psychology
- PSYC.5010 Applied Developmental Psychology
- PSYC.5040 The Family System
- PSYC.5220 Psychology of Diversity
- PSYC.5450 Community and Organizational Change
- PSYC.6110 Program Evaluation
- PSYC.5740 Social and Community Interventions in Autism

**Thesis Option (6 credits)**

- PSYC.7440 Masters Thesis

**Thesis Requirements**

To earn the 42 credits needed for the Master's degree, all matriculated students in Autism Studies have the option of completing a thesis. The thesis will always be a piece of quantitative and/or qualitative research, involving a review of literature, a clear statement of a research question, the design of an appropriate method for collecting data, and the analysis of results as the basis for drawing conclusions. The thesis must:

- be completed over the course of two semesters (usually consecutive), counting for 6 credits toward the degree,
- involve a Thesis Committee of three faculty,
- be written in accordance with University guidelines, and
- be defended by the student in front of the Thesis Committee at a public meeting.

**Bachelor’s to Master’s Program**

Undergraduate psychology majors at the University of Massachusetts Lowell who have a GPA of 3.0 or better are invited to apply to the Bachelor’s-Master’s program. This program allows students to begin graduate level coursework in our Autism Studies Masters program while still pursuing their bachelor’s degree. Up to 6 credits of graduate (500 level or higher) courses completed with a B grade (3.0) or better may be used by the student to count toward both the Bachelors and Master’s degrees.

**Application to the Bachelor’s to Master’s Program**

Application is typically summit during the student’s second semester of their junior year to allow adequate time for the student to take maximum advantage of the opportunity to take graduate courses and double-count these graduate credits, while still staying within the maximum of 45 psychology credits allowable for the undergraduate degree in psychology. Although it is highly recommended that students submit their application during their junior year, application materials can be submitted at any time prior to graduation. However, applications for the Bachelor’s to Master’s program will be reviewed along with all other applications only during the spring review cycle. Application forms and details on applying to graduate school can be accessed from the Graduate Admissions website (https://www.uml.edu/Grad/default.aspx).

As additional advantages, students applying under the Bachelor’s-Master’s option do not have to pay the standard application fee and do not have to take any of the standardized
tests usually required of applicants. The decision to accept a Bachelor’s-Master’s applicant is based on 3 factors:

1. A solid undergraduate record, with an overall GPA of 3.0 or better.
2. Strong letters of recommendation: three are required, and at least two should be from psychology faculty at UMass Lowell.
3. A statement of purpose that clearly describes the student’s interest in the Autism Studies program and how it fits with the students educational and professional goals.

Additional Information from Graduate Admissions for BA/MA Students:

1. Students admitted to the Bachelor’s-Master’s program are accepted on a conditional basis with the requirement that they receive their bachelors degree at the end of the next academic year following their acceptance and graduate with a minimum cumulative GPA of 3.0. If students do not meet this requirement, their masters degree candidacy will be voided and they will be required to re-apply via the traditional application process.
2. Bachelor’s-Master’s students must complete their bachelors degree before graduate admissions can change their status to that of a fully matriculated graduate student.

Resources

Laboratory for Autism Spectrum Disorders

The Laboratory for Autism Spectrum Disorders focuses on two main avenues of research involving adolescents and young adults on the autism spectrum. The first avenue seeks to further our understanding of the processing of emotional stimuli among those with ASD by examining physiological responses and memory for emotion provoking stimuli. The lab's second main research avenue focuses on evaluating various intervention programs for those with ASD. A number of interdisciplinary programs specifically for high functioning adolescents and young adults on the autism spectrum are run through the lab in collaboration with other faculty at UMass Lowell. These include a social skills program, a music program, a fitness program and a movie club. These programs provide a critically needed service to members of our community and their families impacted by ASD.

The Laboratory for Behavior Analysis Research

The Laboratory for Behavior Analysis Research focuses on both basic and applied research issues relevant to children with an Autism Spectrum Disorder and other developmental disabilities. The first area concerns the limited and impaired auditory learning skills often seen in children with an ASD. Research in this area investigates auditory discrimination in the autism population from both behavioral and psychophysiological (EEG) perspectives. The second area concerns how children with intellectual disabilities can acquire an understanding of symbols and their referents (stimulus equivalence). The third area concerns training for parents and paraprofessionals on the sound implementation of treatment methods for children with autism and other developmental disabilities. Research involves evaluating online distance-learning education programs that may offer a potential solution to the problem.

Laboratory for Children and Families

The Laboratory for Children and Families is located in the Department of Psychology at the University of Massachusetts Lowell. The Laboratory provides a site for research on the development of infants and children in the context of their families and communities.

The Center for Research and Community Engagement

The goal of The Center for Research and Community Engagement is to promote the mental health and well being of individuals, families, and communities through education, training, and consultation. Its aim is to provide opportunities for University of Massachusetts faculty, community members, and practicing professionals to work together to integrate theory, research, and practice. The Center sponsors community-based training, professional development workshops, consultation, and research.

Center for Women and Work

The Center for Women and Work is an interdisciplinary center at the University of Massachusetts Lowell. Since the Center is designed to support a wide range of projects, there are exciting opportunities for student involvement in both research and community-based action projects relevant to the theme of women and work.

Ph.D. in Applied Psychology & Prevention Science

- Program Overview
- Program Objectives
- Knowledge Competencies
- Skill Set
- Admission Requirements
Established in 2015, the UMass Lowell Ph.D. program in Applied Psychology & Prevention Science is designed to train students and current practitioners who seek advanced education in the application of psychological theories and methods to address real-world problems, as well as to promote optimal quality of life outcomes. APPS emphasizes three core areas of study:

1. Applied Cognitive Psychology
2. Community and Applied Social Psychology
3. Applied Developmental Psychology

An applied psychological approach that emphasizes the importance of preventing problems and promoting positive behavior in these areas builds on expertise of our faculty, enriches students understanding of the importance of prevention, expands involvement with communities, enhances research skills, and increases opportunities for students career success.

The Applied Cognitive Psychology core area is designed to teach our graduate students how to address real-world issues. Students will be trained to develop evidence-based reforms rooted in a rigorous study of cognitive processes. Such reforms can be applied to confront problems in the domains of education, law, health, and business. Ongoing research in the department explores how to improve the accuracy of both memory performance and meta-cognitive judgments to help students choose optimal study strategies and help legal actors assess eyewitness reliability. Other faculty study health campaign design, the relationship between language and cognition, memory for trauma, and/or issues that face individuals making decisions within the criminal justice system.

The Community and Applied Social Psychology core area is designed to train students to research and analyze the complex relationships between individual, family, and community well-being and the broader socioeconomic, physical, cultural, and geographic environment. This option will produce graduates with the analytic, creative, and practical skills needed to design and implement programs and services that will facilitate positive changes within and across communities. A number of members of our department specialize in issues facing immigrants, psychology and the law, peace and conflict issues both nationally and internationally, positive aging, intersectionality of race/ethnicity, diversity issues in the workplace, participatory action research, and gender-based violence.

The Applied Developmental Psychology core area will train our graduates to conduct research on typical and atypical challenges across the lifespan. Faculty areas of research include neuropsychology, psychophysiology, and autism spectrum disorders (ASD), child maltreatment, and the development of language, especially the ability to tell narratives of personal experiences. Other faculty address issues of family and parent-child relationships, child eyewitness testimony, and aging and social gerontology.

**Program Objectives**

The doctoral degree in Applied Psychology & Prevention Science at UMass Lowell is a psychology-based, research-oriented degree. The program is designed to provide a theoretically grounded and methodologically sophisticated education, and will train students and working professionals in the application of psychological knowledge for improving overall health and wellness at multiple levels, including health promotion and disease prevention. The curriculum of the APPS PhD program is geared toward gaining new knowledge and skills through study, research, and experiential learning opportunities and to meeting the needs of public and private sectors that may serve as potential employers for the programs graduates.

**Knowledge Competencies**

- An understanding of the key concepts, theories, and methodology in the field of Applied Psychology and Prevention Science;
- Ability to assess the costs and benefits of intervention programs designed to prevent problematic behavior, promote health behaviors, and maximize individual and organizational potential and well-being;
- An understanding of and ability to work well with and empower diverse, underrepresented groups in real-world settings;
- A thorough grounding in the ethical conduct of research and practice in real-world settings

**Skill Set**
• Utilize quantitative and qualitative methods to conduct psychological research on major issues related to promoting healthy outcomes, preventing problematic behaviors, and/or intervening to diminish existing problems;
• Assess the effectiveness of organizations and programs;
• Analyze social problems and design appropriate interventions;
• Develop the ability to carry out systemic interventions on multiple levels.

Admission Requirements

For more information about the Application Deadline, consult the Psychology Application Page:

1. Applicants should arrange to have (an) official transcript(s) indicating that they have earned a Bachelors degree, and, if relevant, an official transcript indicating that they have earned a Masters degree (or will in the near future) mailed to the Office of Graduate Admissions by the degree-granting institution(s) at:

Office of Graduate Admissions
Cumnock Hall, Suite 110
One University Avenue
Lowell, MA 01854-5130

Transcripts are required from every college or university attended with the following exceptions:

• Transcripts are not required from colleges or universities where a one-semester study abroad or domestic exchange was completed;
• Transcripts are not required from colleges or universities for which the course names and grades were transferred to the applicants bachelors or Masters degree-granting institution (and appear on those transcripts).

2. International students who are unable to provide official transcripts to the Office of Graduate Admissions must demonstrate that they have earned the equivalent of a Bachelors degree granted by an accredited United States institution before their application will be processed. Please note, the Office of Graduate Admissions reserves the right to have any application credential evaluated.

Degree verification may be obtained for a fee at:

Center for Educational Documentation, Inc.
(http://www.cedevaluations.com/)
P.O. Box 170116
Boston, MA 02117
Phone: 617-338-7171
Fax: 617-338-7101
Website: www.cedevaluations.com
(http://www.cedevaluations.com)

3. An applicants preparation for doctoral study will be assessed using the following grade point average (GPA) criteria. For undergraduate work, adequate preparation is defined as an earned GPA of at least 3.25 (on a 4.0 grading scale). For graduate work, adequate preparation is defined as an earned GPA of at least 3.75 (on a 4.0 grading scale).

4. All applicants are required to take the Graduate Record Examination (GRE) and provide their scores as part of their application. Only the scores from the Verbal and Quantitative sections of the GRE are required to assess applicants preparation for doctoral study.

International applicants are also required to take either the Test of English as a Foreign Language (TOFEL) or the International English Testing System Academic (IELTS Academic) examination and provide their TOEFL Scores or their IELTS Scores (for the Academic IELTS, not the General Training IELTS). This requirement is waived if the applicant has earned a Bachelors or Masters degree from an accredited U.S. academic institution.

Official test scores (GRE, TOEFL/IELTS) must be mailed to the university directly by the testing agencythis requirement applies to all applicants including current UMass Lowell students or UMass Lowell alumni. Both the GRE and TOEFL are administered by ETS (Educational Testing Services); use the school code for UMass Lowell (3911) when requesting any scores from ETS. There is no school code for the IELTS; instead, test takers should provide the address for UMass Lowell Graduate Admissions to have their official scores sent (address listed above).

The GRE Psychology subject test is not required for admission. However, if an applicant has taken the GRE Psychology subject test and would like to report those scores, the applicant may include that information under Other Test Scores section of their application.

5. Three letters of recommendation are required as part of the application. All recommendations must be provided by sources familiar with applicant from an academic context. Please note that, to be considered for admission, all application materials (including letters of recommendation) must be received by the application deadline.

6. Applicants must submit a personal statement describing why they wish to pursue a doctoral degree in Applied Psychology.
GRADUATE – ALL COLLEGES

GRADUATE / COLLEGE OF FINE ARTS, HUMANITIES AND SOCIAL SCIENCES

Requirements are as follows:

1. A total of 42 academic credits, at least 30 of which must be taken at the University of Massachusetts Lowell, are required for the completion of the degree. APPS doctoral degree requirements are as follows:

- **Required Courses** 21 credit hours
- **Approved Electives** 9 credit hours
- **Dissertation** - 12 credit hours

Total must equal 42 credit hours.

Students may request permission to take related courses from other graduate programs at UMass Lowell.

**Core Coursework**

Students are required to take 21 credits of core coursework. PSYC.6400 Theories of Change in Applied Psychology (3 credits), provides students with an integrative and meaningful experience that engages them with the theoretical, practical, and professional questions that applied psychologists address in their efforts to understand and promote change. PSYC.6500, Advanced Quantitative Methods (3 credits), is designed to cultivate and further develop students’ understanding and skills in research methods and advanced data analyses as they prepare to become practitioners of research addressing a range of APPS issues. PSYC.6410 Fundamentals of Prevention Science (3 credits), elaborates on areas introduced in Theories and emphasizes the principles on which prevention science is based. Students will also take two subject matter courses at the 5000 or 6000 level, each 3 credits, chosen from among three core areas of study. Community Social Applied Social Psychology, (CAS). Applied Cognitive Psychology (ACP), and/or Applied Developmental Psychology (ADP). PSYC.6500 is a prerequisite for two more required advanced research methods or data analysis courses (6 credits). The selection of these advanced methods courses in the core is based on identified interests and needs of the student in consultation with the students advisor. Approved methods courses are available in Psychology and also from the Graduate School of Education, the School of Criminology and Justice Studies, and the Department of Work Environment. Students can request that another identified course meets this advanced methods requirement through consultation with their advisor and approval of the Program Director.

**Required Courses (21 credits total)**

- PSYC.6400 Theories of Change in Applied Psychology
- PSYC.6410 Fundamentals of Prevention Science

**plus any two of the following content courses:**

- PSYC.5000 Introduction to Community Social Psychology
- PSYC.5010 Applied Developmental Psychology
- PSYC.5030 Applied Social Psychology
- PSYC.5880 Advanced Cognition
- PSYC.6650 Advanced Community Social Psychology

**Degree Requirements**

A total of 42 academic credits, at least 30 of which must be taken at the University of Massachusetts Lowell, are required for the completion of the degree. APPS doctoral degree requirements are as follows:

- **Full-Time** 6 credits per semester
- **Part-Time** 3 credits per semester
PSYC.6670 Advanced Applied Cognitive Psychology
PSYC.6690 Advanced Applied Developmental Psychology

-plus three advanced methods courses:
- PSYC.6500 Advanced Quantitative Methods (required)

-and any two of the following:

Psychology Department:
- PSYC.7010 Narrative Methods
- PSYC.7020 Participatory Action Research

Work Environment:
- PUBH.5770 Introduction to Biostatistics
- PUBH.6890 Advanced Regression Modeling

Graduate School of Education:
- EDUC.7040 Qualitative Research Methods
- EDUC.7050 Survey Research

Criminology and Justice Studies:
- CRIM.5900 Descriptive and Inferential Statistics
- CRIM.7920 Survival Analysis & Longitudinal Data

Approved Electives (choose any three from among any of the above courses not taken, or from among the following for 9 credit hours):
- PSYC.5220 Psychology of Diversity
- PSYC.5270 Immigrant Psychology & Communities
- PSYC.5460 Grant Writing
- PSYC.5710 Autism and Developmental Psychopathology
- PSYC.5740 Community & Social Interventions in Autism
- PSYC.6110 Program Evaluation
- PSYC.6640 Child Maltreatment
- PSYC.6680 Primary Care Behavioral Health
- PSYC.6750 Seminar in Health Psychology
- PSYC.6760 Seminar in Language Acquisition
- PSYC.6770 Applying Cognitive Psychology to Education
- PSYC.6780 Seminar in Metacognition
- PSYC.6790 Psychology and Law
- PSYC.6800 Aging and Community

PSYC.6810 Health Campaigns: Effects & Processes
PSYC.6930 Directed Study in APPS
PSYC.7030 Selected Topics in Applied Psychology and Prevention Science

Program of Study

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall Semester</th>
<th>Spring Semester</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>PSYC.6400 Theories of Change in Applied Psychology PSYC.6300 Advanced Quantitative Methods CAS. ACP. or ADP 5000/6000 course</td>
<td>PSYC.6410 Fundamentals of Prevention Science Advanced Methods Course CAS. ACP. or ADP 5000/6000 course</td>
</tr>
<tr>
<td>2</td>
<td>Elective Advanced Methods Course Comprehensive Paper 1</td>
<td>Elective Optional Elective(s)* Comprehensive Qualifying Paper 2</td>
</tr>
<tr>
<td>3</td>
<td>PSYC.7630 Dissertation (3/6/9 credits)** Optional Elective(s)*</td>
<td>PSYC.7630 Dissertation (3/6/9 credits)** Optional Elective(s) Oral defense of dissertation proposal</td>
</tr>
</tbody>
</table>

* Optional electives supplement required courses beyond the minimum of 30 credits of course work
** 12 dissertation credits are required

Comprehensive Qualifying Papers

In the second year of doctoral study, students will complete 2 comprehensive doctoral papers: one paper will be a literature review paper focused on a topic within one of the three core areas of study (Community and Applied Social Psychology, Applied Cognitive Psychology, or Applied Developmental Psychology) and one paper will include a quantitative analysis of data.

Upon successfully passing the Comprehensive Qualifying Papers, (see below), a student can begin their dissertation research.

Dissertation

Completion of the dissertation requires:

1. submission of a written dissertation proposal to the students dissertation committee,
2. successful oral defense of the written dissertation proposal,
3. completion and submission of three manuscripts for publication to peer-reviewed journals, and
4. successful oral defense of the three manuscripts.

The minimum number of dissertation credits is 12. Dissertation credits in excess of the required 12 may not be used to substitute for any of the 30 credits of required coursework.

Graduate Teaching Assistants and Graduate Research Assistants

The APPS program has a limited number of Graduate Teaching Assistant (GTA) and Graduate Research Assistant (GRA) positions to support graduate students in the pursuit of their degrees. These positions are awarded to students based on close collaboration between the Program Director, the Dean of FAHSS, and Department Chairs. Graduate assistants work 18 hours per week and are assigned to faculty members within a department of FAHSS to assist in research, instruction, and other professional duties. GTAs and GRAs are assigned as instructors or researchers within departments that match their competencies and research interests.

Certificate Program

Certificate Programs in Psychology

- Behavioral Intervention in Autism for Board Certified Behavior Analyst Preparation (offered fully online)
- Behavioral Management in Autism (BCaBA) (offered fully online)
- Diversity in the Workplace
- Domestic Violence Prevention
- Family Studies

You will need Adobe Acrobat Reader (https://get.adobe.com/reader/) to view any pdf files. It can be downloaded for free from the Adobe website (https://get.adobe.com/reader/).

- Graduate Certificate Application Form

You will need Adobe Acrobat Reader (https://get.adobe.com/reader/) to view any pdf files. It can be downloaded for free from the Adobe website (https://get.adobe.com/reader/).

Behavioral Intervention in Autism

Psychology Department

Contact: Rebecca Markovits (mailto:rebecca_markovits@uml.edu), Ph.D., 978-934-4205

The Behavioral Intervention in Autism Certificate Program has been designed to provide the core knowledge required for Board Certified Behavior Analysts. The 6-course Autism Certificate program has been updated to conform with the BACB’s new task-list standards. It has been fully approved by the BACB to fulfill the specific coursework requirements necessary to become eligible for taking the BCBA exam.

Note: You do not have to be accepted into the certificate program prior to registering for your first course. However, students pursuing BACB certification need to apply for the certificate before taking their 3rd course.

Applicants will have to meet additional BACB requirements to qualify for full BACB certification. For the most current information about BACB certification requirements, please visit http://www.bacb.com (http://www.bacb.com).

In partnership with the Eunice Kennedy Shriver Center, a pioneer in research, education, and service for people with developmental disabilities and their families for over three decades and a part of the University of Massachusetts Medical School, this certificate has been designed to provide professionals in psychology, education, child care, and human services with an understanding of autism and related developmental disorders. An introduction to behavioral methods and how and where such methods can be used and evaluated is included. Interested students should have a background in the psychology of child development. Most courses will be available on-line.

*Professional Certification: This sequence of 6 courses (see courses with asterisks) has been designed to meet the Behavior Analyst Certification Board (BACB) educational requirements for certification as a Behavior Analyst. Note that full BACB certification also involves an experience requirement and an exam not administered by UMass Lowell (see details at www.bacb.com (http://www.bacb.com/)).

Required Courses:

- PSYC.5610 Introduction to Behavioral Intervention in Autism
- PSYC.5620 Teaching and Positive Behavioral Support in Autism
- PSYC.5650 Measurement and Experimental Design in Behavioral Intervention
- PSYC.5660 Functional Analysis and Treatment of Challenging Behavior
• PSYC.5680 Behavioral Intervention Program Models in Autism
• PSYC.5720 Legal and Ethical issues in Professional Practice

Note the PSYC.5610 is a prerequisite or co-requisite for PSYC.5620 and PSYC.5650; PSYC.5620 is a prerequisite for PSYC.5660 and PSYC.5680; PSYC.5650 or 5660 is a prerequisite for PSYC.5720. The recommended sequence is PSYC.5610 and PSYC.5620 together in one semester, followed by PSYC.5650 and PSYC.5660, and finishing with PSYC.5680 and PSYC.5720.

**Gainful Employment Disclosure Information**


**Behavioral Management in Autism (BCaBA)** (offered fully online)

This four-course (12 credit) graduate certificate is open to any student with a bachelor’s degree from an accredited institution. This certificate fulfills the coursework requirements for certification as a Board Certified Assistant Behavior Analyst (BCaBA) and helps prepare students to take the Behavior Analyst Certification Board’s (BACB’s) BCaBA Certification Exam. All four courses are offered online and a student may complete the program in as few as two consecutive semesters.

**Curriculum Outline**

**Required Courses (4 courses, 12 credits total)**

- PSYC.5610 Introduction to Behavioral Intervention in Autism
- PSYC.5620 Teaching and Positive Behavioral Support in Autism
- PSYC.5630 Management Strategies in Applied Behavioral Intervention
- PSYC.5660 Functional Analysis and Treatment of Challenging Behavior

**Note:** PSYC.5610 and PSYC.5620 may be taken concurrently; both are prerequisites for PSYC.5630 and PSYC.5660, which also may be taken together.

Students wishing to pursue certification as a Board Certified Assistant Behavior Analyst through the BACB must apply for and be accepted into the Behavioral Management in Autism Certificate Program and successfully complete the four required courses. This program is approved by the BACB to fulfill their BCaBA coursework requirement, and it is designed to help prepare students for the BACB BCaBA Certification Exam.

Three of the courses in this program can be applied towards the BACB’s BCaBA coursework requirements, and, with program approval, they could count towards UMass Lowell’s MS in Autism Studies or the M.Ed. in Curriculum and Instruction: Autism Studies Option.

**Note:** This program does not confer BACB certification or licensure in any state. While this program is approved by BACB as a BCaBA coursework preparation program, students will need to apply separately to BACB for a BCaBA certification exam. Check the BACB website regularly as the requirements change periodically. Students should also review their state’s government website to see if any additional licensure is required to serve as a BCaBA in their state.

**Gainful Employment Disclosure Information**

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Behavioral%20Management%20in%20Autism%20for%20BCaBA%20Preparation%20-%202042.0101-Gedt.html)

**Diversity in the Workplace**

**Psychology Department**

**Contact:** Michelle C. Haynes (mailto:Michelle_Haynes@uml.edu), Ph.D., 978-934-3925

Over the last 50 years, the workplace has changed dramatically in terms of its composition along various dimensions. Despite this inevitable diversity in the workplace, working with people from different backgrounds is challenging. Many people prefer to work with others who are “like them” in age, gender, race, education, and economic status. There is comfort in sharing the same background and culturally based traditions and ideals. Working with others who do not share similar interpersonal expectations or ways of communicating can contribute to tensions emanating from misattributions and conflicting values.

This certificate is for both future and current industry and organizational leaders who want to advance their theoretical knowledge as well as their hands on skills for working with and managing diverse employees. Certificate candidates will increase their awareness of communication and cultural differences, and be encouraged to develop strategies to effectively manage these differences. Candidates will be challenged to go beyond simply tolerating differences; rather the goal is to improve their work life, organizational culture,
Students who complete this certificate will emerge better equipped to work within our increasingly diverse workplaces. They will acquire knowledge and skills that will enable them to take on leadership roles in both profit and nonprofit organizations.

The core course, Workplace Diversity, introduces students to the theoretical constructs surrounding diversity in the workplace as well as focuses on skill development for managing diversity in the work domain. Courses in the "Social Trends" cluster focus on the broader social, economic, and political forces that affect diversity in the workplace including the changing nature of work, globalization, and public policy. Offerings in the "Systems Dynamics" cluster are courses that enhance students understanding of people from diverse backgrounds and explore the ways in which dynamics within workplaces (and other human systems) shape relations among diverse group.

Courses (12 credits):

Required Course:
- PSYC.5260 Workplace Diversity (3 credits)

Social Trends - select one course:
- 57.542 Gender, Work and Public Policy (3 credits)
- 57.511 Dynamics of Power and Authority (3 credits)
- 57.516 Globalization, Work, and Family (3 credits)

System Dynamics Electives - select one:
- PSYC.5000 Introduction to Community Social Psychology (3 credits)
- PSYC.5050 Work and Family (3 credits)
- PSYC.5220 Psychology of Diversity (3 credits)

Open Electives - select one additional course from either the preceding lists or the list below:
- PUBH.5000 Introduction to Work Environment (3 credits)
- PUBH.5420 Human Factors (3 credits)
- PUBH.6430 Healthy Work Organization Design (3 credits)
- PUBH.5230 Women in the Community (3 credits)
- PSYC.5270 Immigrant Psychology and Communities (3 credits)
- PSYC.5420 Working with Groups (3 credits)
- PSYC.5450 Community & Organizational Change (3 credits)
- 57.503/PUBH.6540 Work and Technology (3 credits)
- 57.512 Community Conflict Resolution (3 credits)
- 57.537 Development Principles (3 credits)

Gainful Employment Disclosure Information

Completion rates, median loans debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Diversity%20in%20the%20Workplace%20-%2030.2301-Gedt.html).

Domestic Violence Prevention

Department of Psychology and School of Criminology and Justice Studies (Interdisciplinary)

Contact: Wilson Palacios, Ph.D., 978-934-4106, CJGradAdvisor@uml.edu (mailto:CJGradAdvisor@uml.edu)

Domestic violence is one of the major social and public health problems in the Commonwealth. The existing degree programs in the School of Criminology and Justice Studies, Community Social Psychology, and programs in the College of Health Sciences each offer relevant courses that greatly assist their graduates working with agencies and clients affected by domestic violence. The certificate provides a focused program for those working in settings where domestic violence is an issue.

- Program Requirements

Gainful Employment Disclosure Information

Completion rates, median loan debt and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Domestic%20Violence%20Prevention%20-%2043.0104-Gedt.html).

Family Studies

Psychology Department

Contact: Andrew Hostetler (mailto:Andrew_Hostetler@uml.edu), Ph.D., 978-934-3979, csp@uml.edu (mailto:csp@uml.edu)

The program is designed to provide professionals who work with families or with children, youth and elders within family systems, with a contemporary understanding of families through a community-based, culturally-sensitive perspective. It provides graduate level education in family support services and in family-community linkages, and exposure to the range
of family support and education approaches in the Merrimack Valley.

**Required Courses:**

- PSYC.5000 Introduction to Community Social Psychology (3 credits)
- PSYC.5010 Applied Developmental Psychology (3 credits)
- PSYC.5040 The Family System (3 credits)

**Electives:**

- PSYC.5020 Seminar in Community Social Psychology (3 credits)*
- CRIM.6220 Intimate Partner Violence (3 credits)

Note: Other electives by approval of Graduate Coordinator.

*Focus of seminar varies; may be applied to certificate only when the focus of the seminar is family-centered.

**Gainful Employment Disclosure Information**

Completion rates, median loan debts and program costs are outlined in the [Graduate Certificate Gainful Employment Disclosure Information](https://www.uml.edu/gainful-employment/Family%20Studies%20-%20%2042.0101-Gedt.html).

**Security Studies**

Security Studies is an interdisciplinary graduate program offered by the College of Fine Arts, Humanities and Social Sciences, and coordinated by faculty in the School of Criminology and Justice Studies. Students can earn a 30-credit Master of Arts or Master of Science degree in one of the following concentrations.

**Master of Arts Degree Concentrations**

- Homeland Defense Note: In September 2014, this program was ranked #6 in the nation by [TheBestSchools.org](http://www.thebestschools.org/rankings/25-best-online-master-homeland-security-degree-programs/).
- Industrial and Economic Security
- International Security

**Master of Sciences Degree Concentrations**

- CBRNE Security
- Critical Infrastructure Protection
- Cybersecurity

Visit the [Security Studies website](https://www.uml.edu/Interdisciplinary/Security-Studies/default.aspx) for more application, alumni, and class schedule information.

**Admission and Application Information**

Applications to the Graduate Program in Security Studies are accepted and processed year-round. Students accepted into the program can begin their courses in the fall, spring or summer terms. A qualitative assessment of each applicant’s transcript and other application materials will contribute to any admissions decision for either the MA or the MS degree program.

**Admissions Requirements for the MA Degree in Security Studies**

1. Completed undergraduate degree from an accredited institution of higher education, with a final cumulative GPA of at least 3.0. A wide variety of undergraduate bachelor’s degree programs will qualify, particularly those in the behavioral and social sciences (such as political science, sociology, criminal justice, psychology, history, international relations, and many others).
2. GRE scores for Verbal and Quantitative in the top 20th percentile. The MAT is acceptable as an alternative to the GRE.
3. International students must submit TOEFL with acceptable scores.
4. Please see the [Office of Graduate Admissions](https://www.uml.edu/Grad/Process/requirements.aspx) for more information about the basic requirements for all master’s and doctoral programs at UMass Lowell.

**Admissions Requirements for the MS Degree in Security Studies**

1. Completed undergraduate degree from an accredited institution of higher education, with a major in a science, technology or engineering discipline and a final cumulative GPA of at least 3.0. Graduates of bachelor’s degree
programs in behavioral and social sciences will also be considered on a case-by-case basis.

(Can be waived with suitable professional experience or relevant science/technology graduate degree)

2. GRE scores for Verbal and Quantitative in the top 20th percentile. The MAT is acceptable as an alternative to the GRE.

3. International students must submit TOEFL with acceptable scores.

4. Please see the Office of Graduate Admissions for more information about the basic requirements for all master’s and doctoral programs at UMass Lowell.

Admissions Requirements for International Students

1. International students apply through the regular admission process. Please see the Office of Graduate Admissions for specific information about the basic requirements for all master’s and doctoral programs at UMass Lowell.

2. Please see the Graduate Admissions Office website for International Students, which describes the Test of English as a Foreign Language requirement for all master’s and doctoral programs at UMass Lowell.

3. International students can also enroll online and complete all requirements to earn a Graduate Certificate without having to meet the admissions requirements for master’s or doctoral degree programs.

Admissions Requirements for the Graduate Certificate in Security Studies

1. Graduate certificate programs are designed for students holding a baccalaureate degree in a field related to the certificate program. The application fee is $50.

2. No graduate record exam (GRE) is required.

3. Applicants to the Graduate Certificate programs do not need to meet the admissions requirements for master’s or doctoral degree programs.

4. Application forms and procedures are available online.

Bachelor’s to Master’s Program

Juniors and Seniors at UMass Lowell who have a 3.0 GPA or better are eligible to apply for the B.S./M.A. (or B.S./M.S.) program. This program allows for completion of both degrees in five years if desired. As part of the program, two graduate classes may be counted toward both the 120 credit hour for the B.S. degree and the 30 credit hours required for the M.A. or M.S. degree. More information about this program is available from the Office of Graduate Admissions.

Transfer Students

If transferring from another graduate program, applicants must have a minimum graduate GPA of 3.5. Transfer students are those who come to UMass Lowell with prior graduate work. They are allowed up to 12 credit hours (with a grade of B or better) from another institution toward the completion of the master’s degree at UMass Lowell. Only graduate courses taken from an accredited graduate school in the United States or Canada within a five-year period prior to the date of admission to the degree requirement may be considered for transfer. More information on the university policy is available online.

Master of Science - Chemical, Biological, Radiological, Nuclear and Explosive Security

CBRNE Security

Students in this area of concentration will develop a solid understanding of chemical, biological, radiological, nuclear and explosives (CBRNE) security. Courses will exam the technical details of weapons and sensor technologies, nonproliferation regimes, the threat of states or terrorists acquiring and using weapons of mass destruction, and the local, state, federal and global efforts to confront this kind of threat.

Core Courses
• Contemporary Security Studies (CRIM.5750)
• Intelligence Analysis: Policy and Practice (CRIM.5780)
• Scientific and Technological Dimensions of National Security (CRIM.6680)
• Research Design (CRIM.5910)
• Security Studies Capstone Research Paper (CRIM.6990)

Electives (Choose 5 from the Following)

• Weapons of Mass Destruction (CRIM.6640)
• Introduction to Biosensors (EECE.5410)
• Principles and Practices of Biological Safety (PUBH.5080)
• Infectious Disease + (MLSC.6130)
• Toxicology and Health (PUBH.5030)
• Exposure and Risk Assessment (PUBH.6161)
• Introduction to Epidemiology (PUBH.5750)
• Risk Assessment (PUBH.6830)
• Radiological Safety and Control I + (RADI.5010L)
• Radiological Safety and Control II + (RADI.5020L)
• Nuclear Instrumentation + (RADI.5060)
• Radiation Biology + (RADI.5620)
• Understanding the Massachusetts Contingency Plan (ENVS.5810)

+ Indicates a course that requires special permission from the instructor before enrolling.

Other graduate-level electives taken at UMass Lowell or at other campuses of the University of Massachusetts may also count toward the 5 electives, based on approval of the Program Director and Graduate Faculty Group.

More information about this program is available from the Office of Graduate Admissions (http://www.uml.edu/Grad/programs/bachelors-masters.aspx).

Master of Arts - Homeland Defense

Homeland Defense

Students pursuing this area of concentration will develop competencies and knowledge relating to homeland security strategy and policy development, critical infrastructure protection, regional and national security intelligence, land and maritime border protection, and the use of new technologies in homeland security. Emphasis is placed on integrating a big picture policy perspective with an understanding of human behavior, systems, and intelligence analysis.

Note: In September 2014, this program was ranked #6 in the nation by TheBestSchools.org (http://www.thebestschools.org/rankings/25-best-online-master-homeland-security-degree-programs/).

Core Courses

• Contemporary Security Studies (CRIM.5750)
• Intelligence Analysis: Policy and Practice (CRIM.5780)
• Scientific and Technological Dimensions of National Security (CRIM.6680)
• Research Design (CRIM.5910)
• Security Studies Capstone Research Paper (CRIM.6990)

Electives (choose five from the following)

• Overview of Homeland Security (CRIM.5740) [Required for students in this concentration]
• Comparative Terrorism and Counterterrorism (CRIM.5720)
• Understanding the Massachusetts Contingency Plan (ENVS.5810)
• Crisis and Emergency Management (CRIM.5700)
• Descriptive and Inferential Statistics (CRIM.5900)
• Domestic Terrorism and Violent Extremism (CRIM.5710)
• Issues in Computer Crime and Cybersecurity (CRIM.6580)
• Weapons of Mass Destruction (CRIM.6640)
• Terrorism Networks (CRIM.6660)
• Counterterrorism Policies and Strategies (CRIM.6690)
• Strategic Intelligence and Homeland Security (CRIM.5880)
• Advanced Security Studies (CRIM.6670)
• Politics and Economics of Public Policy (POLI.5150)
• Threat Assessment and Risk Management (CRIM.5730)
• Criminal Justice Intelligence &Information Sharing (CRIM.5760)
• Transportation System Security and Safety (CRIM.5660)

Other graduate-level electives taken at UMass Lowell or at other campuses of the University of Massachusetts may also count toward the 5 electives, based on approval of the Program Director and Graduate Faculty Group.
Master of Arts

Industrial and Economic Security

Students pursuing this area of concentration will focus their studies and research on topics related to the private sector, including energy security, computer network and facility security, and the defense industry. Courses will also examine global trafficking, economic crime, and the policies and legal frameworks for combating these threats.

Core Courses

- Contemporary Security Studies (CRIM.5750)
- Intelligence Analysis: Policy and Practice (CRIM.5780)
- Scientific and Technological Dimensions of National Security (CRIM.6680)
- Research Design (CRIM.5910)
- Security Studies Capstone Research Paper (CRIM.6990)

Electives (Choose 5 from the Following)

- Economic Crime (CRIM.5260)
- Threat Assessment and Risk Management (CRIM.5730)
- Issues in Computer Crime and Cybersecurity (CRIM.6580)
- Toxic Use Reduction (PUBH.5570)
- Crisis and Emergency Management (CRIM.5700)
- Descriptive and Inferential Statistics (CRIM.5900)
- Organizational Behavior (MGMT.5010)
- Overview of Homeland Security (CRIM.5740)
- Advanced Security Studies (CRIM.6670)
- Transportation System Security and Safety (CRIM.5660)

Other graduate-level electives taken at UMass Lowell or at other campuses of the University of Massachusetts may also count toward the 5 electives, based on approval of the Program Director and Graduate Faculty Group.

(*) indicates permission required from the Manning School of Business faculty.

More information about this program is available from the Office of Graduate Admissions (http://www.uml.edu/Grad/programs/bachelors-masters.aspx).

Master of Arts - International Security

International Security

In this area of concentration, students will develop a comprehensive understanding of complex, intersecting global threats like organized criminal and terrorist networks, and the various policies, strategies and mechanisms to combat these threats.

Core Courses

- Contemporary Security Studies (CRIM.5750)
- Intelligence Analysis: Policy and Practice (CRIM.5780)
- Scientific and Technological Dimensions of National Security (CRIM.6680)
- Research Design (CRIM.5910)
- Security Studies Capstone Research Paper (CRIM.6990)

Electives (Choose 5 from the Following)

- Advanced Security Studies (CRIM.6670)
- Comparative Terrorism and Counterterrorism (CRIM.5720)
- Weapons of Mass Destruction (CRIM.6640)
- Global Trafficking and Criminal Networks (CRIM.6650)
- Terrorism (CRIM.6660)
- Descriptive and Inferential Statistics (CRIM.5900)
- Threat Assessment and Risk Management (CRIM.5730)
- Global Issues and Human Rights and Justice (CRIM.6620)
- Issues in Computer Crime and Cyber Security (CRIM.6580)
- Politics and Economics of Public Policy (POLI.5150)
- Counterterrorism Policies and Strategies (CRIM.6690)

Other graduate-level electives taken at UMass Lowell or at other campuses of the University of Massachusetts may also count toward the 5 electives, based on approval of the Program Director and Graduate Faculty Group.

More information about this program is available from the Office of Graduate Admissions (http://www.uml.edu/Grad/programs/bachelors-masters.aspx).
Master of Science - Critical Infrastructure Protection

Critical Infrastructure Protection

Students pursuing this area of concentration will develop competency and knowledge to manage the increasingly complex security challenges at regional and international airports, commuter and commercial railways, maritime ports, and roadways of the Commonwealth and the broader region. Emphasis is placed on integrating a big picture policy perspective with an understanding of sensor technologies, transportation security, systems engineering, human behavior, and intelligence analysis.

Core Courses

- Contemporary Security Studies (CRIM.5750)
- Intelligence Analysis: Policy and Practice (CRIM.5780)
- Scientific and Technological Dimensions of National Security (CRIM.6680)
- Research Design (CRIM.5910)
- Security Studies Capstone Research Paper (CRIM.6990)

Electives (Choose 5 from the Following)

- Inspection and Monitoring of Civil Infrastructure (CIVE.5110on campus [https://www.uml.edu/catalog/courses/CIVE/5110])
- Overview of Homeland Security (CRIM.5740)
- Transportation System Security and Safety (CRIM.5660)
- Threat Assessment and Risk Management (CRIM.5730)
- Issues in Computer Crime and Cybersecurity (CRIM.6580)
- Exposure and Risk Assessment (PUBH.6161)
- Systems Security and Auditing (MSIT.5140)
- Understanding the Massachusetts Contingency Plan (ENVS.5810)
- Crisis and Emergency Management (CRIM.5700)
- Descriptive and Inferential Statistics (CRIM.5900)
- Weapons of Mass Destruction (CRIM.6640)

More information about this program is available from the Office of Graduate Admissions [http://www.uml.edu/Grad/programs/bachelors-masters.aspx].

Master of Science - Cybersecurity Studies

Cybersecurity

Cybersecurity is an increasingly important concern for government agencies, defense contractors, bio-tech research firms, and many others throughout New England. Students pursuing this area of concentration will develop an understanding of computer network security principles, human behavior, systems, cyber forensics, and the strategies and agencies (federal and state) that are intended to secure the nation from cyber attacks.

Core Courses

- Contemporary Security Studies (CRIM.5750)
- Intelligence Analysis: Policy and Practice (CRIM.5780)
- Scientific and Technological Dimensions of National Security (CRIM.6680)
- Research Design (CRIM.5910)
- Security Studies Capstone Research Paper (CRIM.6990)

Required Electives

- Issues in Computer Crime and Cyber Security (CRIM.6580)
- Computer Network Security (see below)

CS/IT Electives (Choose 4 from the Following)

Online Courses:

The following online courses are offered within the MS in Information Technology [http://continuinged.uml.edu/degrees/MSIT.cfm] program, and can be used to fulfill requirements in the Cybersecurity concentration of the MS in Security Studies program. Enrollment in these courses requires an undergraduate degree in Information Technology, Computer Science, or comparable academic or professional background. Please contact the course instructor for permission to enroll.

- Computer Network Security (MSIT.5610 online) - Required for MS Cybersecurity concentration
- MSIT.5140 Systems Security and Auditing (https://www.uml.edu/Catalog/Courses/MSIT/5410)
- MSIT.5620 Digital Forensics

More information about this program is available from the Office of Graduate Admissions (http://www.uml.edu/Grad/programs/bachelors-masters.aspx).
On Campus Courses: The following courses are offered on campus within the MS in Computer Science program, and can be used to fulfill requirements in the Cybersecurity concentration of the MS in Security Studies program. Enrollment in these courses requires an undergraduate degree in Computer Science or comparable academic or professional background. Please contact the course instructor for permission to enroll.

- Computer Network Security
  (https://www.uml.edu/Catalog/Courses/MSIT/5610)
  (MSIT.5610) - Required for Cybersecurity MS concentration
- MSIT.5410 Information Security, Privacy and Regulatory Compliance
  (https://www.uml.edu/Catalog/Courses/MSIT/5410)
- MSIT.5130 Internet and Web Systems I
- MSIT.5140 Internet and Web Systems II
  (https://www.uml.edu/Catalog/Courses/MSIT/5140)
- MSIT.5150 Operating Systems I
  (https://www.uml.edu/Catalog/Courses/MSIT/5150)
- MSIT.5160 Operating Systems II
- COMP.6160 Advanced Topics in Network Security

Other graduate-level electives taken at UMass Lowell or at other campuses of the University of Massachusetts may also count toward the five electives, based on approval of the Program Director and Graduate Faculty Group.

UMass Lowell also offers a Graduate Certificate in Network Security (http://continuinged.uml.edu/online/certificates/networksecurity.cfm), which can be completed through online courses. Student completing the Network Security program can transfer into the MS in Security Studies: Cybersecurity concentration and have those courses count toward the completion of the Master’s degree.

More information about this program is available from the Office of Graduate Admissions (http://www.uml.edu/Grad/programs/bachelors-masters.aspx).
PSYC.4920 Undergraduate Thesis in Psychology I - Credits: 3
For undergraduate students actively engaged in research leading toward the submission of a written thesis. Under faculty supervision, students will conceptualize and conduct an original, empirical study, refining and sharpening their research, presentation, and writing skills. A program of supervised work will be arranged between the student and a faculty supervisor, leading to the completion of an introduction and literature review, research plan, and IRB proposal.

PSYC.4930 Undergraduate Thesis in Psychology II - Credits: 3
For undergraduate students actively engaged in research leading toward the submission of a written thesis. Under faculty supervision, students will conceptualize and conduct an original, empirical study, refining and sharpening their research, presentation, and writing skills. A program of supervised work will be arranged between the student and a faculty supervisor, leading to the completion and presentation of a written thesis.

PSYC.5000 Introduction to Community Social Psychology (Formerly 47.500) - Credits: 3
Introduces history and contemporary trends of community and social psychology with focus on how social and environmental forces affect individual and group quality of life. This course surveys the history, theoretical frameworks, core values, methods/approaches and orienting concepts in the field.

PSYC.5010 Applied Developmental Psychology (Formerly 47.501) - Credits: 3
Provides a life span developmental perspective on individual and social adaptation and change. Examines appropriate theory and research, and illustrates the influences of environmental, social and cultural factors.

PSYC.5020 Seminar in Community Social Psychology (Formerly 47.502) - Credits: 3
Offered from time to time to highlight specialized areas of faculty interest and to acquaint the student with new developments from a broad range of current psychological theory and research and how these developments might affect social and community life.

PSYC.5030 Applied Social Psychology (Formerly 47.503) - Credits: 3
Introduces students to social psychology as an applied discipline. Covers such applied topics as attitude change, aggression, helping behavior, attribution, and interpersonal influence.

PSYC.5040 The Family System (Formerly 47.504) - Credits: 3
Studies family processes and the interplay between the family and other social, cultural, and socio-economic systems. Topics include parental roles, changing family structures, racial and ethnic factors, and interactions between family, work, and community.

PSYC.5090 Psychological Approaches to Child Maltreatment (Formerly 47.509) - Credits: 3
The course addresses the painful topic of Child Maltreatment in the context of research on optimal, typical, and unacceptable treatment of children, as maltreatment cannot be considered apart from acceptable and even optimal treatment. The impact of maltreatment on the development of the child from the first growth of physical organs in the prenatal infant through the development of moral reasoning in the adolescent is addressed. Both theories and research will be discussed.

PSYC.5120 Applied Research Methods (Formerly 47.512) - Credits: 3
Considers strengths and limitations of various approaches to community and social psychological research. Develops skills for formulating research questions and translating them into practical study designs. Sensitivity to research ethics as well as research practicability and validity are emphasized. Pre- or Co-requisite: 47.500

PSYC.5220 Psychology of Diversity (Formerly 47.522) - Credits: 3
This course introduces students to theoretical, philosophical and experiential frameworks for thinking about diversity in our communities and society. It includes an examination of the experiences of diverse groups, especially traditionally oppressed groups and individuals. This course is designed to engage students in a process of introspection and self-examination about issues such as racism, sexism, classism, and homophobia. Emphasis will be placed on challenging one’s own world view and the way it fits into institutional oppression, as well as the way it may affect our work as community change agents.

PSYC.5230 Women in the Community (Formerly 47.523) - Credits: 3
An examination of women’s roles in the home, community,
and workplace; examines psychological consequences, social structural influences, and options for change. Topics include: housework and childcare; violence against women; workplace stratification issues; and women’s contributions to their communities.

**PSYC.5260 Workplace Diversity (Formerly 47.526) - Credits: 3**

This course will explore the challenges presented by the increasingly diverse workforce within the United States. Students will consider how work groups and organizations can effectively incorporate a diversity of perspectives. Students will consider issues of oppression, discrimination and bias, with particular attention paid to the situation here in the Merrimack Valley. There will also be some focus on personal awareness and the development of skills for addressing diversity concerns.

**PSYC.5270 Immigrant Psychology and Communities (Formerly 47.527) - Credits: 3**

This course will focus on the immigrant experience and the various immigrant groups in the United States with emphasis on recent immigrants in Lowell and Massachusetts. Theories of acculturation and adaptation to a new cultural environment will be extensively examined in the course. An experiential approach will be integrated throughout the course via the incorporation of guest speakers, films, autobiographies/novels, and food. Students will have ample opportunities to read, reflect, discuss and write about the immigrant experience. As our country is a country of immigrants, this course should have relevance to anyone working in the community.

**PSYC.5420 Working with Groups (Formerly 47.542) - Credits: 3**

This course uses a community-based approach to working with groups. Guided by an understanding of theoretical principles, students will gain insights about group dynamics and process. Students will develop and apply various skills, including assessment, enhanced communication, conflict resolution, problem solving, decision-making, and evaluation. Emphasis is placed on working within diverse groups, attaining outcomes, and utilizing resources. Organizational, prevention/intervention, and focus groups are examined.

**PSYC.5430 Psychology and Law (Formerly 47.543) - Credits: 3**

This course focuses on applications of psychological research and practice to the legal system. Drawing from the areas of social, cognitive, developmental, clinical, and neuropsychology, students will critically examine the legal process and compare the law’s informal theories of human behavior to what psychologists know on the basis of theories and research. Topics covered include including the practice of scientific jury selection, jury deliberation and decision-making, police interrogations and confessions, use of the polygraph as a lie-detector test, eyewitness testimony, repressed and recovered memories, the use of hypnosis, child witnesses in sex abuse cases, the death penalty, the insanity defense, and the role of psychologists as trial consultants and expert witnesses.

**PSYC.5450 Community and Organizational Change (Formerly 47.545) - Credits: 3**

A review of skills, techniques, and qualities associated with effective community and organizational interventions. Topics include the possibility and desirability of change, methods for studying change, assessment of needs and resources, visioning and planning, membership recruitment and retention, strategy and tactics, leadership styles, publicizing, funding, advocacy, evaluation techniques, and the personal qualities of the change agent. Both cultural factors and the community context of interventions will be discussed. Application to specific cases will be made. Students will have the opportunity to apply course material to settings outside the classroom.

**PSYC.5460 Grant Writing (Formerly 47.546) - Credits: 3**

This course will be a hands-on course in grant writing. One of the first lessons that you will learn is that grant writing is only to a small degree about writing. Successful grants emerge from working effectively with others to draw out ideas, capture those ideas to create a program or a plan for research, show how the plan is an appropriate one to respond to the "Request for Proposals", and package those ideas so that they make sense to the people who will review the proposal. Grant writing is increasingly a team building activity. Whether or not you obtain the funding is sometimes less important than the networking and planning that you do as a part of developing a grant proposal.

**PSYC.5610 Introduction to Behavioral Intervention in Autism (Formerly 47.561) - Credits: 3**

This course provides an introduction to the causes and diagnosis of autism, scientific validation, applied behavior analysis, and ethical treatment. Students also learn to write functional objectives, plan positive reinforcement, and design an applied measurement system in the context of developing Individualized Family Service Plans and Individualized Education plans. The issue of culturally appropriate interventions is addressed Prerequisite: coursework in the psychology of child development, or permission.
Autism for 3rd - Credits: 3

This course is for students who took 5610 prior to fall 2014 and who need additional hours to qualify for the BCBA exam. It provides an introduction to the causes and diagnosis of autism, scientific validation, applied behavior analysis, and ethical treatment. Students also learn to write functional objectives, plan positive reinforcement, design an applied measurement system in the context of developing individualized Family Service Plans and Individualized Education plans. The issue of culturally appropriate interventions in addressed. Prerequisite: coursework in the psychology of child development, or permission.

PSYC.5620 Teaching and Positive Behavioral Support in Autism (Formerly 47.562) - Credits: 3

This course covers the application of specific behavioral teaching procedures, including prompting, reinforcement, shaping, chaining, error correction and generalization methods, and development of instructional plans. Emphasis is placed on procedures and plans to teach communication, social, self-help and per-academic skills. Application of such methods in inclusive classroom settings is also considered.

PSYC.5621 Teaching and Positive Behavioral Support in Autism for 3rd - Credits: 3

This course is for students who took 5620 prior to fall 2014 and who need additional hours to qualify for the BCBA exam. This course covers the application of specific behavioral teaching procedures, including prompting, reinforcement, shaping, chaining, error correction and generalization methods, and development of instructional plans. Emphasis is placed on procedures and plans to teach communication, social, self-help and per-academic skills. Application of such methods in inclusive classroom settings is also considered.

PSYC.5630 Management Strategies in Applied Behavioral Intervention - Credits: 3

This course provides instruction on areas of the 4th edition task list related to ethically providing behavior analytic services as established by the Behavior Analysis Certification Board and codes of conduct for behavior analysts in the field of applied behavior analysis. Building on knowledge of applied behavior analysis and autism gained in the two prerequisite courses, students will enhance their understanding of best practices in the assessment and treatment of individuals diagnosed with an autism spectrum disorder and how ABA strategies are implemented and evaluated.

PSYC.5650 Measurement and Experimental Design in Behavioral Intervention (Formerly 47.565) - Credits: 3

This course provides advanced coverage of measurement methods used in behavioral intervention. It also offers in-depth coverage of the "within-subject" experimental designs commonly used in behavioral research and practice. Component analysis and parametric analysis methods, and ethical considerations in research, are also covered.

PSYC.5651 Measurement and Experimental Design in Behavioral Intervention for 3rd - Credits: 3

This course is for students who took 5650 prior to Fall 2014 and who need additional hours to qualify for the BCBA exam. This course provides advanced coverage of measurement methods used in behavioral intervention. It also offers in-depth coverage of the "within-subject" experimental designs commonly used in behavioral research and practice. Component analysis and parametric analysis methods, and ethical considerations in research, are also covered.

PSYC.5660 Functional Analysis and Treatment of Challenging Behavior (Formerly 47.566) - Credits: 3

This course covers the purpose, rationale and methods used in conducting and interpreting functional analyses of challenging, or "maladaptive", behaviors (self-injury, stereotypy, aggression). It also describes the full range of behavioral procedures used to decrease or eliminate these behaviors, with emphasis placed on ethical interventions and the desirability of least restrictive and non-aversive strategies.

PSYC.5661 Functional Analysis and Treatment of Challenging Behavior for 3rd - Credits: 3

This course is for students who took 5660 prior to Fall 2014 and who need additional hours to qualify for the BCBA exam. This course covers the purpose, rationale and methods used in conducting and interpreting functional analyses of challenging, or "maladaptive", behaviors (self-injury, stereotypy, aggression). It also describes the full range of behavioral procedures used to decrease or eliminate these behaviors, with emphasis placed on ethical interventions and the desirability of least restrictive and non-aversive strategies.

PSYC.5680 Behavioral Intervention Program Models in Autism (Formerly 47.568) - Credits: 3

This course explores how educational environments can be designed to maximize learning. Different models of effective, evidence-based behavioral interventions are analyzed. The use of teaching activity schedules and staff training to build supportive educational settings is also covered.

PSYC.5681 Behavioral Intervention Program Models in Autism for 3rd - Credits: 3
This course is for students who took 5680 prior to Fall 2014 who need additional hours to qualify for the BCBA exam. This course explores how educational environments can be designed to maximize learning. Different models of effective, evidence-based behavioral interventions are analyzed. The use of teaching activity schedules and staff training to build supportive educational settings is also covered.

PSYC.5710 Autism and Developmental Psychopathology (Formerly 47.571) - Credits: 3
This course is designed to explore Autism Spectrum Disorders (ASDs) in the developing person and in changing social contexts (e.g., family, school, employment) across development. An empirical and theoretical review of developmental transformations and reorganizations across the lifespan provides the basis for examining biological, social, psychological, and cultural contributions to the continuity and discontinuity of both adaptive and maladaptive processes over time as well as an analysis of individual and environmental risk and protective factors across development. Special attention is given to the changing competencies and challenges of developmental periods and their role in the assessment, display, meaning, and implications of ASDs from infancy through adulthood.

PSYC.5720 Legal and Ethical Issues in Professional Practice (Formerly 47.572) - Credits: 3
This course will explore the legal and ethical issues facing professionals working with individuals diagnosed with disabilities, particularly those on the autism spectrum. The goal is to provide behavior analysts and other professionals the opportunity to develop skills in dealing with the complex legal and ethical issues that arise when working in human service fields.

PSYC.5740 Community and Social Interventions in Autism (Formerly 47.574) - Credits: 3
This course will focus on current perspectives of community-based programming for individuals on the autism spectrum, particularly among the adolescent and adult age range. We will overview the challenges experienced by those with an autism spectrum disorder (ASD) during adolescence and adulthood, and consider the issues involved in designing, implementing, and evaluating social and community interventions for this population.

PSYC.5880 Advanced Cognition - Credits: 3
This course will provide an advanced overview of the scientific study of mental processes. Specifically, we will read a number of experimental and review articles that describe or contribute significant advancements to our understanding of memory, decision-making, language, attention, perception, etc. Readings will be critically evaluated and synthesized through discussions and a variety of in-class review activities, with particular emphasis on the role of cognition in a broader human context.

PSYC.6110 Program Evaluation (Formerly 47.611) - Credits: 3
A skill-oriented approach that considers both formative and summative evaluation techniques. Emphasizes mastery of the technical aspects of the evaluation process, and includes consideration of the importance of program evaluation in community psychology, health, education, etc.

PSYC.6250 Advanced Community Dynamics: Lowell (Formerly 47.625) - Credits: 3
An examination of principles that influence community structure, function, and evolution over time. Students will learn how community patterns and activities can best be understood and how community problems and concerns can best be addressed, employing psychological and other conceptual frameworks and perspectives. Specific emphasis will be placed on the historic and diverse city of Lowell. Prerequisites: 47.500 and 47.512.

PSYC.6310 Capstone Practicum I in Community Social Psychology (Formerly 47.6310) - Credits: 3
Provides supervised field experience in a setting appropriate to the student’s area of specialization, plus on-campus class meetings. An average of approximately ten hours of fieldwork in an approved setting for two consecutive semesters is required.

PSYC.6320 Capstone Practicum II in Community Social Psychology (Formerly 47.632) - Credits: 3
Continuation of PSYC.6310, which is pre-requisite.

PSYC.6400 Theories of Change in Applied Psychology (Formerly 47.640) - Credits: 3
Examines major theories of development and change relevant to Applied Psychology; and discusses the use of theories in posing and answering research questions. A major focus of research and practice is on understanding and promoting change (in structures, functions and processes of cognition, emotion, behavior and relationships) over time. In this course, students will examine major theories of change (development, therapeutic and school/community/contextual change), learn to place these theories in comparative, historical and philosophical context, examine efforts in theory integration, and test the direct relevance of theories to posing and
answering their own research questions.

**PSYC.6410 Fundamentals of Prevention Science - Credits: 3**

This graduate course will examine theoretical, empirical, and practical foundations of prevention science for designing and evaluating diverse interventions to prevent human social problems and promote healthy development. The seminar will cover the origins and multidisciplinary roots of prevention science, key concepts, current trends and directions, theoretical approaches, program theory, methodology, research to practice, policy development, and dissemination. Special consideration will be given to conceptual issues in the field such as prevention versus promotion, stages of program development, scaling up, methodological approaches such as randomized controlled trials, quasi-experiments, process and impact assessment, cost-benefit analysis, statistical methodology, dissemination.

**PSYC.6500 Advanced Quantitative Methods (Formerly 47.700/PSYC.7000) - Credits: 3**

This course is designed to provide an overview of the most widely used methods employed by psychologists and other behavioral scientists. You will learn about the common research tools and strategies that psychologists' use in the production of knowledge. The course will provide you with a basic understanding of the strengths and weaknesses of the various research strategies used by psychologists so that you can become an informed consumer of research both in the behavioral sciences and the media. In addition, you will begin to develop and practice a set of research skills that will prepare you for advanced study in the behavioral sciences.

**PSYC.6630 Experimental Analysis of Behavior (Formerly 47.663) - Credits: 3**

This course will explore the basic principles of the experimental analysis of behavior and their application to an understanding of learning. Emphasis will be placed on the historical underpinnings of the field, the methods of analysis, and current issues in the field.

**PSYC.6640 Child Maltreatment (Formerly 47.664) - Credits: 3**

The purpose of this class is to introduce the topic of child maltreatment. Child abuse and neglect and family violence impact people of all ages in all communities. These issues have not been solved and have generated controversy between and within psychology, the legal system, medical, and social service professionals. This course examines the main issues and controversies to foster an understanding of relevant theory, empirical findings, and research methodology.

**PSYC.6650 Advanced Community Social Psychology (Formerly 47.665) - Credits: 3**

Introduces history and contemporary trends of community and social psychology with focus on how social and environmental forces affect individual and group quality of life. This course surveys the history, theoretical frameworks, core values, methods/approaches and orienting concepts in the field.

**PSYC.6670 Advanced Applied Cognitive Psychology (Formerly 47.667) - Credits: 3**

This course is designed to give you an overview of various applications of basic cognitive psychology to everyday problems in four domains: education, law, work, and health. It is by no means a comprehensive survey, and you should see it just as an idiosyncratic introduction to the field of applied cognitive psychology. In this class you will begin learning about how basic research into our cognitive processes can help inform real-life issues.

**PSYC.6680 Primary Care Behavioral Health (Formerly 47.668) - Credits: 3**

This course is designed to prepare applied psychologists to work in primary care medical environments. The course focuses on delivering psychological knowledge relevant to medical treatment in a variety of ways.

**PSYC.6690 Advanced Applied Developmental Psychology (Formerly 47.669) - Credits: 3**

Provides a life span developmental perspective on individual and social and research, and illustrates the influences of environmental, social and cultural factors. Understanding the levels and tasks of development that characterize various ages helps us to understand the role of individuals as they interact in social contexts as well as the role of social contexts in the lives of individuals.

**PSYC.6710 Supervised Practicum in Behavioral Intervention in Autism: I (Formerly 47.671) - Credits: 3**

The practicum sequence of courses is required of all Master of Science in Autism Studies students, whether they have opted for the Fieldwork or University Intensive Practicum option for accumulating supervised experience hours. In this first of a 3-course sequence, students will gain experience in applying behavioral principles and methods to individuals with Autism Spectrum Disorder or other appropriate populations. All
students must have an off-site, approved placement from 10 to 30 hours per week, as determined by BACB requirements; the placement must include direct work with clients. Class time will be used to discuss treatment and analysis strategies in the context of individual cases with which the student is involved during their on-site placement.

PSYC.6720 Supervised Practicum in Behavioral Intervention in Autism:II (Formerly 47.672) - Credits: 3

In this second of a 3-course sequence, students will gain experience in applying behavioral principles and methods to individuals with Autism Spectrum Disorder or other appropriate populations. All students must have an off-site, approved placement from 10 to 30 hours per week, as determined by BACB requirements; the placement must include direct work with clients. Class time will be used to discuss treatment and analysis strategies in the context of individual cases with which the student is involved during their on-site placement.

PSYC.6730 Supervised Practicum in Behavioral Intervention in Autism: III (Formerly 47.673) - Credits: 3

In this third of a 3-course sequence, students will gain experience in applying behavioral principles and methods to individuals with Autism Spectrum Disorder or other appropriate populations. All students must have an off-site, approved placement from 10 to 30 hours per week, as determined by BACB requirements; the placement must include direct work with clients. Class time will be used to discuss treatment and analysis strategies in the context of individual cases with which the student is involved during their on-site placement.

PSYC.6750 Seminar in Health Psychology - Credits: 3

This course focuses on the application of psychological principals to the subspecialty of health psychology. Students will learn about the major topics in health psychology, including health behaviors, stress and health, health moderators, and prevention. Students will be exposed to psychological theories and research methodologies used in health psychology, and to current literature in the field.

PSYC.6760 Seminar in Language Acquisition (Formerly 47.676) - Credits: 3

This course explores the development of oral language and the relationship between oral language and literacy. Receptive and productive abilities in all major aspects of language acquisition will be addressed, including articulation, vocabulary, syntax/morphology, narration, and metalinguistic awareness, as will major theories of language acquisition. Special circumstances such as bilingualism, dialect differences, and use of sign language will also be addressed.

PSYC.6770 Applying Cognitive Psychology to Education (Formerly 47.677) - Credits: 3

This course is designed to provide an in-depth look into the impact of cognitive psychology on education. We will look at basic processes including attention, memory, decision-making, and motivation, starting first from basic theoretical principles. We will then read papers that have taken these theoretical principles as a starting point and applied them to real-life issues in education, such as exam performance and students' self-evaluations of their own performance.

PSYC.6780 Seminar in Metacognition (Formerly 47.678) - Credits: 3

Metacognition is, any reflection or judgment made upon an internal representation such as a memory' (Dunlosky & Metcalfe, 2009, p.145), and refers more broadly to people's cognitions about their cognitions ' thoughts about thoughts. This course will provide a survey of the core concepts, research, and theory about metacognition that has arisen from multiple approaches.

PSYC.6790 Psychology and Law (Formerly 47.679) - Credits: 3

This course is designed to provide an overview of many topics, representing major fields of study within psychology and law. In this course, students will learn about the diversity of interests among legal psychologists as well as innovative and important ideas, theories, and research findings. This class concentrates on the scientific study of psychology and law. The main goal is to provide students with an understanding of relevant theory, empirical findings, and research methodology. This is an interdisciplinary class for students whose research concerns psychology, law, or criminal justice.

PSYC.6800 Aging and Community (Formerly 47.680) - Credits: 3

This course addresses aging processes in diverse community contexts, with an emphasis on practical applications of theory and research to empower elders, promote culturally-appropriate services, and foster intergenerational community. Topics will include theoretical approaches to adult development and aging, with a focus on ecological models and theories, individual differences and strengths that influence aging processes, social support and sense of community among older adults, civic engagement and activism, "aging in place"
and "age-friendly" communities, globalization and aging, dependency and end-of-life care, and intergenerational social justice.

PSYC.6810 Health Campaigns: Effects and Processes (Formerly 47.681) - Credits: 3

The intent of this course is to provide the student with a thorough understanding of the effects and processes of health campaigns -- including theoretical foundations, empirical findings, and practical applications. The emphasis will be on applying this information to diverse aspects of human health, including individual physical and mental health as well as the broader fabric of public health and societal functioning. As the course evolves, students will apply and extend the course concepts through critical analysis of existing health campaigns and through the design of a proposed campaign of their choosing.

PSYC.6910 Directed Study in Community and Social Psychology (Formerly 47.691) - Credits: 3

This course is designed as an independent study under the supervision of a member of the department of a subject not offered in the standard curriculum.

PSYC.6920 Directed Study in Autism (47.692) - Credits: 3

This course is designed as an independent study under the supervision of a member of the department of a subject not offered in the standard curriculum.

PSYC.6930 Directed Study in Applied Psychology and Prevention Science (Formerly 47.693) - Credits: 3

Designed as an independent study under faculty supervision in a topic not offered elsewhere in the curriculum.

PSYC.7010 Narrative Methods (Formerly 47.701) - Credits: 3

Narrative refers to real or imaginary events related often by means of language, but also by means of pictures, songs, and dance. Narrative often involves a sequence of events, representation of the meaning of those events, and description of the context in which they occurred. Narrative is the primary means by which we make sense of our experiences and represent ourselves to and develop intimacy with others. There are important documented differences in narration due to culture, cognition, emotion, age, and gender. To adequately analyze narration requires expertise in a wide variety of analytic methods and is the overarching goal of this course.

PSYC.7020 Participatory Action Research (Formerly 47.702) - Credits: 3

Participatory action research (PAR) is a form of systematic inquiry that is carried out in collaboration with those affected by the issue being studied, for purposes of education and social change. PAR approaches engage those most intimately impacted by social problems in shaping research questions, framing interpretations, and planning meaningful research products and dissemination. PAR is a mechanism for disenfranchised communities to become active policy critics and agents engaged in reform in their communities. This seminar will introduce participants to the epistemological foundations of PAR along with a number of theoretical and practical issues in the design and implementation of participatory action research.

PSYC.7030 Selected Topics in Applied Psychology and Prevention Science (Formerly 47.703) - Credits: 3

Presents a careful consideration of selected topics in the area of Applied Psychology and Prevention Science.

PSYC.7050 Intro to Structural Equation Modeling - Credits: 3

Introduction to basic concepts, principles, and applications of structural equation modeling including path analysis, confirmatory latent variable models, multiple-group modeling, and latent growth curve modeling. Students will learn how to use these techniques in relation to various examples of social science research data.

PSYC.7220 Master's Project in Autism - Credits: 3

For master's graduate students actively engaged in a research or intervention-based project leading to the submission of a written project report. A program of supervised study will be arranged between the student and a faculty supervisor. This course may be repeated once. Permission of instructor.

PSYC.7330 Master's Project in Community-Social Psychology (Formerly 47.733) - Credits: 3

For graduate students actively engaged in developing a change-oriented intervention leading to the submission of a written project report. A program of supervised study will be arranged between the student and a faculty supervisor. Prerequisite: Approval of major advisor.

PSYC.7430 Master's Thesis in Community Social Psychology (Formerly 47.743) - Credits: 3
For graduate students actively engaged in research leading toward the submission of a written thesis. A program of supervised work will be arranged between the student and a faculty supervisor. This course may be repeated for credit, but only a total of 6 credits may be counted toward the Master’s degree. Prerequisite: 47.500 and 47.512 and permission of the faculty member who will supervise the thesis.

**PSYC.7440 Master’s Thesis in Autism Studies**  
(Formerly 47.744) - Credits: 3

For graduate students actively engaged in research leading toward the submission of a written thesis. A program of supervised work will be arranged between the student and faculty supervisor. This course may be repeated for credit, but only a total of 6 credits may be counted toward the Master’s degree. Prerequisite: 47.512 and 47.561 and permission of the faculty member who will supervise the thesis.

**PSYC.7460 Master’s Thesis in Community Social Psychology** (Formerly 47.746) - Credits: 6

For graduate students actively engaged in research leading toward the submission of a written thesis. A program of supervised work will be arranged between the student and a faculty supervisor. Only a total of 6 credits may be counted toward the Master’s degree. Prerequisite: 47.500 and 47.512 and permission of the faculty member who will supervise the thesis.

**PSYC.7630 Dissertation** (Formerly 47.763) - Credits: 3-9

Faculty supervision of doctoral dissertation.
Criminal Justice

School of Criminology and Justice Studies

Objectives of the Graduate Programs

The School of Criminology and Justice Studies offers three graduate programs. These distinct programs provide students with an educational experience designed to meet the diverse needs of graduates across a wide range of career venues, from positions in higher education, to research in private sector firms, to research, policy-making, and administrative positions in the public sector. Each of our graduate programs has been designed to accomplish a number of important objectives.

Please follow these program-specific links for more information:

- Doctor of Philosophy
- Master of Arts
- Graduate Certificates

Master's Program

Master of Arts in Criminal Justice

- Expected Academic / Professional/Occupational Results
- Admission Requirements
- Degree Requirements
- Bachelor's/Master's (BS/MA) Option
- Degree Program
- Masters Thesis
- Course of Study

Expected Academic/ Professional/Occupational Results

It is anticipated that the masters and certificate programs will serve four types of students:

1. Those seeking a terminal masters degree as a prerequisite for entry into the criminal justice field.
2. Those currently in service in the criminal justice system who seek to broaden their skills and obtain job-related knowledge and expertise.
3. Those currently in the criminal justice system seeking to specialize and/or work in some other area of the system.
4. Those currently in the system or pre-service who wish to obtain the training and expertise necessary to meet the growing need for teaching criminal justice at the community college level. In addition, the program will meet the needs of students preparing for doctoral work in criminal justice or related fields. Off-campus graduate courses have been offered in Boston, Woburn, and Bedford, and varied with each semester. Selected courses are also offered via the Internet.

Admission Requirements

In addition to the university requirements for graduate admissions, applicants should have the ability to pursue graduate education, as demonstrated by:

1. Graduation from an accredited four-year institution.
2. Minimum undergraduate grade point average of 2.8 or higher.
3. Acceptable scores on the Graduate Record Examination Aptitude Test or Millers Analogy Test.
4. Two letters of reference from individuals familiar with the educational and/or professional performance of the applicant.
5. One copy of a complete and official transcript from each undergraduate and graduate institution attended.
6. An interview may be requested by the Graduate Admissions Committee.
7. Subject to departmental approval, a maximum of 6 credits of graduate level coursework taken at an accredited university outside of UMass Lowell with a grade of B or better may be transferred into the Criminal Justice masters degree program.
8. Prospective applicants may take a maximum of two classes at UMass Lowell as a non-degree student which may be transferred into the master's program.

Students with a Bachelors degree from an accredited program who have an undergraduate grade point average between 2.5 and 2.8 may, with the permission of the Graduate Coordinator, take limited courses as non-degree students. These non-degree students should take CRIM 5010 Criminological Theory, CRIM 5200 Administration of Criminal Justice. If they successfully complete these two courses with a grade of B or better, they may then make formal application to the program, submitting all required credentials.
A maximum 6 credits of graduate level course work taken at an accredited university outside of UMass Lowell with a grade of B or better may be transferred into the Criminal Justice master’s degree program, with the approval of the graduate coordinator.

**Degree Requirements**

You must complete a minimum of thirty-three (33) credits for the Master of Arts Degree, including a Core Course Sequence of fifteen (15) credits, which includes the following required courses:

1. CRIM.5010 Criminological Theory: Foundations
2. CRIM.5200 Administration of Justice System
3. CRIM.5900 Descriptive & Inferential Statistics
4. CRIM.5910 Research Design
5. CRIM.6130 Law and Public Policy OR CRIM.5210 Managing Criminal Justice Organizations

In addition, all students may choose to complete CRIM.5830/5860 Masters Thesis (6 credits). If you do not undertake the thesis option, two additional classes must be taken to complete the six credit hours.

You should meet with your academic advisor to develop an individualized course of study to meet your degree requirements.

**Bachelor's/Master's (BS/MA) OPTION**

Outstanding undergraduate Criminal Justice majors at the University of Massachusetts Lowell may enroll in a B.S./M.A. program that allows students to complete both degrees in five years (in many cases).

Additional information and how to apply.

**Degree Program**

During the first year of full-time study, students emphasize the five core courses. The decision to complete a thesis should be made before the completion of 24 credits. Full time students will enroll in thesis during the second year of study. Selected specialty courses will be taken during the second or subsequent year. With the approval of the academic advisor, students may select up to nine credits of graduate level courses in other programs at the university. Students will be assigned an academic advisor, usually the Graduate Coordinator, when entering the program. Students will be required to maintain a 3.0 cumulative average. If a student should receive a grade below a B, the academic advisor will meet with the student to discuss methods of improving performance. No more than six credits below a B may be counted toward the degree. If a student should receive a second grade below a B, there will be a review by the Graduate Committee for such actions as a warning, probation, or loss of degree candidacy. Such action will be subject to the approval of the Graduate Dean. All requirements for the degree must be completed within five years of the time the student was first admitted as a matriculated student.

**Masters Thesis**

The thesis will be completed under the direction of a mutually acceptable thesis advisor. The thesis proposal must be approved by the thesis committee. An approved copy of the proposal will be filed with the Graduate Coordinator. The thesis will represent the students ability to formulate, carry out, and present a significant research project. A defense of thesis will be conducted before a panel including the thesis advisor (chair), and the committee members chosen by the student and approved by the Graduate Coordinator. Thesis forms and guidelines are available.

**Course of Study**

Once the majority of the required core courses are completed, students are free to choose the remaining courses in their program of study. Students should meet with their advisor to develop an individualized course of study that best meets their interests and needs.

**Ph.D. Program**

Doctor of Philosophy in Criminology and Criminal Justice

- Expected Results
- Admission Requirements
- Degree Requirements
- Terrorism Study Option
- Doctoral Qualifying Exam
- Doctoral Dissertation
- Ph.D. Handbook, including Course of Study

Expected Academic, Professional, or Occupational Results

The doctoral program is designed to achieve particular outcomes - to produce graduates who:

1. Will conduct interdisciplinary research and teach at both the graduate and undergraduate levels in aspects of
criminology and/or criminal justice depending upon their specific areas of specialty.

2. Will be well prepared for analytical and administrative leadership posts in international and domestic research and policy institutions.

3. Can become policy analysts, managers, and administrators in criminal justice and community venues to help prevent crime in the first place, or alternatively, respond effectively to those who violate the law or who come into contact with the justice system.

4. Will be at the forefront of the expanding frontier of criminology and an ever evolving criminal justice system, and consequently, will more effectively be able to address crime control and criminal justice policy problems through sophisticated research than would be the case otherwise.

Admission Requirements

Doctoral program applicants must demonstrate their ability to pursue doctoral level education as evidenced by:

1. Minimum undergraduate GPA of 3.75; or graduate GPA of 3.66 (if applicable).

2. Verbal and Quantitative scores on the Graduate Record Examination [i.e., generally, the 40th percentile on each GRE component: Quantitative, Verbal and Writing] for admission. Verbal and Quantitative scores on the Graduate Record Examination [i.e., generally, the 50th percentile on each GRE component: Quantitative, Verbal and Writing] for assistantship funding.

3. Three letters of reference from individuals familiar with the educational performance of the applicant. [i.e., academic rather than professional references].

4. Two copies of complete and official transcript from undergraduate and graduate institutions.

5. A personal statement which indicates why the applicant wishes to pursue a doctoral degree in Criminal Justice and Criminology.

6. A writing sample such as a theoretical paper, research paper, or literature review.

7. An interview may be requested by the Graduate Admissions Committee.

8. International applicants must provide official TOEFL scores.

9. The Graduate Admissions Committee can accept transfer credit for graduate courses from an accredited university with a grade of ?B? or better. Transfer credit can be awarded for graduate courses that are substantially similar to ours. Applicants are required to submit Course Descriptions and Course Syllabi for each course.

10. Applicants seeking Graduate Assistantships must be submitted by February 1.

Degree Requirements

The doctoral degree in Criminology and Criminal Justice is a 60 credit-hour doctoral program. The curriculum has been developed to incorporate a theoretically grounded and methodologically sophisticated set of courses as a highly necessary foundation for the evidence driven and ?best practices? approaches to the substantive concentration areas. The basic layout of the doctoral program is depicted below. Please download the Graduate Programs Guide (https://www.uml.edu/docs/PhD%20Student%20Handbook%20Final%20Rev.%208_17%20%2802%29_tcm18-53258.pdf) for further information on the three tiers of course work and complete descriptions of all degree requirements and procedures.

<table>
<thead>
<tr>
<th>Required Courses (42 credits)</th>
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<tbody>
<tr>
<td>CRIM.5010</td>
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<tr>
<td>CRIM.5900</td>
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<tr>
<td>CRIM.5910</td>
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<tr>
<td>CRIM.6010</td>
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<td>CRIM.6020</td>
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<td>CRIM.6890</td>
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<td>CRIM.6900</td>
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<td>CRIM.7XXX</td>
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<tr>
<td>CRIM.7XXX</td>
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</tbody>
</table>

Controlled Elective (3 credits)

One of the following courses

| CRIM.7XXX | Advanced Statistical Analysis (3) |
| CRIM.7XXX | Qualitative Data Analysis (3) |

Free Elective (3 credits)

One course that is either in or related to criminal justice (could be external to the School of Criminology & Justice Studies)

Dissertation (12 credits)

Terrorism Studies Option
Students interested in the study of terrorism and counter-terrorism within the Ph.D. in Criminology and Criminal justice program should indicate this in the Statement of Purposes during the application process. All other admission requirements are the same. If accepted into the Ph.D. program and the Terrorism Studies Option, students will be assigned an appropriate advisor from the tenured faculty of the Center for Terrorism and Security Studies. The program of study requires 60 credit hours of study, with terrorism-specific course requirements in Tier I (B, D) and Tier II (A, B). For more information, please contact the Criminal justice Graduate Advisor via e-mail: CJGradAdvisor@uml.edu (mailto:CJGradAdvisor@uml.edu).

### Required Courses (39 credits)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>CRIM.3010</td>
<td>Criminological Theory: Foundations</td>
</tr>
<tr>
<td>CRIM.5900</td>
<td>Descriptive and Inferential Statistics</td>
</tr>
<tr>
<td>CRIM.5910</td>
<td>Research Design</td>
</tr>
<tr>
<td>CRIM.6020</td>
<td>Nature and Extent of Crime</td>
</tr>
<tr>
<td>CRIM.6690</td>
<td>Counterterrorism Policies &amp; Strategies</td>
</tr>
<tr>
<td>CRIM.6900</td>
<td>Advanced Regression</td>
</tr>
<tr>
<td>CRIM.6910</td>
<td>Advanced Research Design</td>
</tr>
<tr>
<td>CRIM.6920</td>
<td>Qualitative Research Methods</td>
</tr>
<tr>
<td>CRIM.7100</td>
<td>Advanced Research in Terrorism</td>
</tr>
<tr>
<td>CRIM.6XXX</td>
<td>Professional Development</td>
</tr>
<tr>
<td>CRIM.6XXX</td>
<td>Advanced Theory of Political Violence</td>
</tr>
<tr>
<td>CRIM.7XXX</td>
<td>Advanced Qualitative Methods</td>
</tr>
<tr>
<td>CRIM.7XXX</td>
<td>Research Seminar</td>
</tr>
</tbody>
</table>

**Controlled Electives (9 credits)**

**One of the following courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRIM.5710</td>
<td>Domestic Terrorism and Violent Extremism</td>
</tr>
<tr>
<td>CRIM.5XX</td>
<td>Theories of Civil War</td>
</tr>
</tbody>
</table>

**One of the following courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>CRIM.5720</td>
<td>Comparative Terrorism &amp; Counter-terrorism</td>
</tr>
</tbody>
</table>

**Elective**

either inside or outside the department

**One of the following courses:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRIM.7XXX</td>
<td>Advanced Statistical Analysis</td>
</tr>
<tr>
<td>CRIM.7XXX</td>
<td>Qualitative Data Analysis</td>
</tr>
</tbody>
</table>

**Dissertation (12 credits)**

Preliminary and Comprehensive Examinations

There are two examinations outside of the classroom that students must take and pass in the doctoral program: preliminary exam (PE) and the comprehensive exam (CE).

**Preliminary Exam**

The PE will be given to students after completion of eighteen hours of required course work in May at the conclusion of the spring semester for both full-time and part-time students. A retake of the PE will be conducted in August prior to the star of the fall semester of the student’s second year, in time to allow a final decision of pass/fail before course work starts. Thus students are given two chances to pass the preliminary exam.

The purpose of the PC will be to assess the students’ comprehension and application of materials required in the

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>CRIM.5010</td>
<td>Criminological Theory: Foundations</td>
</tr>
<tr>
<td>CRIM.6010</td>
<td>Criminological Theory: Advanced</td>
</tr>
<tr>
<td>CRIM.6XX</td>
<td>Advanced Theory of Political Violence</td>
</tr>
<tr>
<td>CRIM.3900</td>
<td>Descriptive and Inferential Statistics</td>
</tr>
<tr>
<td>CRIM.3910</td>
<td>Research Design</td>
</tr>
<tr>
<td>CRIM.6900</td>
<td>Advanced Regression Analysis</td>
</tr>
</tbody>
</table>

**Comprehensive Exam**

The CE will be administered during the students’ third year in the program (if full-time) or in the student’s last year of coursework. More specifically the CE will be taken in January, before the start of the spring semester. The purpose of the CE will be for the student to propose, design and justify a research study in a manner reflective of the general and specific theoretical, substantive, and methodological knowledge expected of students embarking on their dissertation research. Because the topic of the exam will be reflective of the student’s expertise and interests, and the exam will be completed in take home format, enhanced expectations for the quality of responses will be assessed accordingly.

**Dissertation Requirement**

Consistent with practice of other top doctoral programs nationally, the doctoral program in Criminology and Criminal Justice accepts the three-paper option as an alternative to the traditional dissertation. Students must complete one OR the other but not both.

The traditional dissertation typically includes an introduction, literature review, outline of hypotheses, discussion of data and methodology, a series of analytical chapters, and a conclusion/discussion chapter of results and implications.

Alternatively, the three-paper option is composed of a set of articles that together represent a significant and coherent contribution to out knowledge in Criminology and Criminal Justice. These three papers, once completed, are preceded by an introduction that places the articles in context of the relevant academic literature. The works are then followed by a chapter that draws out the principal conclusions and their relevance and contribution to the field. These papers are written in the style of a journal article and must be of publishable quality, as determined by the candidate’s committee.

**Certificate Program**

### Graduate Certificates in Criminal Justice

The graduate program also offers six 12-credit certificates that are designed to meet the diverse needs of criminal justice professionals:
Domestic Violence Prevention
Forensic Criminology
Leadership & Policy Development
Security Studies
Victim Studies

Admission Requirements

In addition to the university’s requirements for graduate admission, applicants should have the ability to pursue graduate education, as demonstrated by:

1. Graduation from an accredited four-year institution.
2. Minimum undergraduate grade point average of 2.8 or higher.
3. Two copies of a complete and official transcript from each undergraduate and graduate institution attended.
4. An interview may be requested by the Graduate Admissions Committee.

Download the Graduate Certificate Application Form (pdf) (https://www.uml.edu/docs/Graduate%20Certificate%20App%20Only%20082016_tcm18-3292.pdf)

You will need Adobe Acrobat Reader (https://get.adobe.com/reader/) to view any pdf files. It can be downloaded for free from the Adobe website (https://get.adobe.com/reader/).

Certificate Requirements

- University regulations do not allow transfer of class(es) from another institution for the graduate certificate program.
- Classes may count for both the Masters degree and one certificate program. The same class can not be used for two different certificates.
- Once the requirements for a certificate have been completed you must submit a Graduate Certificate Clearance Form. This form may be found on the Registrar’s website under forms.
- Four courses must be completed within a five year period with a minimum of a 3.00 Grade Point Average and with no more than three credits below an earned grade of B (3.00).

Graduate Certificate in Domestic Violence Prevention

Departments of the School of Criminology and Justice Studies and Psychology

Coordinators:
Wilson Palacios, Ph.D.
Email: CJGradAdvisor@uml.edu (mailto:CJGradAdvisor@uml.edu)
Phone: 978-934-4106

Domestic violence is one of the major social and public health problems in the Commonwealth. The existing degree programs in Criminal Justice, Community Social Psychology, and the College of Health Sciences each offer relevant courses that greatly assist their graduates working with agencies and clients affected by domestic violence. The certificate provides a focused program for those working in settings where domestic violence is an issue. Courses may be applied to the relevant department’s Master’s degree program with the approval of the department’s graduate coordinator.

Required Courses (one of the 3-credit courses in each of the four groups):

Group 1:
- CRIM.6310 Intimate Partner Violence (cross-listed as PSYC.6220)
- CRIM.6320 Responding to Child Abuse and Mistreatment

Group 2:
- PUBH.6250 Health Policy
- CRIM.5200 Administration of Criminal Justice
- CRIM.6300 Victimology
- PSYC.5040 The Family System

Group 3:
- CRIM.5910 Research Design
- CRIM.5950 Program Evaluation Methods
- PSYC.5120 Applied Research Methods
- PSYC.6110 Program Evaluation

Group 4:
- PUBH.6160 Law and Ethics in Healthcare
- PUBH.6250 Health Policy
- CRIM.6520 Social Ecology of Crime
- CRIM.6030 Gender, Race, and Crime
- CRIM.6310 Intimate Partner Violence (cross-listed as
Graduate Certificate in Forensic Criminology

**Gainful Employment Disclosure Information**

Completion rates, median loan debts and program costs are outlined in the [Graduate Certificate Gainful Employment Disclosure Information](https://www.uml.edu/gainful-employment/Forensic%20Criminology%20-%20-%2043.0104-Gedt.html).

**Graduate Certificate in Leadership & Policy Development**

**Graduate Coordinator:**
Wilson Palacios, Ph.D.
Email: CJGradAdvisor@uml.edu
Phone: 978-934-4106

The graduate certificate provides a focused program for criminal justice managers and administrators. This specialized education will increase the knowledge and skills necessary to administer delivery of high quality and cost effective services. This program is designed to respond to the changes taking place in the criminal justice field which require up-to-date management skills.

**Required Courses** (total of 6 credits):

- CRIM.5210 Managing Criminal Justice Organizations
- CRIM.6130 Law and Public Policy

**Plus two of the following** (total of 6 credits):

- CRIM.5220 Issues in Policing
- CRIM.5240 Issues in Corrections
- CRIM.5260 Economic Crime
- CRIM.5910 Research Design
- CRIM.5950 Program Evaluation Methods
- CRIM.6250 Seminar Juvenile Justice and Youth Crimes
- CRIM.6260 Community Based Corrections
- PSYC.5460 Grant Writing
- POLI.5150 Politics and Economics of Public Policy
Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Gainful Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Criminal%20Justice%20Leadership%20and%20Policy%20Development%20-%20%2043.0104-Gedt.html)

Graduate Certificate in Security Studies

Graduate Coordinator:
Arie Perliger, Ph.D.
email: Arie_Perliger@uml.edu
Phone: 978-934-4106

This graduate-level certificate program addresses the increasing global and local concern involving security issues. The program consists of three required courses plus one elective course that can be chosen from a list of courses in the student’s particular area of interest.

After the tragedies of September 11, 2001, national policymakers called upon state and local law enforcement agencies to work together in strengthening our national defense. The formulation of the Homeland Security Act was a legislative effort to implement a "total" security infrastructure composed of federal, state, local, and private law enforcement agencies as well as a vast range of organizations that historically did not interface with one another.

Because of these recent changes in government, there is a growing need to understand the type of information gathering that occurs in these agencies, strategies for sharing the information while maintaining data quality, and ways to use the information for strategic planning, policy development and analysis. There are also concerns about how to go about gathering and analyzing this critical information without infringing upon the public’s civil liberties and privacy rights.

In response to the demand for knowledge in this area, UMass Lowell’s School of Criminology and Justice Studies has developed a graduate-level program designed to educate students in the complex nature of threats and how to manage them. Students can focus their studies in areas such as risk management and analysis; organizational and systems integration; legal and political policy and ethical issues in responding to threats; policy development and analysis; and the use of technology in implementing national security.

Intended Audience

The program is appropriate for students with a general interest in homeland security, professionals who are currently employed in security-related jobs, and for those interested in pursuing careers in security.

Required Courses (9 credits):

- CRIM 5740 Overview of Homeland Security
- CRIM 5720 Terrorism and Counter-Terrorism
- CRIM 5750 Contemporary Security Studies

Plus one of the following (3 credits):

- CRIM.5700 Crisis and Emergency Management
- CRIM.5710 Domestic Terrorism and Hate Crimes
- CRIM.5730 Threat Assessment and Risk Management
- CRIM.5260 Economic Crime
- CRIM.6940 Crime Analysis and Mapping
- CRIM.5760 Criminal Justice Intelligence and Information Sharing
- CRIM.5780 Intelligence Analysis: Policy and Practice
- CRIM.6580 Issues in Computer Crime and Cyber Security
- CRIM.6660 Terrorist Networks
- CRIM.6680 Scientific and Technical Dimensions of National Security
- CRIM.6640 Weapons of Mass Destruction

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Gainful Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Security%20Studies%20-%20%2043.9999-Gedt.html)

Graduate Certificate in Victim Studies

Graduate Coordinator:
Wilson Palacios, Ph.D.
email: CJGradAdvisor@uml.edu
Phone: 978-934-4106

The Graduate Certificate in Victim Studies is a 12-credit program consisting of one required course (3 credits), one Victimization elective (3 credits), and two Skills and Knowledge electives (6 credits).

The purpose of the proposed Graduate Certificate in Victim Studies is to provide multidisciplinary specialized knowledge of crime victim issues, crime victims rights, and formal responses to victims so that students may apply that knowledge within their own professional context. Completion of the certificate will provide students with the background to understand strengths and limitations of current responses to crime victims so they can be a part of initiatives and programs to prevent crime victimization, be prepared to engage in research and evaluation focused on crime victims issues, and respond
effectively to victims of crime in a culturally appropriate manner.

Unlike many graduate certificates which are designed to provide specialized knowledge within a particular field, the Graduate Certificate in Victims Studies is designed to provide specialized knowledge on crime victims that can be applied in a broad range of fields. The courses offered draw from programs in Criminal Justice and Criminology, Education, Psychology, and Regional Economics and Social Development. All students will take a core overview course in Victimology, one course about a specific type of victimization, and two courses pertaining to skills, theory and/or evaluation.

Elective courses are organized in clusters according to skills and knowledge content. These options are intended to guide students as to how they can tailor their education to their particular interests and/or professional needs. For example, a program director in a human services agency might take Program Evaluation or Grant Writing.

In recent semesters, a number of graduate students enrolled in the Criminal Justice Masters and certificate programs, who are working in victim services, have expressed an interest in taking more courses in that field through UML. In addition, many of our students who have completed our Domestic Violence Prevention Certificate have expressed interest in further course work which addresses the diverse range of victims of other types of crimes, e.g. identify theft, economic crime, and cyber stalking. Therefore, the proposed certificate is distinct from the Domestic Violence Prevention Certificate and will focus on crime victims more broadly and also include victims of crimes committed by non-family members and strangers.

Target Audience

The target audience for the proposed certificate includes professionals or potential professionals in fields that come in direct contact with victims of crime, as well as those who simply seek to better understand victimization. Some of the professionals this would include are those who provide direct services to victims, those who supervise victim programs, and those who come in contact with victims as a part of their professional lives. Some examples include victim advocates, prosecutors, health services workers, law enforcement and corrections personnel, youth services workers, social workers, journalists, and first responders.

Required course: (3 credits)

- CRIM.6300 Victimology

Elective Courses:

Victimization Electives (choose one of the following 3 credit courses):

- CRIM.5600 Gender, Race and Crime
- CRIM.6310 Intimate Partner Violence
- CRIM.6320 Responding to Child Mistreatment
- PSYC.5090 Psychological Approaches to Child Maltreatment

Skills and Knowledge Electives (Choose two of the following 3 credit courses):

Please note that clusters are suggested groupings based on student interest and their utility for application to current or potential employment. However, students are free to choose any two courses from the list.

Criminal Justice Cluster:

- CRIM 5200 Administration of Criminal Justice
- CRIM.5600 Gender, Race, and Crime
- CRIM 6310 Intimate Partner Violence
- CRIM 6320 Responding to Child Mistreatment
- CRIM 6500 Violence in America
- CRIM 6510 Criminal Homicide

Policy Cluster:

- CRIM 6130 Law and Public Policy
- POLI.5150 Politics and Economics of Public Policy

Program Director Skills Cluster:

- PSYC.5460 Grantwriting
- PSYC.6110 Program Evaluation

Psychology & Helping Cluster:

- PSYC.5000 Introduction to Community Social Psychology
- PSYC.5090 Psychological Approaches to Child Maltreatment (available online)
- PSYC.5220 Psychology of Diversity
- PSYC.5270 Immigrant Psychology and Communities
- PSYC.5420 Working with Groups

Research & Evaluation Cluster:

- CRIM.5900 - Research Methods in Criminal Justice
  or
- PSYC.5120 - Applied Research Methods
  AND
• PSYC.6110 - Program Evaluation
  or
• EDUC.6423 - Program Evaluation

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Victim%20Studies%20-%20-%2043.9999-Gedt.html)
CRIM.5010 Criminological Theory: Foundations
(Formerly CRIM 501/521) - Credits: 3
This course provides a detailed examination of the best known and most influential theories of crime causation. Topics include: theory construction, hypothesis testing, theory integration, and the links among theory, research, and policy.

CRIM.5200 Administration of Justice (Formerly 44.503/CRIM 520) - Credits: 3
An examination of the components of the criminal justice system and a review of the administration of federal, state and local criminal justice agencies, including a focus on criminal law and procedure.

CRIM.5210 Managing Justice Organizations (Formerly 44.570/CRIM 521) - Credits: 3
A range of criminal justice management issues are addressed, including organizational structure, purpose, rewards and relationships, leadership and management styles, and the development of effective change strategies by criminal justice agencies. The complex role of the criminal justice manager in both the adult and juvenile justice system is emphasized.

CRIM.5220 Issues in Policing (Formerly 44.541/CRIM 522) - Credits: 3
An introduction to research on the police, both basic research and applied, evaluative research. Since police discretion was “discovered” in the 1950s, basic research has focused on factors that explain the discretionary use (and abuse) of police authority, and particularly on factors that would signify bias in police decision-making, and also on the mechanisms by which police may be held accountable to the public. Evaluative research, beginning with the Kansas City Preventive Patrol Experiment in the 1970s, has been concerned with estimating the effects of programmatic and tactical innovations on social conditions' such as crime, fear of crime, satisfaction with police services and quality of life.

CRIM.5230 Courts and Sentencing (Formerly CRIM 523) - Credits: 3
Examines the various philosophies and theories of punishment and the distinct court structures and approaches to sentencing. Students will explore recent changes in sentencing policies and will study the social and economic costs of incarceration. We will examine sentencing disparities and their appropriateness based on offender and victim characteristics such as race and gender. Explores the debates regarding contemporary sentencing practices and investigates the increasing use of specialized courts and their effectiveness.

CRIM.5240 Issues in Corrections (Formerly 44.550/CRIM 524) - Credits: 3
This course reviews the development of institutional corrections and the issues surrounding the punishment of criminals in secure settings. The course also surveys the management of correctional institutions, including custody, classification, reception, programming, release, staffing, scheduling, collective bargaining, prisoners' rights, and other related issues.

CRIM.5250 Juvenile Justice and Youth Crime (Formerly CRIM 525) - Credits: 3
Examines the historical development of juvenile justice in the U.S., how the juvenile justice system operates, the rationale for treating juveniles differently from adults, and the extent of youth crime in the United States according to official statistics and self-report data.

CRIM.5260 Economic Crime (Formerly 44.574/CRIM 526) - Credits: 3
Introduction to economic crime including nature, causes, consequence, investigation, and prevention. Empirical findings and major economic crime cases will also be examined.

CRIM.5400 Criminal Profiling (Formerly 44.542/CRIM 540) - Credits: 3
An overview of the development and characteristics of violent offenders, some of whom will evolve to become criminal psychopaths. The class provides an analytical understanding of the unique characteristics of serial criminals and the methodologies used to commit their crimes.

CRIM.5410 Forensic Psychology (Formerly 44.543/CRIM 541) - Credits: 3
This course applies psychological theories, principles, and research to issues of concern to the criminal justice system with a special focus on the intersection of the mental health and criminal justice systems.

CRIM.5600 Gender, Race & Crime (Formerly 44.560) - Credits: 3
The implications of criminal laws, criminal justice practices and programs. Focus on inequalities based on gender, race and class.

CRIM.5660 Transportation Systems Safety and
Security (Formerly 44.566) - Credits: 3
This course will look at safety, security and emergency management with regard to transportation operations; multimodal transportation security threats, vulnerabilities, risk and strategies to mitigate and incident; and the security of supply chains and critical infrastructure. The course will use case studies to provide the student with the knowledge, skills, and abilities to effectively safeguard the movement of assets within interconnected transportation networks.

CRIM.5700 Crisis and Emergency Management (Formerly 44.513/CRIM 570) - Credits: 3
This course will provide a broad introduction to the critical challenges of disaster management. The course will address past and present strategies for reducing and responding to hazards posed by both manmade and natural disasters. Emphasis will be placed on what we can learn from the history of disasters, and on how we can apply those lessons to the management of future events.

CRIM.5710 Domestic Terrorism and Violent Extremism (Formerly 44.526/CRIM 571) - Credits: 3
This course examines the evolution and contemporary nature of domestic terrorist threats and violent extremist movements that the U.S. has confronted over the past several decades. Special attention is focused on right-wing militias, religious extremists, racial supremacist/hate groups, and extreme environmental and animal rights groups. Students will also learn about political and socioeconomic factors that enable a terrorist group’s ideological resonance, prison radicalization, the role of the Internet in mobilizing individuals toward violent behavior, and the legal and criminal justice dimensions of responses to terrorism.

CRIM.5720 Comparative Terrorism and Counterterrorism (Formerly 44.549/CRIM 572) - Credits: 3
This course examines a broad spectrum of terrorist groups and counterterrorism responses in over a dozen countries, including Colombia, Germany, India, Israel, Italy, Northern Ireland/UK, Pakistan, Somalia, Spain, Sri Lanka, Turkey and Yemen. This comparative analysis will help students develop and understand of patterns and trends within political violence (including radicalization, tactics, financing, targeting behavior, malevolent creativity, disengagement and de-radicalization) and the many different policies and strategies adopted by governments in response to terrorist threat.

CRIM.5730 Threat Assessment and Risk

Management (Formerly 44.554/CRIM 573) - Credits: 3
The goal of this course is to enhance understanding and increase expertise regarding risk management and the impact of terrorism on economic and other critical infrastructures in the United States. The course will provide the tools (operational and statistical) and technology required to mitigate these risks. A second purpose of the course is to examine and critically discuss current and future methods to create best practices in security management.

CRIM.5740 Overview of Homeland Security (Formerly 44.567/CRIM 574) - Credits: 3
The U.S. has embraced the homeland security monolith without a full understanding of what it encompasses. This course provides a comprehensive overview of homeland security and defense as undertaken in the United States since 9/11. The course critically examines the current body of knowledge with a specific focus on understanding security threats, sources, and reasons for these threats. The roles of the key players at the federal, state and local levels, the policies and procedures enacted since 9/11, and the homeland security system in practice are also examined.

CRIM.5750 Contemporary Security Studies (Formerly 44.568/CRIM 575) - Credits: 3
This course examines the complex nature of key domestic and international security threats and responses. Topics include terrorism and insurgency, transnational organized crime, WMD proliferation, cyber-security, intelligence, national and homeland security strategies, critical infrastructure protection, and theories of international security.

CRIM.5760 Criminal Justice Intelligence and Information Sharing (Formerly 44.599/CRIM 576) - Credits: 3
A primary function of law enforcement is the gathering of information. However, information by itself does little to support the law enforcement mission. Intelligence, in the context of law enforcement, is the outcome of rigorous analysis of information, and often generates key decisions and/or guides tactical strategies that help facilitate the enforcement mission. This course examines the role of information and intelligence in defining and achieving the law enforcement mission. Problem solving tools such as SARA, and management tools like COMPSTAT, which rely heavily on both information and intelligence, are discussed. In a world now confronted by the threat of terrorism, the course examines the sharing/lack of sharing of information and intelligence among local law enforcement and federal agencies and the impact of this
contentious relationship.

CRIM.5780 Intelligence Analysis Policy and Practice (Formerly CRIM.578) - Credits: 3

Students will examine the tradecraft of intelligence collection and analysis from various perspectives. Topics will include strategies, tactics, legal and ethical implications, sources, means, methods, limitations, covert action, methods of analysis, and case studies of prominent intelligence successes and failures in the last half century.

CRIM.5800 Criminal Justice Scholarship (Formerly 44.501/CRIM.580) - Credits: 3

This course is designed to improve the writing skills of graduate students. This will be done in the context of the important subject area of evidence based criminal justice research and policy.

CRIM.5830 Master’s Thesis - Criminal Justice (Formerly 44.743/CRIM 583) - Credits: 3

CRIM.5860 Master’s Thesis - Criminal Justice (Formerly 44.746/CRIM 586) - Credits: 6

CRIM.5880 Strategic Intelligence and Homeland Security (Formerly 44.588) - Credits: 3

This course is designed to provide an overview of the past, present, and future role of intelligence in national security. The course addresses the development and institutional structure of intelligence organizations and explains their purpose, roles, responsibilities, and realms of authority. It also provides an overview on oversight and accountability of intelligence agencies, intelligence cultures, the impact of technology, the development of collection and analytic capabilities, and the interaction between intelligence and policy. The course makes extensive use of case studies to examine incidents where intelligence played a significant role and the dilemmas in its application, primarily in the areas of national security and military policy.

CRIM.5900 Descriptive & Inferential Statistics (Formerly 44.580/44.590) - Credits: 3

This course is a rigorous introduction to statistical inference: probability theory, confidence intervals, and hypothesis tests. The course also covers regression analysis, which is developed in a non-technical way, with an emphasis on interpretation of regression results, using examples from recent research.

CRIM.5910 Research Design (Formerly CRIM.591) - Credits: 3

Research design is a graduate-level introduction to methodology as used in criminology/criminal justice. The course surveys the research design enterprise and covers a host of issues on the measurement and collection of data, and other procedures that influence whether a research study will lead the investigator to scientifically rigorous information. This course explains various strategies for devising social science studies, compares the relative benefits of various designs, and identifies the tools necessary to conduct studies that will yield data worthy of analysis and interpretation. This material will be valuable for students who will conduct research and administrators who must evaluate the research of others.

CRIM.5950 Program Evaluation (Formerly 44.595) - Credits: 3

A detailed examination of methods of evaluating criminal justice programs. Focuses on both process and outcome evaluation.

CRIM.6000 Professional Development - Credits: 3

This course is designed to support the professional development of doctoral students as they pursue a research-oriented graduate degree. Specific material will sensitize students to the expectations for the quality of their work, as well as enhance preparation for developing a research agenda, publishing scholarly manuscripts, seeking external funding, and navigating the job market. This course will also discuss topics relevant to preparing graduate students for teaching at the undergraduate level, including course development, lecture/activity planning, and classroom management.

CRIM.6010 Criminological Theory Advanced (Formerly 44.601) - Credits: 3

The course examines contemporary criminological thought by assessing major theories that anchor the discipline of criminology. Also explores the causal structure of these theories, the level of analysis at which they reside, the assumptions that underlie them, their strengths and weaknesses, and their policy implications.

CRIM.6020 Nature and Extent of Crime and Criminals (Formerly CRIM 602) - Credits: 3

Exposes students to the major measurement methods for the incidence of crime and prevalence of criminals. Students will become versed in using data derived from any of the three primary sources of crime statistics: police-based measures (UCR, NIBRS), victim surveys (NCVS), and self-reports of criminal behavior (Monitoring the Future, National Youth Survey).
CRIM.6030 Correlates of Crime and Justice  
(Formerly CRIM 603) - Credits: 3

This course examines the nature of the relationships among attributes and indices at the individual, situational, and aggregate levels to various forms of crime and systems of justice. The implications of criminal laws, criminal justice practices, and programs are examined with a focus on inequalities based on gender and race.

CRIM.6040 Women and Crime (Formerly 44.565/CRIM 604) - Credits: 3

Examination of the interplay between gender, crime, and criminal justice. Since much of the information about crime and the criminal justice system is presented in relation to men, a course focused on women and crime fills a tremendous gap in the criminal justice discourse. The goal of this course is to provide an understanding of the unique ways that gender may affect crime and criminal justice experiences.

CRIM.6110 Law and Social Control  
(Formerly CRIM 611) - Credits: 3

This course examines and analyzes the various means by which society attempts to control criminal conduct. Social control encompasses both formal and informal mechanisms and a variety of institutions and social processes to deter inappropriate conduct, if possible, and/or punish and reform such conduct. Social control has evolved considerably over time and various social control philosophies and techniques have been prevalent at one time but not in others. Because social control is a response to inappropriate conduct, the course will also provide a brief introduction to the concepts of deviance and crime and the differential social control needs and priorities posed by different kinds of inappropriate conduct.

CRIM.6120 Drugs, Crime and Justice  
(Formerly CRIM 612) - Credits: 3

This course surveys the historical development and contemporary context of the use of criminal sanctions to combat the use of illicit drugs. The relationship between drug use/abuse and crime is explored. The course also provides a policy analysis of the alternative means available to deal with the drugs-crime issue (legalization, decriminalization, interdiction, tougher criminalization).

CRIM.6130 Law and Public Policy  
(Formerly 44.573/CRIM 613) - Credits: 3

The course is an introduction to crime and the efforts to control crime through public policy. We explore the foundations of the policy-making process at the federal, state, and local levels. The course also considers broad theoretical applications pertaining to public opinion, national culture, and comparative analyses among Western democracies and their differing approaches to crime. This course employs a variety of learning tools, from roundtable discussions to policy cases.

CRIM.6220 Seminar in Policing (Formerly CRIM 622) - Credits: 3

This seminar examines the contemporary research literature in policing with a focus on the key research issues. Through a critical examination of the literature, students gain an understanding of the significant topic areas that have been pursued and develop an agenda for further research.

CRIM.6230 Seminar in Courts and Sentencing  
(Formerly CRIM.623) - Credits: 3

This seminar examines the contemporary research literature in adjudication and sentencing with a focus on the key research issues. Through a critical examination of the literature, students gain an understanding of the significant topic areas that have been pursued and develop an agenda for further research.

CRIM.6240 Seminar in Corrections (Formerly CRIM 624) - Credits: 3

This seminar examines the contemporary research literature on institutional corrections with a focus on the key research issues. Through a critical examination of the literature, students gain an understanding of the significant topic areas that have been pursued and develop an agenda for further research.

CRIM.6250 Seminar in Juvenile Justice and Youth Crime  
(Formerly CRIM 625) - Credits: 3

This seminar examines the contemporary research literature concerning juvenile justice with a focus on the key research issues. Through a critical examination of the literature, students gain an understanding of the significant topical areas that have been pursued and develop an agenda for further research.

CRIM.6260 Community Based Correction  
(Formerly 44.650/CRIM 626 ) - Credits: 3

This course presents a detailed examination of current theory, research, and policy development in the field of community corrections, both nationally and internationally. Topic areas include sentencing, probation, parole, fines, community service, and intermediate sanctions (intensive supervision, house arrest/electronic monitoring, boot camps). Issues include the punishment vs. control argument, community justice models,
special offender populations (drug offenders, sex offenders, mentally ill offenders, AIDS), and the cost effectiveness of community corrections.

CRIM.6270 Technology, Crime, and Social Control
(Formerly CRIM 627) - Credits: 3

This course examines the application of new technological advances in the criminal justice system. Topic areas include the new technology of crime commission, and the corresponding new technology of crime control strategies. Our focus will be on the application of both "hard" technology (e.g. equipment, hardware, devices, etc) and "soft" technology (e.g. computer software programs, information systems, classification devices, and other problem-solving applications) in each of the following areas: crime prevention, police, courts, institutional corrections, community corrections and the private sector.

CRIM.6280 Innovation and Leadership in Criminal Justice (Formerly CRIM 628) - Credits: 3

This course critically examines one of the core concepts of criminology and criminal justice: change—at the individual, group, and organizational levels. There is a "brief history" of change in police, court, and correctional organizations, focusing primarily on major reform initiatives and change strategies introduced by criminal justice managers over the past fifty years (e.g. in policing—problem-oriented and broken windows policing, in the courts—federal mandatory sentencing and parole abolition, specialized courts, and in corrections—the new techno-prison, privatization of institutional and community corrections, control-oriented community supervision). For each part of the criminal justice system, we examine the major types of change strategies employed by criminal justice managers to implement major reforms: empirical rational, normative re-educative, and power coercive strategies.

CRIM.6300 Victimology (Formerly CRIM 522) - Credits: 3

This course examines the study of crime victims and of the patterns, impact, and formal responses to criminal victimization. Particular attention is given to research issues such as measurement of victimization, fear of crime and related measures, and conducting research with victimized populations, as well as discussion of current issues in the field of Victimology. Substantive topics may include theories of victimization, the overlap between victims and offenders, social-psychological and other impacts of victimization on primary and secondary victims, media coverage of victimization, and evaluation of prevention and intervention programs for victims (criminal justice system based programs and others).

CRIM.6310 Intimate Partner Violence (Formerly 44.622/CRIM 631) - Credits: 3

An examination of the nature and extent of intimate partner violence and an analysis of the causes and consequences of violence between partners as well as the latest research regarding the criminal justice response.

CRIM.6320 Responding to Child Maltreatment
(Formerly 44.623/CRIM 632) - Credits: 3

Introduction to empirical findings and theoretical perspectives concerned with the maltreatment of children and youth. Includes an examination of prevalence rates, risk factors, consequences, and system responses.

CRIM.6400 Criminal Mind and Behavior (Formerly 44.545) - Credits: 3

This course is designed to address a broad range of topics relevant to criminal behavior and the development of the so-called criminal personality. Factors that are considered to influence the evolution of criminal mentality are examined and the laws and the past and current response of the criminal justice system to repeat offenders are explored.

CRIM.6410 Mental Health & Criminal Justice (Formerly 44.546/CRIM 641) - Credits: 3

The course focuses on how and why individuals with serious mental illness become involved in the criminal justice system, and on how the criminal justice and public mental health systems respond to that involvement. Topics include law enforcement responses, court-based strategies, mental health and corrections, community supervision of individuals with mental illness, violence and mental disorder, and unique challenges associated with female and juvenile populations.

CRIM.6420 Sex Crimes and Offenders (Formerly 44.646/CRIM 642) - Credits: 3

This course examines the nature of sex offenses as well as the mind of the sex offender, and focuses on motives, possible victims, and rehabilitation. The responses of the mental health and criminal justice systems are examined and the effectiveness of those responses is assessed.

CRIM.6500 Violence in America (Formerly CRIM 650) - Credits: 3

This course provides an in-depth analysis of the causes, context, and control of a wide range of violent crimes. Topics covered in this class include: Murder, rape, robbery, assault,
and violence in the helping professions, the workplace, school, gang violence, cult violence, and institutional violence. For each form of violence, we examine issues related to (1) the extent of the problem, characteristics of the crime, victim, and offender, (2) causation, (3) crime prevention, and (4) crime control strategies.

CRIM.6510 Criminal Homicide (Formerly 44.575/CRIM 575) - Credits: 3
A survey of the nature and extent of criminal homicide. There will be five main components: statutory definitions of homicide; theories of homicide; homicide rates over time and across jurisdictions; trends and patterns in homicide characteristics; and cross-cultural comparisons. Homicide is an important topic in criminology for three reasons: (1) it is the crime of greatest severity in any penal code; (2) it is a fairly reliable barometer of all violent crime; and (3) at a national level, no other crime is measured as accurately, precisely, and comprehensively.

CRIM.6520 Social Ecology of Crime (Formerly 44.520) - Credits: 3
This course provides an overview of issues in the ecology of crime, with particular emphasis on the area of communities and crime by addressing existing criminological theories and how they can be applied to the study of community crime levels. This includes a critical analysis of existing empirical research. We will also read and discuss anthropological approaches to crime in neighborhoods. Attention will be given to both the factors that influence community-level crime rates, as well as the effects that community characteristics have on the behavior and outcomes of individuals.

CRIM.6530 Gangs (Formerly CRIM 653) - Credits: 3
An introduction to the study of gang problems in the U.S. by exploring the nature of gangs, including issues such as defining gangs, types of gangs, female gang involvement, etc. The course also examines theory and methods of understanding gangs and the group process of gangs and investigates the criminal involvement of gangs, focusing on gang members’ involvement in extortion, drugs, violence, and other crimes. Also examines programs for social intervention and law enforcement, and policy issues.

CRIM.6540 Elite Deviance and White Collar Crime (Formerly 44.523) - Credits: 3
This course introduces the concept of white collar crime as an area of scientific inquiry and theory formation. It critically examines the latest scholarship on the subject by looking at white collar crime from a multiplicity of perspectives and reference points, ranging from a focus on the offense, offender, legal structure, organizational structure, individual and organizational behavior, to victimization and guardianship, with special attention on the interaction between these components. The course also pays special attention to definitional issues, typologies of white collar crime, and assesses the nature, extent and consequences of white collar crime nationally and internationally. To enhance the understanding of white collar crime in today’s IT development and society, the course will pay a special attention to roles of information and technology and E-commerce within white collar crime. Finally, the course examines current criminal justice system efforts at controlling white collar crime.

CRIM.6550 Substance Abuse and Crime (Formerly 44.563/CRIM 655) - Credits: 3
This course examines the dynamics of substance abuse, the interrelationship between substance abuse and crime, and the use of both criminal and civil law to deal with the problems posed by substance abuse.

CRIM.6560 Criminal Careers Foundations (Formerly CRIM 656) - Credits: 3
This course examines the concept of the “Criminal career” By examining the scholarly progression through which this term has evolved. We will investigate three main venues: (1) the research that originated in the early 1900’s at the University of Chicago (Shaw and Sutherland); (2) the work of the Gluecks between 1930 and 1957; and (3) the two Philadelphia Birth Cohort Studies. These three research venues are largely responsible for the origin and sustenance of the criminal career paradigm in criminology.

CRIM.6570 Criminal Careers Contemporary (Formerly CRIM 657) - Credits: 3
Examines contemporary research on the "criminal career paradigm" which has dominated criminological research over the past 20 to 25 years. Despite a widely held belief that this area of inquiry has been significant, desirable, worthwhile, etc., there have been a number of polemical publications that have spawned a debate over the yield attained through criminal career research on the one hand, and the value of or necessity for a longitudinal approach to studying criminal behavior on the other. These debates will be examined and the nature of contemporary inquiry into criminal careers will be examined.

CRIM.6580 Issues in Computer Crime and Cyber Security (Formerly 44.642/CRIM 658) - Credits: 3
This course will examine the history and evolving nature of the relationship between technology, crime, and security, with a particular focus on legitimate and illegitimate Internet
commerce, and cyber criminal methodologies and techniques. We will study major issues in cyber security including criminal and state-sponsored hacking; data, intellectual property, and identity theft; financial and personal data security; cyber-terrorism; tools and methods used to exploit computer networks, and strategies to protect against them; and new and emerging technologies. This course will be taught specifically for non-computer science majors, although students with computer science backgrounds are welcome for the experiences that they can bring to the class discussions.

CRIM.6610 Comparative Criminal Justice (Formerly CRIM 661) - Credits: 3

Examines crime, crime control and crime prevention from a comparative perspective. A number of key countries are analyzed to identity innovative practices in policing, the administration of justice, and corrections, with an eye on their applicability, if any, to criminal justice practices in the United States. Developments in select countries are examined to learn critical lessons about the interplay between culture, types of government, quality of life, and levels and types of crimes. Islamic justice systems are explored to enrich our knowledge of cultural differences and their effects on crime control. Points of divergence between various countries and the United States are analyzed to assess differences in perception regarding the causes of crime and differences in the effectiveness of crime prevention, rehabilitation and punishment efforts. We will furthermore investigate transnational and international crime problems, focusing on terrorism, nuclear weapons, organized crime and drug smuggling. Finally, the course will examine current multi-national efforts in controlling crime problems.

CRIM.6620 Global Issues and Human Rights and Justice (Formerly CRIM 662) - Credits: 3

This course examines the impact of global issues on crime and justice and the intersection of social control and human rights approaches to crime. The course interweaves readings, lectures and discussion of justice and law; security and safety; socio-economic development; and comparative cultures and institutions in an examination of the impact of globalization, migration, labor exploitation, war and transnational agendas on the construction of crime, the development and control of criminal opportunity structures, and legal justice system responses. It examines the complex interactions between global context, human rights and social control approaches to crime. Topics include human trafficking; children and war; refugees and migration; and transnational crime in a global economy.

CRIM.6630 Prisons A Global Perspective (Formerly CRIM 663) - Credits: 3

This course provides a comprehensive, global assessment of the use/misuse of prisons and jails in North America (U.S. focus), and in other parts of the world, including selected countries in Europe, Asia, Africa, and South America. A broad range of topics are compared among U.S. and global policies and practices. Topics include: (1) who goes to prison and why; (2) sentencing disparity and sentencing reform movements; (3) prison life and prison organization; (4) prison classification; (5) inmate, staff, and management culture; (6) prison violence and disorder; (7) treatment programs; (8) the links between prison culture and community culture; (9) the prospects for offender change; and (10) offender reentry.

CRIM.6640 Weapons of Mass Destruction (Formerly 44.643/CRIM 664) - Credits: 3

This course explores the threats that weapons of mass destruction (WMD) pose to the U.S. and its interests along with the strategies to meet those threats. The course will examine the technical aspects, history, and contemporary threat of each category of weapon Chemical, biological, radiological, and nuclear followed by a critical analysis of U.S. and global efforts to limit access to these weapons and prohibit their production, proliferation and use. The course will also review some aspects of WMD attack response, recovery, and mitigation.

CRIM.6650 Global Trafficking and Criminal Networks (Formerly 44.644/CRIM 665) - Credits: 3

Illicit economic activities are a global phenomenon with local impact. This course will examine the threat that global trafficking poses to a nation’s security, political stability, economic development, and social fabric. The lessons in this advanced graduate-level seminar are organized around the trafficking activities of greatest concern to the United Nations, Interpol, IAEA and other international agencies’ as well as to the U.S. Departments of State, Defense, Justice, and Homeland Security.

CRIM.6660 Terrorism Networks (Formerly 44.577/CRIM 666) - Credits: 3

This course will explore the dynamics of terrorist networks and will equip students with an understanding of the drivers of terrorist network formation, development and disintegration. The course will also provide students with knowledge and understanding of how, why and when networks expand, affiliate, and occasionally splinter. And finally, students will be guided through the applicability of network theory and analysis to the design of hypothetical operational responses and contingency planning surrounding the disruption or containment of terrorist networks.

CRIM.6670 Advanced Security Studies (Formerly CRIM 667) - Credits: 3
This course examines the complex nature of key domestic and international security threats and how nations respond to them. While the traditional focus of security studies has been the phenomenon of war, the past two decades have seen tremendous growth and expansion of the field. Some scholars have studied the threat, use and control of military force, while others have studied various forms of political violence such as terrorism, organized crime, and insurgency or armed rebellion. Research in this field also incorporates scholarship on the politics of defense and foreign policymaking, traditional theories of international relations, comparative analysis of national and regional case studies, ethics and morality of security policies, and transnational issues like arms trafficking, piracy, and the proliferation of materials and technology for weapons of mass destruction. Overall, the study of national and international security has evolved into a complex, interdisciplinary field, as demonstrated on the list of journals and websites provided on the last page of this syllabus. Each lesson in this course draws on a large and diverse body of readings, including academic journal articles, government reports, and original source materials.

CRIM.6680 Scientific & Technological Dimensions of National Security (Formerly 44.569/CRIM 668) - Credits: 3

In this required course for the MS in Security Studies program, students will take this course to learn all about the efforts in the public and private sector to design new sensors, scanner, and the general role of science and technology in homeland and national security.

CRIM.6690 Counterterrorism Policies and Strategies (Formerly 44.576/CRIM 669) - Credits: 3

This course examines the formulation and implementation of U.S. national strategies for combating terrorism, protecting critical infrastructure, and preventing the proliferation of chemical, biological, radiological and nuclear weapons or materials that could be used by terrorists. Students will develop an understanding of the structure and operations of key federal agencies, state and local fusion centers, and examine the political, legal, moral and ethical issues of countering modern terrorism threats.

CRIM.6700 Seminar in Terrorism Studies (Formerly CRIM 670) - Credits: 3

This course will offer an in-depth examination of one more special topics within the field of terrorism. Examples include terrorist psychology, the use of women and children by terrorist groups, models of successful hostage negotiation or the use of social network analysis to understand the evolving nature of a terrorist threat. Students should consult with their advisor and the program director before registering for this course.

CRIM.6800 Selected Topics (Formerly 44.680) - Credits: 3

A comprehensive examination of a current issue in criminal justice.

CRIM.6830 Directed Study (Formerly CRIM 683) - Credits: 3

This course is designed as an independent study of a subject not offered in the standard curriculum.

CRIM.6890 Special topics in Criminal Justice and Criminology (Formerly CRIM.689) - Credits: 3

Special topics classes are used to address timely issues that do not fit into the regular course offerings.

CRIM.6900 Advanced Regression Analysis (Formerly CRIM 690) - Credits: 3

This course focuses on statistical methods that are useful in the investigation of hypotheses in the social sciences and the analysis of public policies and programs. The bulk of the course is a detailed examination of the bivariate and multiple regression models estimated using Ordinary Least Squares (OLS), with an emphasis on constructing regression models to test social and economic hypotheses. Several special topics in regression analysis are addressed as well, including violations of OLS assumptions and the use of dummy variables, interaction effects. Throughout, examples are drawn from the literature so students can see the models and methods in action.

CRIM.6910 Advanced Research Design (Formerly 44.691) - Credits: 3

This course focuses on measurement and data development strategies and techniques to facilitate effective statistical analysis. Topics include the logic of causal inquiry and inference, the elaboration paradigm and model specification, handling threats to internal validity, hierarchies of design structure (experimental, quasi-experimental and non-experimental), linking design structure to affect estimation strategies, and analyzing design elements in published literature. Students will select a research topic in consultation with the instructor and prepare a written comparative design analysis.

CRIM.6919 Directed Study in Criminal Justice (Formerly CRIM.691) - Credits: 3
This course is designed as an independent study of a subject not offered in the standard curriculum.

**CRIM.6920 Qualitative Research Methods (Formerly CRIM 692) - Credits: 3**

This course designed to increase students' knowledge and understanding of the design and process of qualitative research in criminology. The material covered in this course includes the nature and uses of qualitative research; the design of qualitative research; grounded theory and the use of qualitative research to advance new theories and critically evaluate tenants or assumptions of widely held explanations of criminal behavior and justice system functioning; and the ethics of qualitative research. Qualitative research methodologies including ethnography, case studies, participant observation, interviewing, content analysis, and life history narrative / life course analysis will be studied. Students will develop and initiate their own qualitative research and learn first-hand about the conduct of such research, the sequencing of data collection, data analysis, and more data collection. Students will learn the uses of computer assisted software programs designed to assist qualitative data analysis.

**CRIM.6930 Survey Methods (Formerly CRIM 693) - Credits: 3**

This course exposes students to the use of survey methods in social science research. Emphasis is placed on interview and questionnaire techniques and the construction and sequencing of survey questions as well as the use of Likert and Thurstone scales. Attention is also devoted to sampling theory, sampling designs, and sampling and non-sampling errors.

**CRIM.6940 Crime Analysis and Mapping (Formerly 44.594/CRIM 694) - Credits: 3**

This course examines the use of new technologies to analyze crime patterns and develop crime prevention strategies. Students study theories that explain the geographic distribution of crime and learn how to use Geographic Information Systems to study crime in ways that draw upon theory as well as how to apply GIS techniques in the law enforcement and corrections fields.

**CRIM.6960 Program Evaluation Methods (Formerly 44.595/CRIM 695) - Credits: 3**

An examination of the methods and techniques of evaluation research. Evaluation research includes the issues that characterize the generic research enterprise. In addition to the usual research concerns and problems, evaluation research must also address problems that are unique to determining whether a program, treatment, law, or policy, has had the desired effect when implemented in practice. This task is especially problematic with social policy contexts. The agenda for the course has two main components. First, the course will concern the structural features of designing and conducting a program evaluation. The second component will be an analysis of actual program evaluations in the literature.

**CRIM.6970 Security Studies Project Design and Defense (Formerly 44.697/CRIM.697) - Credits: 3**

Under faculty supervision, students in the MS in Security Studies program will design a science or technology-related project that demonstrates mastery in a subject relevant to security. Examples could include chemical or biological sensors, computer firewall intrusion detection system, baggage scanners, signals interception device, etc.

**CRIM.6980 Security Studies Capstone 1 Data Collection and Analysis (Formerly 44.698/CRIM.698) - Credits: 3**

This course is the first of a 2-part culminating capstone experience for students in the MA in Security Studies program at UMass Lowell. Incorporating the tools learned in 44.591: Research Design and Methods, students are required to design a research question, gather and analyze information, and write a Master’s level research paper of at least 50 pages on a topic of their choosing related to security studies. The design of the 2-course capstone sequence emphasizes independent research and writing, thus required class periods are kept to a minimum.

**CRIM.6990 Security Studies Capstone Research Paper (Formerly 44.699/CRIM.699) - Credits: 3**

This course represents the culminating capstone experience for students in the MA in Security Studies program at UMass Lowell. Incorporating the tools learned in 44.590, Research Design and Methods, students are required to design a research question, gather and analyze information, and write a Masters level research paper of at least 50 pages on a topic of their choosing related to security studies. Students will provide drafts of their paper to their faculty supervisor periodically during the semester, and the final version will be submitter for grading on the basis of quality research and writing.

**CRIM.6993 Capstone Research Paper in Criminal Justice - Credits: 3**

This course is the culminating, final core requirement for the Masters in Criminal Justice. In this course, students will write an integrative research paper (generally 50-60 pages in length, double-spaced, in the current style guide) on a topic of their choosing within the realm of criminal justice. By integrative, we mean you are expected to draw upon material you have covered in several of the courses.
in this program, including (but not limited to) Administration of Criminal Justice, Criminological Theory: Foundations, Descriptive and Inferential Statistics, Research Design, Managing Criminal Justice Organizations, or Law & Public Policy. You may enroll in this course at the same time as one of your elective courses, but it is assumed that you have already completed all requirements for the Masters in Criminal.

CRIM.7000 Dissertation Seminar I (Formerly CRIM.701) - Credits: 3
This is the first part of a two-semester sequence in which students develop a plan and a template for the conduct of the various stages of the doctoral dissertation. Topics include: theoretical foundations, hypothesis development, sampling design, construct measurement, data collection, and analysis of quantitative or qualitative data.

CRIM.7010 Dissertation Seminar II (Formerly CRIM.702) - Credits: 3
This is the second part of a two-semester sequence in which students develop a plan and a template for the conduct of the various stages of the doctoral dissertation. Topics include: theoretical foundations, hypothesis development, sampling design, construct measurement, data collection, and analysis of quantitative or qualitative data.

CRIM.7030 Dissertation Supervision (Formerly CRIM 703) - Credits: 3
Direct supervision with a dissertation advisor (3 credits).

CRIM.7060 Dissertation Supervision (Formerly CRIM 706) - Credits: 6
Direct supervision with a dissertation advisor (6 credits).

CRIM.7090 Dissertation Supervision (Formerly CRIM 709) - Credits: 9
Direct supervision with a dissertation advisor (9 credits).

CRIM.7100 Advanced Research in Terrorism (CRIM 710) - Credits: 3
This course focuses on describing and understanding how research and evidence-based analysis helps us to understand, explain and predict changes in terrorist behavior. The course makes use of case studies to illustrate quantitative and qualitative research methods, and to approach research questions on terrorism from multiple levels of analysis. The course will also examine successful examples of interdisciplinary research and will help students navigate the pathway from theoretically informed research on terrorism to policy and practitioner-relevant counter-terrorism.

CRIM.7110 Continued Dissertation Review (Formerly CRIM 711) - Credits: 1
Direct supervision with a dissertation advisor (1 credit).

CRIM.7160 Dissertation Seminar Accelerated (Formerly CRIM 716) - Credits: 6
This course is an accelerated version of the CRIM 701/702 sequence. It is suitable for students who have already acquired the data for their doctoral thesis research and thus can accomplish the plan and template for the conduct of the various stages of the doctoral dissertation in one semester. Topics include: theoretical foundations, hypothesis development, sampling design, construct measurement, data collection, and analysis of quantitative or qualitative data. Prerequisite: Doctoral Candidacy in Criminology.

CRIM.7410 Thesis Review (Formerly 44.741) - Credits: 1

CRIM.7900 Categorical and Limited Dependent Variables (Formerly CRIM 790) - Credits: 3
The estimation of empirical models is essential to public policy analysis and social science research. Ordinary Least Squares (OLS) regression analysis is the most frequently used empirical model, and is appropriate for analyzing continuous dependent variables that meet certain distributional assumptions. This course examines several types of advanced regression models for dependent variables that violate one or more of the assumptions of the OLS regression model. For example, some dependent variables may be categorical, such as pregnant or not, employed or not, etc. Other dependent variables may be truncated or censored, such as contributions to an individual retirement account that are limited by law to certain dollar amounts. Still others may be counts of things, like the number of children born to a given woman or the number of traffic accidents on a given day. The principal models examined in the course are binary logit and probit, multinomial logit, ordinal logit and probit, tobit, and the family of Poisson regression models. The Heckman correction for selection and Event History Analysis are also addressed. All these models are estimated using maximum likelihood estimation (MLE). The course focuses on the application and interpretation of the models, rather than statistical theory.

CRIM.7910 Structural Equation Modeling (Formerly CRIM 791) - Credits: 3
This course is an introduction to structural equation modeling (SEM). SEM represents a general approach to the statistical examination of the fit of a theoretical model to empirical data. Topics include observed variable (path) analysis, latent variable models (e.g., confirmatory factor analysis), and latent variable SEM analyses.

CRIM.7920 Survival Analysis and Longitudinal Data
(Formerly CRIM 792) - Credits: 3

Criminological research often involves the study of change over time in both individuals and groups. Analyzing such over time poses a number of methodological and statistical challenges, however, and these must be addressed to derive valid inferences from data analysis. This course will examine several techniques that are appropriate for such analyses. These include the family of univariate, bivariate and multivariate techniques collectively known as "survival" or "event history analysis" that are appropriate for studying processes such as recidivism and length of time individuals spend in various programs. The course will also describe zero-inflated Poisson trajectory and latent growth curve models, as well as multilevel models for change. Emphasis will be on application as opposed to theory.

CRIM.7930 Data Reduction and Factor Analysis
(Formerly CRIM 793) - Credits: 3

Criminologists are often confronted with datasets containing numerous variables resulting from surveys and archival data extraction. It is advantageous to reduce the number of variables while still maintaining the integrity of the measurement of crucial concepts. Factor analysis is a valuable statistical technique for reducing the number of variables and detecting possible underlying structure (s) in the relationships among variables. This course will examine major factor analytic techniques such as Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) designed to find underlying unobservable (latent) variables that are reflected in the observed variables or manifest variables. In addition the course will examine the various factor rotation procedures commonly used to ensure that the derived factors or dimensions are orthogonal and do not either introduce multicollinearity problems or exacerbate collinearity issues already present in the data.

CRIM.7940 Multi-Level Modeling - Credits: 3

This course covers multilevel statistical models, which are increasingly being used in the social sciences to analyze clustered data. The course will introduce students to the theory and concepts of multilevel model and will address both the statistical and theoretical advantages to using multilevel models to analyze clustered data. The course will largely take an applied approach, meaning that it is designed to prepare students for putting the techniques covered in the course to use in a "real world" context. As such, course lectures and assignments will cover a range of relevant issues, including data acquisition, data exploration, estimation of multilevel models with statistical software, and reporting of results from multilevel analyses.
SOCI.5020 Managing Human Service Organizations -
Credits: 3

The purpose of this course is to introduce students to the specific context of managing a human service organization in a nonprofit of public environment. Topics covered may include strategic planning in a mission driven organization, budgets in a nonprofit context, human resources management, human services leadership, the role of fund raising and development, public sector advocacy, and working a Board of Directors. This course is required for MPA students in Human Service Management (HSM) Option.

SOCI.5100 Asylum and Refugee Policy - Credits: 3

This course provides an introduction to asylum and refugee policy, including its historical development, current implementation, and interdisciplinary considerations. After understanding the legal underpinnings of current policy, students will examine the journey of a refugee or asylum applicant, beginning with push/pull migration factors and moving to experiences in the receiving context. Students will leave the course with practical knowledge for working with asylum and refugee populations.

SOCI.5150 Social Policy and Inequalities - Credits: 3

Social Policy and Inequalities is a semester-long course that analyzes the social policies in the United States and Massachusetts that address persistent and structural inequalities in education, health and healthcare access, immigration, workforce, and human services. We will pay particular attention to social policies that contribute to or seek to alleviate inequalities based on race, gender, income and wealth, sexuality and disabilities. The course will identify key features of policy development, implementation and evaluation and interrogate the underlying patterns of inequalities at each stage. The course will analyze case studies of policies such as those related to poverty and income inequality; affirmative action; education; workforce development and employment.
MUSR.5200 Recording Analysis (Formerly 78.520) - Credits: 3
Recognition of the unique dimensions of audio recordings, and evaluation of how they can be crafted to support musical expression. Aural analysis of audio device performance, integrity of audio quality, recording environments, and sound source characteristics. Understanding of the mix as musical interpretation and performance.

MUSR.5210 Sound Synthesis 2 (Formerly 78.421/521) - Credits: 3
Advanced sound synthesis techniques are studied and supplemented with sound synthesis studio laboratory work. The course will cover MIDI implementation in analog and digital sound synthesis, the historic origins of computer music and electro-acoustic music, live electronic music performance, audio equipment and applications of MIDI-based and functional devices and processors, advanced music production and sound synthesis via MIDI. Permission of Coordinator and Chair.

MUSR.5450 Advanced Mix Techniques (Formerly 78.545) - Credits: 3
This course develops deep technical mastery and advanced aesthetic achievement in the multitrack mixdown phase of sound recording. Key families of effects are covered from first principles and technical basics to advanced applications. Processes are integrated into contemporary production strategies for music, film, game, broadcast, and live mixing.

MUSR.5500 Advanced Video Production (Formerly 78.550) - Credits: 3
Extends basic music production skills into the professional sphere. Hands on experience is emphasized. Students are involved with exercises that teach approaches to dramatic lighting, audio-recording skills for challenging environments, specialized camera techniques used in Hollywood productions, and refined editing techniques. After completing several short video presentations, students will produce a multi-tracked production that demonstrates their competency in video and audio recording, sound effects, narration, and refined editing techniques. Prerequisite: 78.350

MUSR.5900 Advanced Acoustics for Audio (Formerly 78.590) - Credits: 3
This course includes measuring, predicting and modifying the acoustic behavior of rooms, instruments, and speaker enclosures, culminating in original student designs. An in-depth study of sound perception will also be included along with the latest research in live sound reinforcement and related technologies. Students must complete an original research project by the end of the term.

MUSR.5950 Graduate Directed Study in SRT (Formerly 78.595) - Credits: 3
This course is an in-depth study of the systems and standards that collectively define “digital fusion”, the convergence of all known media on a common platform and practice. Text, music, sound, images, and moving pictures are all digital objects that are stored, processed, and transmitted using the same set of technologies. The course examines each of these technologies and their common foundation in contemporary digital computing. The course also examines the impact of digital fusion on the traditional 3-tier media value-chain (producer/publisher/wholesaler/retailer/end user). Prerequisite: 78.630

MUSR.6100 Digital Media (Formerly 78.610) - Credits: 3
This course is an in-depth study of the systems and standards that collectively define “digital fusion”, the convergence of all known media on a common platform and practice. Text, music, sound, images, and moving pictures are all digital objects that are stored, processed, and transmitted using the same set of technologies. The course examines each of these technologies and their common foundation in contemporary digital computing. The course also examines the impact of digital fusion on the traditional 3-tier media value-chain (producer/publisher/wholesaler/retailer/end user). Prerequisite: 78.630

MUSR.6300 Technologies of Audio (Formerly 78.630) - Credits: 3
In-depth study of historical, current, and cutting edge technologies of audio devices, systems, and software; includes performance specifications, design and operational parameters, and interface considerations at all systems levels.

MUSR.6400 Production Practicum (Formerly 78.640) - Credits: 3
Experimental and current recording production techniques, and historically significant approaches to recording. Performance of advanced production work including acoustic and electronic sound sources, automated mixdown, stereo and surround mixing, synchronization and MIDI, audio for visuals, multimedia. Studio production work led by lecture/demonstration classes and individual student research.

MUSR.6500 Research in Sound Recording Technology (Formerly 78.650) - Credits: 3
An introduction to the knowledge and skills common to research in all areas of music: finding resources, reading and interpreting research, and understanding and applying the principles of objective investigation. The research paradigms of technology and engineering, the humanities, the natural sciences, and the social and behavioral sciences are explored and contrasted. This course consists of a sequence of lectures and individual student research projects.
must write a report or research document.

**MUSR.6600 Seminar in Audio (Formerly 78.660) - Credits: 3**
Current topics are explored in a seminar setting requiring student participation and research. Topics selected for in-depth examination might include advanced SRT-related research methods and materials; advanced facility and systems design; experimental technologies and media; experimental production practices or artistic projects; evaluations of recordings; audio industry trends; facility and career management. Prerequisite: 78.630.

**MUSR.6950 Directed Study and Research in SRT. (Formerly 78.695) - Credits: 3**
An in-depth independent study with a member of the Sound Recording Technology faculty. The topic and scope of the study must be approved by the faculty member and the Coordinator of SRT,

**MUSR.7400 Masters Recording Project (Formerly 78.740) - Credits: 6**
Planning and execution of a substantial recording project under the supervision of an SRT faculty member.

**MUSR.7410 Masters Recording Project A (Formerly 78.741) - Credits: 3**
Planning and execution of a substantial recording project under the supervision of an SRT faculty member. First part of two-course sequence. 78.742 - Masters Recording Project B must subsequently be taken to satisfy masters degree capstone requirement.

**MUSR.7420 Masters Recording Project B (Formerly 78.742) - Credits: 3**
Planning and execution of a substantial recording project under the supervision of an SRT faculty member. Second part of two-course sequence to satisfy masters degree capstone requirement.

**MUSR.7430 SRT Masters Thesis (Formerly 78.743) - Credits: 6**
The thesis is a scholarly investigation in SRT or an audio-related field resulting in a comprehensive written document. The student must complete acceptable research and defend it before a thesis committee. The choice of a thesis topic and a thesis advisor, the formation of a thesis committee, and the procedures for the preparation of the thesis and its defense are described in detail in the Master’s Degree Requirements section of the UMASS Lowell Graduate Catalog. The specific procedures required by the Department of Music are published by the Department and are available in the main office.

**MUSR.7440 SRT Masters Thesis A (Formerly 78.744) - Credits: 3**
The thesis is a scholarly investigation in SRT or an audio-related field resulting in a comprehensive written document. The student must complete acceptable research and defend it before a thesis committee. The choice of a thesis topic and a thesis advisor, the formation of a thesis committee, and the procedures for the preparation of the thesis and its defense are described in detail in the Master’s Degree Requirements section of the University of Massachusetts Lowell Graduate Catalog. The specific procedures required by the Department of Music are published by the Department and are available in the main office. First part of two-course sequence. 78.745 - SRT Masters Thesis B must subsequently be taken to satisfy masters degree capstone requirement.

**MUSR.7450 Continued Graduate Research SRT (Formerly 78.745) - Credits: 1-3**
The thesis is a scholarly investigation in SRT or an audio-related field resulting in a comprehensive written document. The student must complete acceptable research and defend it before a thesis committee. The choice of a thesis topic and a thesis advisor, the formation of a thesis committee, and the procedures for the preparation of the thesis and its defense are described in detail in the Master’s Degree Requirements section of the University of Massachusetts Lowell Graduate Catalog. The specific procedures required by the Department of Music are published by the Department and are available in the main office. Second part of two course sequence to satisfy masters degree capstone requirement.

**MUSR.7460 SRT Masters Thesis B (Formerly 78.746) - Credits: 3**
The thesis is a scholarly investigation in SRT or an audio-related field resulting in a comprehensive written document. The student must complete acceptable research and defend it before a thesis committee. The choice of a thesis topic and a thesis advisor, the formation of a thesis committee, and the procedures for the preparation of the thesis and its defense are described in detail in the Master’s Degree Requirements section of the University of Massachusetts Lowell Graduate Catalog. The specific procedures required by the Department of Music are published by the Department and are available in the main office. Second part of two course sequence to satisfy masters degree capstone requirement.
Zuckerberg College of Health Sciences

The graduate programs of the Zuckerberg College of Health Sciences at UMass Lowell prepare health care providers with specialized knowledge and skills for the roles of practitioner, leader and researcher.

View the faculty in the College of Health Sciences (https://www.uml.edu/Health-Sciences/faculty/Faculty-list.aspx).

Graduate Programs Offered

Certificates:
- Public Health Studies
- Pharmaceutical Science

Master of Public Health
- Public Health (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Public-Health/Default.aspx)

Master of Science (MS) - degree awarded in the following fields:
- Clinical Laboratory Sciences
  Concentrations: Clinical Research, Clinical Administration, Health Informatics, Nutritional Sciences, Pharmaceutical Science, Professional Science Master's - Pharmaceutical Sciences, Public Health Laboratory Sciences, Option
- Professional Science Master's - Clinical Laboratory Sciences
- Health Informatics and Management
  Concentrations: Health Informatics, Health Management
- Nursing
- Work Environment - This program is not accepting new applicants at this time.
  Options: Occupational and Environmental Hygiene, Epidemiology, Ergonomics / Safety

Doctor of Physical Therapy (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf) (DPT)

Doctor of Philosophy (PH.D.) - degree awarded in the following field:
- Nursing, Health Promotion

Pharmaceutical Science

Post-Master's Doctorate in Nursing Practice (DNP) Program

Doctor of Science (SC.D.) - degree awarded in the following field:
- Work Environment
  Options: Occupational and Environmental Hygiene, Epidemiology, Ergonomics / Safety, Work Environment Policy, Cleaner Production and Pollution Prevention

Graduate certificates are available in some academic majors.

Professional Science Master's in Pharmaceutical Sciences

Admissions and Degree Requirements

Applicants to the UMass Lowell Professional Science Master's (PSM) program in Pharmaceutical Sciences must possess a BS degree or be in their last semester of a baccalaureate program. Up to 12 credits of appropriate graduate coursework with a grade of B or better can be transferred into the program if approved by the Graduate Coordinator of the Pharmaceutical Sciences programs.

The Professional Science Master's in Pharmaceutical Sciences program will consist of 36 credits of coursework to be completed either full-time or part-time. Full-time students should complete the program within two years and part-time students should complete the program within five years. The Program Coordinator and advisors in the program will advise PSM students about course selections.

Upon admission or through the successful completion of prerequisite courses, students will be expected to have successfully demonstrated undergraduate level knowledge in calculus, general and organic chemistry, biochemistry and biology or anatomy and physiology.

Curriculum Plan

Pharmaceutical Science Core Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHRM.6100</td>
<td>Principles of Pharmaceutical Sciences</td>
<td>3</td>
</tr>
<tr>
<td>PHRM.6120</td>
<td>Principles of Pharmaceutical Sciences Lab</td>
<td>1</td>
</tr>
</tbody>
</table>
CHEM.5500  Biochemistry I  3 credits
CHEM.5620 or CHEM.6310  Biopharmaceutical Development OR Principles of Medicinal Chemistry I  3 credits
PHRM.6600  Pharmacokinetics and Drug Metabolism  3 credits
PHRM.6400  Pharmaceutical Analysis  3 credits
PHRM.6420  Pharmaceutical Analysis Lab  1 credit
PHRM.6410  Drug Delivery  3 credits
XXXX.XXXX  Pharmaceutical Science Elective  3 credits

Total: 23 credits

PLUS Courses

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSMA.5550</td>
<td>Leadership for Scientists</td>
<td>3 credits</td>
</tr>
<tr>
<td>PSMA.5450</td>
<td>Professional and Scientific Communication</td>
<td>3 credits</td>
</tr>
<tr>
<td>XXXX.XXXX</td>
<td>PLUS Elective</td>
<td>3 credits</td>
</tr>
</tbody>
</table>

Total 9 credits

Pharmaceutical Sciences elective options include (but not limited to): BIOL.5760, BIOL.5820, BIOL.5930, CHEM.5140, CHEN.5260, CHEN.5450, CHEN.5480, MLSC.5600

PLUS elective options include (but not limited to): MKTG.5010, MGMT.5010, ENTR.6500, ENTR.6450, MKTG.6300, PSMA.5350, PSMA.5650, MGMT.5750, FINA.6400, MECH.5760, MLSC.7700

Professional Internship Requirement

PSMA.5000 Professional Development (0 credit), PSMA.5100 Internship (0 credit), &PSMA.5010 Reflective Seminar (1 credit) are required for students to complete the Professional Internship requirement of the PSM. A Professional Internship must be a minimum of 350 hours and 3-6 months in length. The internship is designed to provide students with an opportunity to obtain real-world experience in business, government agencies, non-profit organizations or research laboratories. Internships or research project experiences will typically take place in pharmaceutical, biotechnological or medical device companies or institutions. Consideration will be given for students that have previous or current professional employment in the pharmaceutical sciences, however, in these cases, a new project experience will be required that adds to the students current set of skills.
Department of Biomedical & Nutritional Sciences

The UMass Lowell Department of Biomedical and Nutritional Sciences offers the following graduate programs:

- **Master of Science in Clinical Laboratory Sciences**
  Concentrations: Clinical Research
  (https://www.uml.edu/Catalog/Graduate/Health-Sciences/Clinical-Lab-Nutritional-Sci/Masters.aspx#Clinical)
  Clinical Administration
  (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Clinical-Lab-Nutritional-Sci/Masters.aspx#Clinical-Administration)
  Health Informatics
  (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Clinical-Lab-Nutritional-Sci/Masters.aspx#Health-Informatics)
  Nutritional Sciences
  (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Clinical-Lab-Nutritional-Sci/Masters.aspx#Nutritional-Sciences)
  Public Health Laboratory Sciences
  (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Clinical-Lab-Nutritional-Sci/Masters.aspx#P-H-Lab-Sci)
  Option: Professional Science Master's Option
  (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Clinical-Lab-Nutritional-Sci/Masters.aspx#Professional-Science-Masters)

- **Master of Science in Pharmaceutical Science**
  Option: Professional Science Master's in Pharmaceutical Science

- **Graduate Certificates:**
  Clinical Pathology
  Nutritional Sciences
  Pharmaceutical Science
  Public Health Laboratory Sciences

- **Bachelor’s-Master’s Program**

- **Doctoral Program:** Pharmaceutical Science

Program Philosophy

The Master of Science degree program in Biomedical Sciences provides medical technologists and individuals with medical, biological or biochemical backgrounds with specialized knowledge in the clinical sciences. The mission of the program is to allow individuals to expand their understanding of the clinical sciences and be able to apply state-of-the-art research techniques to the advancement of diagnostic technology. Knowledge of such skills will permit upward mobility into entry level supervisor positions and dissemination of clinical information in educational settings. Students may choose from concentrations in research, clinical administration, health informatics, nutritional sciences and public health laboratory sciences.

Faculty in the Department of Biomedical and Nutritional Sciences have extensive research track records. Many are recognized nationally and internationally as experts in their fields and participate in professional organizations, holding office at local and national levels. Department faculty are successful in obtaining research funding and are very productive in publishing their research findings in peer-reviewed scientific journals.

Program Overview

The Master of Science program is typically completed in two years, however, students may choose to progress through the program on a part-time basis. The Bachelor’s-Masters program in one additional year beyond the B.S. degree. The program integrates management components from the Health Management and Policy Program, and environmental health components from the department of Work and Environment. Students take a required core of five courses and then select five program concentration courses from among the areas of research, nutritional sciences, clinical administration, health informatics and public health laboratory sciences. Students may also select a Professional Science Masters combining business courses and business internship. Online graduate certificate programs allow gradual transition from a work setting into this academic program. Students may continue on into programs such as Ph.D. in Biomedical Engineering and Biotechnology (participant in UMass system-wide graduate degree program) or the Ph.D. in Chemistry, Biochemistry Option (in collaboration with Chemistry Department).

Admission Requirements

1. A baccalaureate degree from an accredited university or college with a recommended GPA of 3.0 or better.
2. Sound preparation in the biological or clinical sciences with a chemistry background for the research concentration.
3. A minimum official score on the Graduate Record Examination Aptitude Test (GRE) of 151 verbal and 157 quantitative. GRE’s are required unless the student has
completed a previous American Masters degree. For students who graduated from a university in a country where English is not the official language. TOEFL scores should be at least 550 (paper-based), 213 (computer-based), or 79 (internet-based). The GRE is not required fro the certificate programs.

4. For the Clinical Administration concentration: clinical certification is required.

5. For the Clinical Research concentration, sound preparation in the biological or clinical sciences is required, to include successful completion of a course in biochemistry or equivalent.

6. Three letters of recommendation pertaining to academic ability and professional performance unless the applicant is already a student in the undergraduate program and applying into the Bachelor’s-Master’s Program.

7. Students will also be asked to submit a personal statement and a resume.

Program Requirements

The student must possess basic statistical and computer skills prior to admission, or may complete without credit within the graduate program of study, an introductory course in computers and a course in statistics prior to the third semester. Skill level can be determined through discussion with the Graduate Coordinator.

Master of Science in Clinical Laboratory Sciences

The UMass Lowell Department of Biomedical and Nutritional Sciences offers a Master of Science in Clinical Laboratory Sciences with the choice of five concentrations and one option:

Concentrations:

- Clinical Research
- Clinical Administration
- Health Informatics
- Nutritional Sciences
- Public Health Laboratory Sciences

Option:

- Professional Science Master's

Degree Requirements

The Master of Science degree program in Clinical Laboratory Sciences requires the successful completion of a minimum of 15 semester hours of graduate level courses. These include 15 credit hours of core courses and either: A) a non-project option where 15 course credits are selected from a concentration area. B) A project option where a student takes 12 credit hours of graduate project and 15 course credits from a concentration area. Students may petition to transfer up to 2 graduate course credits of related content from other programs, and this requires approval by the department graduate coordinator and or department graduate faculty committee. The M.S. Program in Clinical Laboratory Sciences with Professional Master’s Option (PSM) requires 34 total credits (see below).

Part-Time Study

Students are allowed to matriculate on a part-time basis (taking one or two courses) and most professionally employed students that pursue the M.S. degree in Clinical Laboratory Sciences do so. Most classes meet once per week and are scheduled in the evening or online for student convenience.

Bachelor's-Master's Program

Undergraduate students in this program move through the master’s program at an accelerated rate by taking two 500-level courses during their senior year and count those credits toward both their undergraduate and graduate degrees. Student apply during their Junior year.

Program of Studies

Core Curriculum

The core curriculum includes the following courses (15 credits) and must be taken by each program student:

- HSCI.5500 Human Development and Pathophysiology (3cr)
- MLSC.6400 Quality Assurance, Control and Improvement in the Clinical and Public Health Laboratory (3cr)
- MLSC.5750 Topics in Clinical Laboratory Sciences (3cr)
- MLSC.5530 Advanced Clinical Chemistry (3cr)
- MLSC.5800 Clinical Applications of Molecular Genetics (3cr)

Concentration Areas

A. Clinical Research

Students selecting this concentration are expected to have prior certification or a sound preparation in the biological sciences and chemistry. In addition to the core curriculum, students must take the following prescribed elective:

- MLSC.5510 Advanced Pathophysiology (3cr)
Students selecting the project option take Project (4cr) and 12 credits from departmental course offerings or from courses approved by the Graduate Coordinator and/or department graduate committee. Students not selecting the project option are required to take 12 graduate course credits in addition to the core curriculum and the Advanced Pathophysiology course.

Students not selecting the project option are required to take 15 graduate course credits in addition to the core curriculum.

*Note: Other graduate level courses from outside of the Clinical Laboratory Master’s Program may be used as electives with Graduate Coordinator pre-approval.

**B. Clinical Administration**

Students selecting this concentration must have a clinical certification approved by the chairperson of the Department of Clinical Laboratory and Nutritional Sciences. In addition to the core curriculum, students must take the following graduate Health Administration courses or others approved by the Graduate Coordinator:

PUBH.5020 Organizational Behavior in Health Care (3cr)
PUBH.5140 Health Care Management (3cr)
PUBH.6070 Health Care Information Systems (3cr)
PUBH.6250 Health Policy (3cr)

Students selecting the project option take Project (4cr) and 12 credits of graduate Health Administration course offerings. Students not selecting the project option are required to take the four concentration courses and an additional 3cr department elective.

*Note: Other graduate level courses from the Health Services Administration Program may be substituted for these courses with Graduate Coordinator approval. Students not selecting the project option are required to take 15 graduate course credits in addition to the core curriculum.

**C. Health Informatics**

This concentration is intended for students with a background in health who wish to be prepared to apply current information technology to the management of health care services and information. Students must possess a baccalaureate degree and basic computer skills. In addition to the core curriculum, students must take an additional 3cr department elective and the following graduate Health Informatics courses or other as approved by the Graduate Coordinator:

PUBH.6070 Healthcare Information Systems (3cr)
PUBH.5310 Health Informatics (3cr)
PUBH.6320 Health Information System Planning (3cr)
PUBH.6330 Healthcare Database Design (3cr)

Students not selecting the project option are required to take 15 graduate course credits in addition to the core curriculum.

**D. Nutritional Sciences**

This concentration is designed for students with a baccalaureate degree in an allied health or biological sciences field who wish to enhance their understanding of nutrition and health promotion. In addition to the core curriculum, students must take the following graduate Nutritional Sciences courses:

NUTR.5720 Nutrition and Gene Expression (3cr)
NUTR.5060 Biochemistry of Lipids (3cr)
NUTR.5630 Vitamins and Minerals (3cr)
NUTR.5820 Seminar in Advanced Nutrition (3cr)

Students also select Project (4 Cr) and 12 credits from departmental course offerings or from courses approved by the department chair, graduate coordinator or graduate committee. Students not selecting the project option are required to take 15 graduate course credits in addition to the core curriculum. The four graduate Nutritional Sciences courses offered also comprise the Graduate Certificate in Nutritional Sciences. Students may apply for this certificate program before official matriculation in the master’s degree program.

Students not selecting the project option are required to take 15 graduate course credits in addition to the core curriculum.

**E. Public Health Laboratory Sciences**

This concentration is intended for qualified students with a background in Clinical Laboratory Sciences, Community Health, Environmental Health, Health Administration, Work Environment, Biological Sciences or Chemistry who would like to help satisfy a critical need for qualified public health scientists.

Students must possess a baccalaureate degree and basic computer skills.

In addition to the core curriculum, students in this concentration must take the required course, Introduction to Public Health and the Public Health Laboratory, and an additional 4 courses. Three of these courses must be selected from one of the following areas.

Required Course - Department of Clinical Laboratory and Nutritional Sciences

MLSC.5410 Introduction to Public Health and the Public Health Laboratory (3 cr)

Concentrations/Elective Courses (credits)

Infectious Disease and Quality Control - Department of Clinical Laboratory and Nutritional Sciences

- MLSC.6130 Infectious Disease (3 cr)
- MLSC.6150 Medical Mycology and Parasitology Lecture (3 cr)
MLSC.5120 Medical Bacteriology Lecture (3 cr)
MLSC.6400 Quality Assurance, Control and Improvement in the Clinical and Public Health Laboratory (3 cr)

Health Management and Policy - Department of Community Health and Sustainability

PUBH.5140 Health Care Management (3 cr)
PUBH.5020 Organizational Behavior in Health Care (3 cr)
PUBH.6260 Leadership and Change (3 cr)
PUBH.6040 Health Data Analysis (3 cr)

Health Informatics - Department of Community Health and Sustainability

PUBH.6070 Healthcare Information Systems (3 cr)
PUBH.6320 Healthcare Information System Planning (3 cr)
PUBH.6330 Healthcare Database Design (3 cr)

Environmental Testing - Department of Work Environment

PUBH.5750 Introduction to Epidemiology (3 cr)
PUBH.5030 Toxicology and Health (3 cr)
PUBH.5061 Introduction to Environmental Health (3 cr)
PUBH.6220 Biomarkers for Occupational &Environmental Health (3 cr)

Professional Sciences Masters Option

This degree option (34 total credits) contains approximately 2/3 science (24 credits) and 1/3 business/communication (9 credits) courses and a 1 credit internship experience with reflective seminar (34 credits program total). The 5 required scientific core courses are the same. Three department elective courses may selected from the following:

STEM Elective Courses (9 cr), choose any three

MLSC.7340 MS Project in Clinical Laboratory Sciences (3 cr)
MLSC.5510 Advanced Pathophysiology (3 cr)
MLSC.5310 Clinical Immunohematology (3 cr)
MLSC.6150 Medical Mycology and Parasitology (3 cr)
NUTR.5060 Biochemistry of Lipids (3 cr)
NUTR.5720 Nutrition and Gene Expression (3 cr)
NUTR.5820 Seminar in Advanced Nutrition (3 cr)

NUTR.5630 Vitamins and Minerals (3 cr)
NUTR.5650 Lab Methods in Nutrition Assessment (3 cr)
MLSC.5410 Introduction to Public Health and the Public Health Laboratory (3 cr)

(Other graduate level courses outside of the Department of Clinical Laboratory & Nutritional Sciences will be considered to be included on an individual basis.)

Business Courses Required (9 credits)*

PSMA.5450 Professional and Scientific Communication
PSMA.5550 Leadership for Scientists
PSMA.5350 Project Management for Science Professionals

*All offered online
Also required:
Preparation Seminar (0.0 cr)
Reflective Seminar (1.0 cr)

Professional Experience (1 credit)
MLSC.7700 Professional Internship

A Professional Internship is required for students in this program and is expected to be a minimum of 350 hours and have 3-6 month duration. The internship is designed to provide students with an opportunity to obtain real-world experience in business, government agencies, non-profit organizations or research laboratories. Internships or research project experiences will typically take place in Clinical, Pharmaceutical, Diagnostic, Biotechnological or Medical Device Companies or Institutions.

Research experience can also be obtained at the university or other research centers. Given the number of full time faculty in the department, the university will assist the Department of Clinical Laboratory and Nutritional Sciences and the students with arranging corporate internships. To be eligible for the Professional Internship, students will be required to have 1) completed a minimum of 12.0 credits of STEM courses, 2) completed a minimum of 6.0 credits of PLUS courses, 3) attained an overall minimum GPA of 3.0 and 4) department permission.

Since most program students will have a scientific background and are in a scientific Master of Sciences Program, Professional Internships with a business will be most desirable. Consideration will be given for students that have previous or
current professional employment experience, however, in these cases, a new project experience will be required that adds to the students current set of skills. All students will be required to submit a final written report and give oral presentation on their work at a Seminar. All post-internship students will participate in this seminar. All Professional Internships require department faculty supervision. Students should register for 36.770 during the final semester of internship participation.

Graduate Certificates in Biomedical & Nutritional Sciences

The UMass Lowell Department of Biomedical and Nutritional Sciences offers three graduate certificate programs.

- Clinical Pathology
- Nutritional Sciences
- Public Health Laboratory Sciences

Graduate Certificates in Biomedical & Nutritional Sciences - General Information

Clinical Pathology

Biomedical and Nutritional Sciences Department

Contact: Nancy Goodyear, Ph.D. (mailto:nancy_goodyear@uml.edu), 978-934-4427

Clinical Pathology combines the theoretical and technical knowledge of human anatomy and physiology, clinical chemistry, genetics, immunology, microbiology, hematology, histocompatibility, cellular pathology and other fields as they pertain to the diagnosis, monitoring and prevention of disease.

The 12 credit Graduate Certificate in Clinical Pathology is a unique program that was developed for medical laboratory personnel, medical professionals, nurses, biologists and biochemists who are interested in expanding and updating their knowledge in clinical pathology. Personnel employed in the biomedical and biotechnology industries are another population of students who will benefit from this certificate program.

Required Courses:

- HSCI.5500 Human Development and Pathophysiology
- MLSC.5510 Advanced Pathophysiology

Electives - Choose 2:

- MLSC.5530 Advanced Clinical Biochemistry
- MLSC.5800 Clinical Applications of Molecular Genetics
- MLSC.6130 Infectious Disease
- MLSC.6157 Medical Mycology and Parasitology

Gainful Employment

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Clinical%20Pathology%20-%20%2051.1099-Gedt.html)

Nutritional Sciences

Biomedical and Nutritional Sciences Department

Contact: Nancy Goodyear, Ph.D. (mailto:nancy_goodyear@uml.edu), 978-934-4427

Current emphasis on dietary concerns in the areas of science or medicine and society-at-large demonstrate the need for post-baccalaureate programs in the nutritional sciences. This 12 credit certificate program is designed for the health professional (e.g. medical technologist, clinical lab scientist, biologist, nurse, physician, physical therapist, exercise physiologist, athletic trainer, personal trainer) currently employed with experience in a health career or related science field. Students must present evidence that they have baccalaureate degree in any one of the above or related fields.

Required Courses:

- NUTR.5060 Biochemistry of Lipids
- NUTR.5630 Vitamins and Minerals
- NUTR.5720 Nutrition and Gene Expression
- NUTR.5820 Seminar in Advanced Nutrition

Gainful Employment

Completion Rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Nutritional%20Sciences%20-%20%2030.1901-Gedt.html).

Public Health Laboratory Sciences

Biomedical and Nutritional Sciences Department

Contact: Nancy Goodyear, Ph.D., 978-934-4427

This 12 credit certificate program will help to satisfy a critical and timely need for qualified public health laboratory scientists. Students must take a total of 4 courses consisting of 2 required courses and 2 electives. The student must meet with the coordinator of this program to select the electives that best fit their educational needs.

Required Courses (from the Department of Biomedical and
Nutritional Sciences

**Offered Online only** - two courses for a total of six credits

- MLSC.5410 Introduction to Public Health and the Public Health Laboratory
- MLSC.6130 Infectious Disease

**Elective Courses** (from the Department of Biomedical and Nutritional Sciences and Department of Work Environment)

**Online Courses**

- PUBH.5040 Health Data Analysis
- PUBH.5080 Principles and Practices of Biological Safety
- PUBH.5160 Laboratory Environmental Health and Safety
- MLSC.5800 Clinical Applications of Molecular Genetics

**On Campus Courses**

- MLSC.6400 Quality Assurance, Control and Improvement in the Clinical and Public Health Laboratory
- PUBH.5060 Principles of Environmental Health
- PUBH.6190 Measurement of Chemical Exposures
- PUBH.5030 Toxicology and Health

For qualified individuals, the 12 earned graduate credits are transferable to an appropriate graduate degree program with the approval of the graduate program coordinator.

**Gainful Employment**

Completion rates, median loan debts and program costs are outlined in the [Graduate Certificate Gainful Employment Disclosure Information](https://www.uml.edu/gainful-employment/Public%20Health%20Laboratory%20-%20Certificate.html).
MLSC.5310 Clinical Immunohematology (Formerly 36.531) - Credits: 3

Lecture and case study discussions look at the major red cell antigen/antibody systems that are of importance in understanding transfusion therapies, compatibility testing, and pathological diseases. Emphasis is on differentiation and clinical significance of each system. Donor selection regulations, component preparation, and hemotherapy will also be discussed. Students will be required to do a presentation, poster, and paper on an advanced topic in Clinical Immunohematology.

MLSC.5410 Introduction to Public Health and the Public Health Laboratory (Formerly 36.541) - Credits: 3

This course is designed to provide an overview of public health and the public heath laboratory covering topics such as the legal basis and history of public health, public health structure, communications and interactions, and epidemiology. Emphasis will be placed on the role of the public health laboratory and its core functions, its role in policy development, infectious disease, environmental issues, emergency preparedness, newborn screening, global issues, and public health research. Public health laboratory methodology, regulation and improvement, and quality assurance will also be examined.

MLSC.5510 Advanced Pathophysiology (Formerly 36.551) - Credits: 3

Disease processes as appropriate and inappropriate as variants of normal physiological functions. A detailed examination of certain important and illustrative diseases rather than a survey of diseases in general.

MLSC.5530 Advanced Clinical Chemistry (Formerly 36.553) - Credits: 3

This course is designed to give an in-depth understanding in clinical chemistry. Topics include: analytical techniques and the selection of methodologies. The course allows for a detailed examination and discussion of selected articles from the Journal of Clinical Chemistry.

MLSC.5600 Molecular Pathology (Formerly 36.560) - Credits: 3

This graduate course is designed to study the molecular aspects of disease. Applications and techniques utilized in the field of molecular pathology are emphasized. This course is intended to provide students with information required to understand the increasing role of molecular pathology in the daily practice and management of chronic disease in medicine. Major emphasis on strength and limitations of clinical diagnostics technologies and their utilization in these applications are presented. This course will also provide a review of current molecular pathology literature and principles as they relate to specific organ systems.

MLSC.5750 Topics in Clinical Laboratory Science I (Formerly 36.575) - Credits: 3

This course provides students with the knowledge that is fundamentally necessary to understand the routine operations of the clinical diagnostic laboratory. The course will familiarize students with the diagnostic application of the most current testing methodologies and also provide a forum to discuss and critically review primary literature pertinent to current clinical laboratory issues.

MLSC.6000 Biomarker Discovery & Applications - Credits: 3

This course will cover the burgeoning field of biomarkers research, with a special focus on biomedical and clinical applications. The course is organized in three main sections: (I) Biomarker discovery and validation, including types of biomarkers and platforms for discovery (proteomics, metabolomics, multiplex technologies); (II) biomarker applications in clinical and health research; and (III) new frontiers in biomarkers research. Examples of biomarker applications will include organ systems, disciplines (clinical lab sciences and clinical trials, environmental health, toxic tort and forensic litigation), and regulatory perspectives.

MLSC.6130 Infectious Disease (Formerly 36.613) - Credits: 3

This course is designed for graduate students in the health sciences focusing on the pathophysiology of infectious disease. Major infectious organisms will be discussed as biological models and presented in the way they affect major systems of the body. Emphasis will be placed on journal readings describing significant episodes of emerging infections and current technology in diagnosis and treatment of infectious diseases.

MLSC.6150 Medical Mycology and Parasitology (Formerly 36.615) - Credits: 3

This course is designed to instruct students in diagnostic medical mycology and parasitology. Diseases, specimen collection and handling, laboratory identification and treatment of medically significant fungi and parasites will be studied. Discussion of AIDS related infections and prophylactic treatment will be evaluated. Life cycles of parasites, prevention
and environmental protection plans will be analyzed.

MLSC.6400 Quality Assurance, Control and Improvement in the Clinical and Public Health Lab (Formerly 36.640) - Credits: 3

This course is designed to provide an overview of total quality management issues in the Clinical and Public Health laboratory. Topics presented will include CLIA and quality control in the laboratory, clinical and public health laboratory QC calculations, charts and graphs, regulations involving new control lots, out-of-control QC situations, method comparison, instrument validation, and quality assurance. Emphasis will be placed on meeting all federal regulations including the FDA, state regulations, as well as meeting professional agency regulations such as JCAHO, CAP, and APHL.

MLSC.7330 Graduate Project - Clinical Laboratory Sciences (Formerly 36.733) - Credits: 3

An independent study or laboratory project which has been approved and is under the direction of the project advisor. Projects are approved by the graduate coordinator in conjunction with the project advisor.

MLSC.7340 Graduate Project - Clinical Laboratory Sciences (Formerly 36.734) - Credits: 1-4

An independent study or laboratory project which has been approved and is under the direction of the project advisor. Projects are approved by the graduate coordinator in conjunction with the project advisor.

MLSC.7430 Master’s Thesis - Clinical Lab Sciences (Formerly 36.743) - Credits: 3

Analytical and/or experimental work conducted under the direction of a thesis advisor and in accordance to the Graduate School Guidelines. Students are required to submit a written proposal for approval by a thesis committee and to present an oral defense at a college seminar.

MLSC.7440 Master’s Thesis - Clinical Laboratory Science (Formerly 36.744) - Credits: 4

Research Design and Methodology. Analytical and/or experimental work conducted under the direction of a thesis advisor and in accordance to the Graduate School Guidelines. Students are required to submit a written proposal for approval by a thesis committee and to present an oral defense at a college seminar.

MLSC.7530 Doctoral Research (Formerly 36.753) - Credits: 3

MLSC.7560 Doctoral Research (Formerly 36.756) - Credits: 6

MLSC.7590 Doctoral Research (Formerly 36.759) - Credits: 9

MLSC.7700 Professional Internship and Seminar (Formerly 36.770) - Credits: 1

A Professional Internship is required for students in the Professional Sciences Option of the Clinical Laboratory Sciences Masters Program. It is expected to be a minimum of 350 hours and have 3-6 month duration. The internship is designed to provide students with an opportunity to obtain real-world experience in business, government agencies, non-profit organizations or research laboratories. Internships or research project experiences will typically take place in Clinical, Pharmaceutical, Diagnostic, Biotechnological or Medical Device Companies or Institutions. Research experience can also be obtained at the University or other Research Centers. All students will be required to submit a final written report and give oral presentation on their work at a Seminar that all post-internship students participate in. To be eligible for the Professional Internship, students will be required to have 1) completed a minimum of 12.0 credits of STEM courses, 2) completed a minimum of 6.0 credits of PLUS courses, 3) attained an overall minimum GPA of 3.0, and 4) Department Permission.

NUTR.5060 Biochemistry of Lipids(Formerly 36.506) - Credits: 3

This advanced course in the nutritional biochemist and physiology of lipids will detail the role of lipids in the normal and pathological processes at both the cellular and whole organism level. Topics will range from general discussions of the digestion, absorption and transport of lipids to the role of eicosanoids and lipid soluble anti-oxidants during normal and diseased states, such as atherosclerosis, diabetes and hypertension. Subject matter will also include a discussion of the various interventions for the prevention and treatment of certain of these disease states. There will also be discussion of the current issues in lipid nutrition.

NUTR.5630 Vitamins and Minerals(Formerly 36.563) - Credits: 3

Provides a foundation for understanding the role of vitamins and minerals in human nutrition. Emphasis is placed on their roles in human biochemistry and physiology. The mechanism of action for each nutrient is examined. The course will explore the effects of nutrient deficiency, and identify the best dietary sources for each vitamin and mineral.
NUTR.5720 Nutrition and Gene Expression (Formerly 36.572) - Credits: 3

Regulation of eukaryotic gene expression by specific nutrients, hormones, and metabolites will be discussed. Transcriptional, post-transcriptional, and translational mechanisms of specific nutrients with emphasis in disease development or prevention. The information gained will be useful for design of appropriate diets, based on inherited biochemical characteristics. This course will enable students to link their knowledge of nutrition with the growing body of knowledge on the human genome and specific hereditary diseases with a nutritional component. Students will be required to submit a paper in nutrition and gene expression, on a topic agreed upon by student and instructor.

NUTR.5820 Seminar in Advanced Nutrition (Formerly 36.582) - Credits: 3

Review and analysis of contemporary research publications in human nutrition. Recently discovered nutrients that may be essential to human health will be evaluated. We will critically examine the benefits of dietary modification in controlled investigations. Course will focus on published studies of the relation of dietary practices to health and disease. We will examine nutrition policy, and the way scientific findings in nutrition translate into public health practice. This course will be of value to students who wish to critically examine literature in human nutrition, and who seek to develop new directions for nutrition research.

NUTR.6000 Programs and Principles in Public Health Nutrition - Credits: 3

This course provides advanced study in public health and community nutrition. Concepts related to cultural competency, public health and nutrition policy, health promotion, and the nutrition care process will be learned through lectures, quest lectures, in-class activities, case studies, and peer-led discussions. Students will have the opportunity to practice skills in community and public health nutrition settings such as food pantries and senior nutrition centers.

NUTR.6010 Nutrition Assessment (Formerly 36.601) - Credits: 3

This course provides an overview of tools used to assess nutritional health, dietary adequacy, dietary variety, and food security. Lectures and lab will be integrated together to demonstrate and provide experience in methods needed to assess, screen, and monitor physiological and dietary indicators of nutritional health. There will be an emphasis on methods and tools for assessing body composition, biochemical indicators, dietary intake, energy expenditure, and physical activity. Students will learn how to select and apply these methods in community, clinical and research settings and determine the strengths and limitations of each assessment tool.

NUTR.6020 Public Health Nutrition (Formerly 36.602) - Credits: 3

This course will examine a broad range of community-based nutrition research, programs and policies within the United States. Settings for public health nutrition programs have broadened to include non-profit agencies, worksites, health centers, clinics, hospitals, schools, churches, supermarkets, sports centers, senior centers, and emergency feeding sites. Students will engage in experiential learning and use case studies to practice innovative approaches to community nutrition. Field visits will allow students to interact with and learn from public health experts. Students will be required to write a funding proposal for a community nutrition program that they have developed in small groups.

NUTR.6030 Global Nutrition (Formerly 36.603) - Credits: 3

This course is an examination of the food and nutrition issues around the world. The impact of food production and food intake on the environment and global nature of our food systems will be reviewed. The course will also include consideration of specific nutrient deficiencies, as well as nutrition-related aspects of infectious and chronic disease along with the programs and resources available to combat malnutrition for children and adults worldwide.

NUTR.6040 Nutrition Epidemiology (Formerly 36.604) - Credits: 3

This course is designed for graduate students who are interested in conducting or better interpreting epidemiologic studies relating diet and nutrition status to disease and health. There is an increasing awareness that various aspects of diet and nutrition may be important contributing factors in chronic disease. There are many important problems, however, in the implementation and interpretation of these studies. The purpose of this course is to examine methodologies used in nutritional epidemiologic studies in lecture and lab settings, and to review the current state of knowledge regarding diet and other nutritional indicators as an etiologic factor in disease.

NUTR.6050 Food and Nutrition Management - Credits: 3

This course provides advanced study in food and nutrition management principles. Topics include management theory, personnel selection, training, evaluation, organizational behavior, communication, governmental influences, labor
management relations, marketing, and budgeting. This course requires group work, development of a business plan, and completion of management related case studies.

**NUTR.6060 Advanced Clinical Nutrition - Credits: 3**

This course provides advanced study in clinical nutrition. Topics include the nutrition care process, standardized language and documentation, evidence-based practice, confidentiality of medical records, JCAHO regulations, and coding and billing. Case studies will be completed to review and advanced learning about medical nutrition therapy for acute and chronic nutrition-related diseases. As part of this course, students will practice providing nutrition assessment, counseling, education, professional documentation, and evaluation in clinical nutrition settings.

**NUTR.6660 Community Nutrition Supervised Practice - Credits: 1**

This supervised practice experience is the application of knowledge and skills in community and public health nutrition. Students will practice nutrition assessment, nutrition counseling, and nutrition education for a wide range of populations at high nutritional risk. Students will develop cultural awareness and skills in cultural competency.

**NUTR.6670 Food and Nutrition Management Supervised Practice - Credits: 1**

This supervised practice experience is the application of knowledge and skills in food and nutrition management. There will be hands-on experience in human resource and financial management. Management skills specific to the food service industry, including management functions related to safety, security and sanitation, will also be incorporated. Students will also be able to apply knowledge in food production, distribution, and food service systems along with skills in menu planning. There will be an emphasis on using strategies to reduce waste and protect the environment.

**NUTR.6680 Clinical Nutrition Supervised Practice - Credits: 1**

This supervised practice experience is the application of knowledge and skills in clinical nutrition. Students will receive hands-on experience in nutrition assessment, diagnosis, and treatment of nutrition-related diseases while using skills in nutrition counseling and applying principles from behavior change theories. Students will be able to practice documentation of nutrition care and participate as members of an interdisciplinary team.

**NUTR.7100 Nutrigenomics (Formerly 36.710) - Credits: 3**

The elucidation of the human genome has created a unique opportunity to study and understand how nutrients and bioactive food components influence gene expression and product activity. This knowledge will allow for a better understanding of how these interactions vary with individual genetic diversity in the development of chronic disease states. The goal will be to improve the quality of life through the use of diet in the prevention and treatment of human disease. This includes the use or restriction the specific nutrients and food compounds to maintain homeostasis in the body from the biochemical level to organ systems. The ability for nutritionists and healthcare professionals to create and optimize diets requires and understanding of the interactions between nutrients and genes, proteins and metabolic pathways in regulation of disease pathways.
HSCI.5020 Graduate Global Health Experience - Credits: 3

The Global Health Experience provides an experiential learning experience in health within a country outside of the United States. Students will study the health issues of a given country while examining the socio-cultural, economic and environmental determinants of health within that society. The strengths and weaknesses of the existing health care system will be analyzed. Students will explore the culture, environment, and health care system under the direction of College of Health Sciences faculty.

HSCI.5500 Human Development and Pathophysiology (Formerly 30.550) - Credits: 3

The physiological steady state of the human body and disruptions that result over the life span will be examined as well as the pathophysiological mechanism manifested in disease states. The course addresses defense, compensating, and adaptive responses to the pathophysiological processes as they apply to the various systems rather than being a survey course of diseases.

HSCI.5510 Clinical Pathophysiology - Credits: 3

The student will examine disease processes as variants of normal physiological functions with emphasis on understanding the pathophysiologic basis of common diseases in certain systems. This graduate level course is a comprehensive exploration of the etiology, pathogenesis, clinical manifestations, and treatment of disease.

HSCI.5770 Health Disparities in a Global Economy (Formerly 30.577) - Credits: 3

This course will survey the field of environmental health and the links between environmental stressors and impacts on public health. The course will explore human and industrial activities that impact on environmental health such as population, food production, air and water pollution, waste, the built environment, toxic substances, pests, and global climate change. The course will also examine the types of diseases and illnesses that result from environmental impacts.

HSCI.6140 Health Care Management (Formerly 30.614) - Credits: 3

PUBH.5061 Environmental Health (Formerly 19.506) - Credits: 3

This course will survey the field of environmental health and the links between environmental stressors and impacts on public health. The course will explore human and industrial activities that impact on environmental health such as population, food production, air and water pollution, waste, the built environment, toxic substances, pests, and global climate change. The course will also examine the types of diseases and illnesses that result from environmental impacts.

PUBH.5070 Leadership and Management in Public Health - Credits: 3

This course provides and introduction and overview to leadership, management, and organizational behavior in health care, reflecting the uniqueness of this sector. The course integrates theory with practice through readings, lectures, written assignments, and guest presentations from different organizational perspectives. Assessment, practice and development of leadership, managerial and organizational skills will be accomplished through team exercises and small group work. You will be encouraged to analyze your own leadership style and skills within the context of healthcare as well as interview and learn from other leaders in the healthcare setting.

PUBH.5130 Assessment and Planning in Public Health - Credits: 3

This course presents methods, concepts and techniques required for the identification of resources and needs, and planning of public programs and interventions to meet those needs at the community, state, and national levels. Students will engage in community planning and assessment activities in the classroom and field.

PUBH.5760 Biostatistical Programming - Credits: 3

This course is designed to provide familiarity with several types of statistical software commonly used in public health research. The course covers topics including: reading raw data and existing data sets; modifying data; combining data sets; applying basic statistical procedures; and sorting, summarizing, and printing data.

PUBH.5930 Directed Study (Formerly 19/31/32.593) - Credits: 1-3

PUBH.6910 Advanced Program Evaluation - Credits: 3

The focus of this course is on advanced evaluation methods to assess the impact of public health programs and policies. Using examples of real world evaluations of public health initiatives, students will learn methods of collecting, analyzing, interpreting, and communicating information used in evaluation reports. Ethical and practical issues in evaluation
research will be discussed. Students with draft and evaluation proposal.
Programs of Study

Pharmaceutical sciences is an exciting field that offers many different career opportunities in the biopharmaceutical and pharmaceutical industries, and in research and academia. We offer an M.S., Professional Science Masters and Ph.D. program in Pharmaceutical Sciences.

Pursue the degree that’s right for you:

- Masters support technical roles in research and production settings that will help meet the demand for new drugs that treat human disease and evaluate the safety and effectiveness of drug therapies.
- Professional Science Masters gain both technical and business skills to work in the laboratory and assume leadership roles in the pharmaceutical industry.
- Ph.D. discover new drugs that treat human disease and evaluate the effectiveness and safety of drug therapies.

Visit the Pharmaceutical Sciences program website.

Contact:

Brenda Geiger (mailto:brenda_geiger@uml.edu)

Program Coordinator

Weed Hall

978-934-3872

Masters in Pharmaceutical Sciences

Admission and Degree Requirements

Applicants to the M.S. or Professional Science Masters programs in Pharmaceutical Sciences must have a B.S. degree or be in the last semester of their baccalaureate program. Up to 12 credits of graduate work of appropriate course work with a grade of B or better can be transferred into the UMass Lowell MS Pharmaceutical Science programs if approved by the Graduate Coordinator.

Upon admission or through the successful completion of prerequisite courses, students will be expected to have successfully demonstrated undergraduate level knowledge in biochemistry, calculus, general and organic chemistry and biology or anatomy and physiology.

The M.S. curriculum will consist of 32 credits of coursework. Coursework will generally be scheduled in the fall and spring semesters. Full-time students should finish in 12 months by taking course during the summer terms. Students who attend part-time should finish within five years.

The Program Coordinator and advisors in the program will guide M.S. students through a part-time or full-time program of study. Full-time study is equivalent to 9 credits per semester.

Example Plan of Study by Semester for Full-Time M.S. Students

**Fall Semester**

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<th>Course Name</th>
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<td>CHEM.5500</td>
<td>Biochemistry I</td>
<td>3 credits</td>
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<tr>
<td>PHRM.6100</td>
<td>Principles of Pharmaceutical Sciences</td>
<td>3 credits</td>
</tr>
<tr>
<td>PHRM.6120</td>
<td>Principles of Pharmaceutical Sciences Lab</td>
<td>1 credit</td>
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<tr>
<td>BIOL.5420</td>
<td>Cell Biology (a)</td>
<td>3 credits</td>
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**Spring Semester**

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<td>CHEM.5620</td>
<td>Pharmaceutical Biochemistry (b)</td>
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<td>PHRM.6400</td>
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**Summer Term I**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLSC.5510</td>
<td>Advanced Pathophysiology (c)</td>
<td>3 credits</td>
</tr>
<tr>
<td>PHRM.6600</td>
<td>Pharmacokinetics &amp; Drug Metabolism</td>
<td>3 credits</td>
</tr>
<tr>
<td></td>
<td><strong>Total:</strong></td>
<td><strong>6 credits</strong></td>
</tr>
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</table>

**Summer Term II**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHRM.6410</td>
<td>Drug Delivery</td>
<td>3 credits</td>
</tr>
<tr>
<td>PUBH.5770</td>
<td>Introduction to Biostatistics</td>
<td>3 credits</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>6 credits</strong></td>
</tr>
</tbody>
</table>

**Total Credits for MS degree: 32 credits**

- (a) OR BIOL.5760 Cell Culture or CHEN.5350 Cell and
Microbe Cultivation
(if Cell Biology or equivalent training was previously completed at either the undergraduate or graduate level)

- (b) OR CHEM.6310 Principles of Medicinal Chemistry I (3 credits)
- (c) OR HSCI.5500 Human Development and Pathophysiology (3 credits)

**Pharmaceutical Sciences Elective options include (but are not limited to):**

- BIOL.5760 Cell Culture
- BIOL.5820 Cancer Biology
- BIOL.5930 Immunology
- CHEM.5140 Advanced Analytical Chemistry
- CHEM.5260 Chromatography
- CHEN.5350 Cell and Microbe Cultivation
- CHEN.5450 Protein Isolation and Purification
- CHEN.5550 Biopharmaceutical Regulatory Compliance
- CHEN.5480 Engineering Process Analytics
- MLSC.5600 Molecular Pathology

Other pharmaceutical sciences elective options may be added to this list or be approved by the Graduate Coordinator.

**Certificate in Pharmaceutical Science**

Brenda Geiger, Ph.D. (mailto:brenda.geiger@uml.edu) 978-934-3872

This graduate certificate is a four-course program in Pharmaceutical Sciences intended for individuals who are interested in getting acquainted with pharmaceutical sciences. The courses offered in the certificate program are foundation courses in the Pharmaceutical Sciences MS and Ph.D. programs.

**Prerequisites:**

- Baccalaureate degree from an accredited institution with a minimum GPA of 3.00.
- Completed undergraduate courses in calculus, general and organic chemistry, biochemistry and biology or anatomy and physiology with grades of C or above.

**Required Courses:**

- PHRM.6100 Principles of Pharmaceutical Sciences
- PHRM.6400 Pharmaceutical Analysis
- PHRM.6410 Drug Delivery
- PHRM.6600 Pharmacokinetics and Drug Metabolism

**Gainful Employment Disclosure Information**

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information.

**Ph.D. in Pharmaceutical Sciences**

**Admissions and Degree Requirements**

Students from the MS program with a cumulative GPA of a 3.5 or greater may apply to the Ph.D program and, if accepted proceed with advanced standing in the Ph.D program and will be eligible to take the qualifying exam, which must be successfully completed within one year of acceptance. External applicants to the Ph.D program will be accepted if they have a MS degree in Pharmaceutical Sciences with a cumulative GPA of 3.5 or greater from another college or university, but may be required to take any additional core curriculum courses they have not previously taken.

Upon completion of the core curriculum these students will be required to attempt the qualifying exam within 6 months and must successfully complete the qualifying exam within one year. Students in the Ph.D program are also required to take a minimum of 12 more credits of Advanced Elective courses. Other advanced Elective options may be added to this list or be approved by the Graduate Coordinator and the student’s Research Advisor.

The Program Coordinator and advisors in the Ph.D. program will guide graduate students through a full-time program of study. Full-time study is equivalent to 9 credit hours per semester.

**Advanced Elective List for Ph.D. Students**

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL.5210L</td>
<td>Genomics Laboratory</td>
<td>2 credit hours</td>
</tr>
<tr>
<td>BIOL.5290</td>
<td>Recombinant Protein Production Technology</td>
<td>4 credit hours</td>
</tr>
<tr>
<td>BIOL.5320</td>
<td>Genomics</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>BIOL.5340</td>
<td>Genomics Laboratory</td>
<td>1 credit hour</td>
</tr>
<tr>
<td>BIOL.5670</td>
<td>Molecular Biology</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>BIOL.5690L</td>
<td>Molecular Techniques</td>
<td>4 credit hours</td>
</tr>
<tr>
<td>BIOL.5890</td>
<td>Practical Protein Crystallography</td>
<td>4 credit hours</td>
</tr>
<tr>
<td>CHEM.5380</td>
<td>Biochemical Mechanisms</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>CHEM.5510</td>
<td>BioChemistry II</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>CHEM.5660</td>
<td>Advanced Physical Biochemistry</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>CHEM.5660</td>
<td>Nanomaterials and Nanostructures</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>CHEM.5680</td>
<td>Structural Analysis</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>CHEM.5700</td>
<td>Advanced Protein Chemistry</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>Course Number</td>
<td>Course Name</td>
<td>Credits</td>
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<tr>
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</tr>
<tr>
<td>CHEM.6320</td>
<td>Principles of Medicinal Chemistry II</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>MLSC.5800</td>
<td>Clinical Applications of Molecular Genetics</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>NUTR.7100</td>
<td>Nutrigenomics</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>RADL.5410</td>
<td>Radiochemistry</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>RADL.5620</td>
<td>Radiation Biology</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>RADL.5980</td>
<td>Introduction to Medical Imaging</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>PHRM.7080</td>
<td>Mechanisms of Drug Action</td>
<td>3 credit hours</td>
</tr>
<tr>
<td>SubTotal # Advanced Elective Credits Required</td>
<td>12 - 13 Credit Hours</td>
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</table>

**Dissertation and Research Courses**

(total courses required = 4)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHRM.7550</td>
<td>Graduate Research</td>
<td>12 - 27 credit hours</td>
</tr>
<tr>
<td></td>
<td>(4-0 per semester)</td>
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</tr>
<tr>
<td>PHRM.7590</td>
<td>Doctoral Dissertation</td>
<td>4 - 9 credit Hours</td>
</tr>
<tr>
<td>SubTotal Dissertation &amp;Research Credits Required</td>
<td>Minimum 26</td>
<td></td>
</tr>
</tbody>
</table>
PHRM.6100 Principles of Pharmaceutical Sciences (Formerly PHSC 610) - Credits: 3

The purpose of this introductory course in the pharmaceutical sciences is to provide an overview of the drug development process, involving drug discovery, drug action, and drug delivery. The student will become acquainted with cutting-edge research in discovery, action, and delivery. This course provides a foundation in pharmaceutical sciences along with theoretical, practical, regulatory, and professional issues in the pharmaceutical sciences.

PHRM.6120 Principles of Pharmaceutical Sciences Laboratory - Credits: 1

The purpose of this introductory course in the pharmaceutical sciences is to provide an overview of the drug development process, involving drug discovery, drug action, and drug delivery. Laboratory experiments will be performed to exemplify and expand upon the principles covered in Principles of Pharmaceutical Sciences lecture.

PHRM.6200 Pharmacokinetics (Formerly PHSC 620) - Credits: 3

This course focuses on the study of the biochemical and physiological effects of drugs and the mechanisms of their actions. The quantitative aspects of drug absorption, distribution, metabolism, and excretion will be explored. The philosophy of pharmacokinetic modeling and its application in practice will be introduced.

PHRM.6300 Pharmaceutical Research Design and Ethics (Formerly PHSC 630) - Credits: 3

This course explores research methodologies and statistics that are commonly used in pharmaceutical research. Scientific integrity in research will be discussed, as well as ethical issues in conducting pharmaceutical research in the laboratory.

PHRM.6400 Pharmaceutical Analysis (PHSC 640) - Credits: 3

Students in this course learn about modern analytical methods used to analyze the purity, strength, and quality of drugs and pharmaceutics.

PHRM.6410 Drug Delivery (Formerly PHSC 641) - Credits: 3

The biological, biophysical and chemical factors that influence drug delivery systems will be analyzed. Principles of cellular drug transport, in vivo drug transport, and modern drug delivery, including drug targeting will be explored. The course will also address membrane trafficking and intracellular transport and the utilization of these mechanisms in drug delivery and targeting.

PHRM.6420 Pharmaceutical Analysis Laboratory - Credits: 1

Students in this course analyze the purity, strength, and quality of drugs and pharmaceutics by applying modern analytical methods. Raw materials and completed dosage forms will also be analyzed in the laboratory.

PHRM.6501 Drug Discovery - Credits: 3

Drug discovery is the translational application of biology, chemistry, medicine, business and law in the identification of new medicines. This course is designed to provide each student with a full understanding of the challenges and opportunities that face scientists engaged in this enterprise in the biotech and pharmaceutical industries. Active learning objectives (case studies; project team work) are included to supplement the more didactic course materials, and to provide a simulation of the approaches used in industry to accomplish the key goal—the nomination of a clinical drug candidate worthy of extensive investment and testing in humans.

PHRM.6600 Pharmacokinetics and Drug Metabolism - Credits: 3

This course focuses on the study of the biochemical and physiological effects of drugs and the mechanisms of their actions. The quantitative aspects of drug absorption, distribution, metabolism, and excretion will be explored. The philosophy of pharmacokinetic modeling and its application in practice will be introduced. An overview of the structure, function and regulation of major drug metabolic enzymes and transporters will also be emphasized.

PHRM.6700 Drug Metabolism (Formerly 36.707) - Credits: 3

This course provides an overview of the structure, function and regulation of major drug metabolic enzymes and transporters.

PHRM.6800 Mechanisms of Drug Action (Formerly 36.708) - Credits: 3

This course reviews the general principles of drug action and the pharmacological activities of various classes of drugs. The major focus is on the molecular mechanisms of drug action, with a detailed discussion of one or more prototypes of each drug class. Selected examples of drug discovery and development are also discussed. At the completion of the
course, students will have knowledge of the molecular basis of pharmacological activity, the mode of action of major classes of therapeutic agents and familiarity with rational approaches to drug design.

PHRM.7090 Pharmacogenomic Principles and Applications (Formerly 36.709) - Credits: 3

Pharmacogenomics utilizes knowledge related to the variability in the human genome to understand and predict the differences in drug response and toxicity of pharmaceutical agents. This includes not only the determination of pharmacologically relevant genes that alter individual pharmacokinetic and pharmacodynamic response but also those polymorphism's and other mutations that predispose a person to development of various diseases. Personalizing therapies based on genotypic information should increase efficacy and decrease toxicity of agents. Current applications covered include anti-cancer and anti-viral therapies and anticoagulation.

PHRM.7100 Advanced Topics in Pharmaceutical Sciences (PHSC 710) - Credits: 2

Select advanced topics and the evaluation of scientific literature in pharmaceutical sciences will be discussed in this seminar.

PHRM.7110 Clinical Research Design and Methodology (Formerly PHSC 711) - Credits: 3

Experimental research methodologies and the ethical issues in clinical pharmaceutical research will be analyzed. Principles of translational research will be discussed. Students will develop a pharmaceutical clinical trial protocol.

PHRM.7120 Pharmacoepidemiology (Formerly PHSC 712) - Credits: 3

In this course the student applies epidemiological knowledge, reasoning, and research methods to the examination of the use and effectiveness of pharmacotherapy in human populations.

PHRM.7130 Applied Clinical Pharmacokinetics (Formerly PHSC 713) - Credits: 3

This course reviews the major methods, models, and equations used in pharmacokinetics with their physicochemical and physiological assumptions and limitations. Current graphic and computer methods of applying pharmacokinetics experimental and clinical data will be explored. Clinical research literature and approaches to the design of studies will be explored.

PHRM.7140 Nanotechnology and Drug Delivery (Formerly PHSC 714) - Credits: 3

A multidisciplinary course covering nanotechnology based drug delivery, materials and processes for novel drug delivery systems, synthesis of biocompatible nanoparticles for healthcare, product design, products today and regulatory issues.

PHRM.7550 Graduate Research - Credits: 1-9

Enrolled students will be completing supervised research as they progress toward the completion of their degree.

PHRM.7590 Doctoral Dissertation - Credits: 1-9

Enrolled students anticipate completion of all dissertation requirements during the semester in which they are enrolled for this course.
DPTH.5100 Models and Measurement in Disability (Formerly 34.510) - Credits: 3

This course will introduce students to the World Health organization’s International Classification of Function and discuss its implications for models and measurement of disability. Discussion will focus on defining and measuring disability based on the enabling-disabling process with both temporal and spatial dynamics. Temporal dynamics will include both short cycle dynamics (days to weeks) as well as longer range cycles (i.e. the life cycle). Spatial dynamics will include multi level - bidirectional interactions that emerge through cell, organ, system, organism, and environmental scales. The multi level structure will be emphasized as mechanism to link disciplines and the need for diverse strategies required for examining, evaluating and intervening for reducing disability. There will be an emphasis on the important recurrent feedback loops between human and environment in long-term health trajectories and transitions from health to disability and from acute disturbances to chronic conditions. These discussions will occur in two primary areas: musculoskeletal and cardiovascular system dynamics. Open to: Undergraduate Seniors and Graduate Students It is recommended that students have completed at least a year of upper division exercise physiology, biological science, engineering or psychology coursework. In addition, a year of general physics and a semester of statistics or research methods is recommended but not required.

DPTH.6010 Clinical Anatomy (Formerly 34.601) - Credits: 3

Clinical Anatomy is a study of the structures of the human body, utilizing lectures, demonstrations and A.V. materials. It is a foundation course for physical therapy procedures courses. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6020 Neuroscience: Anatomy (Formerly 34.602) - Credits: 3

Neuroscience anatomy presents the form and functions of the human nervous system. It is a foundation course for physical therapy procedure courses. The student is introduced to clinically relevant neuroanatomy through a close examination of the signs and symptoms of a variety of pathologies, including lesions, tumors, injuries, and congenital disorders. Clinical examples are freely used to highlight the integral relationship between structural anatomy and functional impairment.

DPTH.6030 Anatomy Laboratory (Formerly 34.603) - Credits: 1

Clinical Anatomy Laboratory is a visualization of the structures of the human body utilizing laboratory dissection of prosected parts and human cadavers. The laboratory also incorporates the recognition of underlying structures using surface anatomy and palpation of body and soft tissues. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6040 Neuroscience: Physiology/Neurology (Formerly 34.604) - Credits: 3

Neuroscience presents the principles of neurophysiology, neurology, and motor control as related to the practice of physical therapy. Topics in neurophysiology include: conduction and transmission of the nerve impulse, neuromuscular synaptic transmission and skeletal muscle contraction, muscle tone and spinal reflexes, the neurophysiology of sensation and movement, and the transmission of pain. Neurological conditions will be integrated with these various neurophysiological topics through the use of case studies and will include: peripheral nerve injuries, neuromuscular conditions, and diseases/conditions of the central nervous system. An introduction to the major theories of motor control and their applications to physical therapy examination and intervention will be discussed through problem solving and case studies. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6050 Physical Therapy Interventions I Lecture (Formerly 34.605) - Credits: 3

This course introduces the student to the principles of patient evaluation and treatment utilizing case studies to integrate didactic information into practical clinical situations. The appropriate use of evaluation procedures and the rationale for safe and effective use of treatment procedures are emphasized. Topics include: principles of biomechanical analysis, body mechanics, principles of goniometry and muscle testing, patient positioning and transfers, gait training and activities of daily living with assistive devices, wheelchair prescription and mobility, isolation/sterile technique, wound care, monitoring vital signs, heat and cold modalities, aquatic therapy, and evaluation of normal gait. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6060 Neuroscience Laboratory (formerly 34.606) - Credits: 1

Neuroscience laboratory includes the study of the anatomy and function of the human brain, spinal cord, peripheral and autonomic nervous systems through prossection, audiovisual resources and experimental procedures. The gross anatomy of the human brain and spinal cord will be visualized using prossections of human specimens, models, and slides. The second half of the laboratory will focus on the Neurological
Evaluation including evaluation of reflex function, assessment of sensory and cerebellar mechanisms, and testing cranial nerve function in typical and simulated atypical subjects. Motor learning activities and Cognitive Testing will be performed. To help synthesize the course content each student will present a neuropahtology case study.

DPTH.6070 Physical Therapy Interventions I Laboratory (formerly 34.607) - Credits: 1

This laboratory course develops the psychomotor skills necessary to apply the didactic knowledge presented in the Physical Therapy Interventions I Lecture to clinical situations. The safe and effective performance of various evaluation and treatment techniques is emphasized. Topics include: patient interviewing; isolation/sterile techniques; wound care and bandaging; monitoring vital signs; patient positioning and bed mobility; transfers; gait training and activities of daily living with assistive devices; wheelchair mobility; massage/soft tissue mobilization/lymph edema management; heat and cold modalities; gait analysis; goniometry and strength testing; postural analysis and anthropometry. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6080 Musculoskeletal Physical Therapy I (formerly 34.608) - Credits: 3

This course is the first of a three-course series which explores physical therapy management of musculoskeletal dysfunction. In this first course, general models for physical therapy intervention will be presented. The evaluation, treatment and prevention of pathological conditions affecting the musculoskeletal system of the lower extremity will be emphasized. Normal function will be included as a basis for recognizing and therapeutically resolving dysfunction of skeletal and joint structures, muscles and soft tissues. A problem-solving approach to resolve impairments, contributing to functional limitations and disabilities, will be stressed. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6090 Medical/Surgical Pathology (formerly 34.609) - Credits: 3

This course presents an introduction to the study of diseases commonly seen in people with conditions treated by physical therapists. Mechanisms of cell growth, response to injury, and cell death are reviewed. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6100 Musculoskeletal Physical Therapy I Laboratory (formerly 34.610) - Credits: 1

This laboratory course develops the psychomotor skills to allow clinical application of didactic knowledge gained in Musculoskeletal Physical Therapy I Lecture. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6110 Professional Issues/Clinical Practice (formerly 34.611) - Credits: 3

This course will be divided into two sections. The first course section will provide an overview of physical therapy as a profession. Student Generic Abilities will be introduced as they apply to classroom instruction and clinical practice. The APTA (American Physical Therapy Association) Standards of Practice, Code of Ethics, disciplinary Process, The Scope of Physical Therapy Practice and The Massachusetts Practice Act will be discussed. The second course section will emphasize the development of effective teaching and learning strategies as it applies to physical therapy in the clinical setting. Discussions and exercises will center on the concepts of motivation and compliance in learning, learning/teaching styles, documentation, designing measurable goals, clinical teaching methods/techniques and tools, the art of effective communication, reinforcement strategies, principles of evaluation and giving effective feedback. Emphasis is placed on creating a climate that encourages learning. A teaching experience will be planned, implemented and evaluated by each student group. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6120 Cardiopulmonary Physical Therapy I (formerly 34.612) - Credits: 3

In Cardiopulmonary Physical Therapy students will learn the essentials of physical therapy examination, evaluation and intervention for patients with pathological cardiopulmonary conditions. The course emphasizes a problem solving, clinical decision-making approach. Successful completion of the course requires the ability to integrate and synthesize information from this course with prerequisite and other related courses in a variety of cardiopulmonary case based problem-solving experiences.

DPTH.6140 Cardiopulmonary Physical Therapy I Laboratory (formerly 34.614) - Credits: 1

Cardiopulmonary Physical Therapy Laboratory is taken concurrently with Cardiopulmonary Physical Therapy 34.612. The Laboratory experiences are designed to provide an opportunity to practice examination, evaluation, and interventions as discussed in lecture and demonstrate psychomotor proficiency in each procedure. The course emphasizes procedures employed by the physical therapist in dealing with cardiopulmonary conditions. In addition, students will be expected to integrate and synthesize information from related courses in a variety of cardiopulmonary problem
solving experiences. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6150 Clinical Education I Seminar (formerly 34.615) - Credits: 1

This course is the first in a series of two one-credit seminars. The first installment will provide an overview of the clinical education experience portion of the Doctor of Physical Therapy program. Topics include; the roles of clinical educators, the process of obtaining and assigning clinical sites, the clinical performance instrument (CPI), appropriate communication in the clinical setting, ethical practice, psychosocial aspects, and generic abilities.

DPTH.6160 Research Methods (formerly 34.616) - Credits: 3

This course presents the role of research in the development and critical analysis of physical therapy clinical practice. Students are guided through the process of clinical scientific research including the following content areas: philosophy of science and causation, problem and hypothesis identification, review and analysis of scientific literature, methods of hypothesis testing, data analysis and interpretation and critique/evaluation of research results.

DPTH.6170 Neurological Physical Therapy Lecture I (formerly 34.617) - Credits: 3

This course is the first of two courses dealing with the physical therapy management of adult patients/clients with neurological dysfunction. Concepts, practical applications, and strategies based on theories of motor skill development, motor control, and motor learning will be discussed. A variety of neurological conditions with different levels of impairments, activity limitations, and participation restrictions will be examined. Emphasis is on the development of clinical decision making skills using a problem solving approach. Practice is fostered in the development of appropriate plans of care. Concurrent laboratory classes emphasize the development of specific assessment and intervention skills.

DPTH.6190 Neurological Physical Therapy Laboratory I (formerly 34.619) - Credits: 1

This laboratory course must be taken concurrently with Neurological Physical Therapy I, DPTH.6170. Emphasis is on the development of problem solving and psychomotor skills necessary for successful management of the patient/client with neurological dysfunction. Videos and patient demonstrations are used to develop skills in examination, evaluation, and clinical decision making. Peer practice is used to promote the development of psychomotor skills in advanced therapeutic exercise and functional training. Problem solving in the application of interventions for different levels of impairments, activity limitations, and participation is stressed.

DPTH.6200 Neurological Physical Therapy II (formerly 34.620) - Credits: 3

This course is the second of two courses dealing with physical therapy management of adult patients/clients with neurological dysfunction. Concepts, practical applications, and strategies based on theories of motor skill development, motor control, and motor learning will be discussed. A variety of neurological conditions with different levels of impairments, activity limitations, and participation restrictions will be examined. Emphasis is on the development of clinical decision making skills using a problem solving approach. Practice is fostered in the development of appropriate plans of care. Concurrent laboratory classes emphasize the development of specific assessment and intervention skills.

DPTH.6210 Musculoskeletal Physical Therapy II Lecture (formerly 34.621) - Credits: 3

This course is the second of a three-course series which focuses on physical therapy management, and summarizes medical and surgical management of musculoskeletal dysfunction. The evaluation, treatment and prevention of pathological conditions affecting the upper extremity will be emphasized. Normal function will be included as a basis for recognizing and therapeutically resolving dysfunction of skeletal and joint structures, muscular and soft tissue. A problem-solving approach to resolve impairments, which contribute to activity limitations and participation restrictions, will be stressed.

DPTH.6220 Neurological Physical Therapy II Laboratory (formerly 34.622) - Credits: 1

This laboratory course must be taken concurrently with Neurological Physical Therapy II, DPTH.6200. Emphasis is on the development of problem solving and psychomotor skills necessary for successful management of the patient/client with neurological dysfunction. Videos and patient demonstrations are used to develop skills in examination, evaluation, and clinical decision making. Peer practice is used to promote the development of psychomotor skills in advanced therapeutic exercise and functional training. Problem solving using case studies in the application of interventions for different levels of impairments, activity restrictions and participation limitations is stressed.

DPTH.6230 Musculoskeletal Physical Therapy II Laboratory (formerly 34.623) - Credits: 1

This laboratory course develops the psychomotor skills to
allow clinical application of didactic knowledge gained in Musculoskeletal Physical Therapy II Lecture. The safe and effective performance of examination and treatment procedures are taught using demonstrations, peer practice, and case studies as they pertain to the shoulder, elbow/forearm, and wrist/hand regions of the body. Examination procedure are organized by body regions and include interview questions, observation, palpation, anthropometric measurements, goniometry, joint play mobility, muscle strength testing, and special test. Treatment procedures focus on integrating bandaging/taping, joint mobilization/manipulation, passive and active stretching techniques, and progressive strengthening exercises with principles taught.

DPTH.6250 Physical Therapy Interventions II
(formerly 35.625) - Credits: 3

This course is a study of advanced physical therapy procedures which utilize electrophysics and electrophysiology in evaluating and treating a variety of physical impairments. The course will emphasize theories and techniques used in electrodiagnosis, electromyography, functional electrical stimulation, iontophoresis, transcutaneous electrical stimulation, biofeedback, laser and therapeutic electrical currents including light and radar waves. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6260 Geriatric Physical Therapy (formerly 34.626) - Credits: 3

This course will focus on the special needs of the elderly and on the physical therapy management of the geriatric client. The physical changes associated with normal aging as well as pathological changes will be discussed and analyzed. Program planning will stress holistic consideration of the rehabilitative, cognitive/behavioral, and psychosocial needs of the elderly. (Re)Evaluation including functional evaluation, treatment planning (and treatment plan evaluation), treatment cost effectiveness, documentation, reimbursement issues will be analyzed as they relate to the physical therapy management of the geriatric client. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6270 Physical Therapy Interventions II Laboratory (formerly 34.627) - Credits: 1

This course is a practical application of theories and principles presented in 34.625, Physical Therapy Interventions II Lecture. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6280 Musculoskeletal Physical Therapy III
(formerly 34.628) - Credits: 3

This course provides the second-year physical therapy student with an introduction to physical therapy evaluation and management of dysfunction of the cervical, thoracic and lumbar spine, ribcage, and pelvis. The development of evaluation strategies, documentation skills, organized clinical decision making, and effective patient management techniques will be emphasized. Discussions and exercises will focus on developing patient diagnoses, functional problems lists, long and short-term goals, and treatment strategies. Critical thinking/problem solving strategies will be incorporated into all aspects of patient management. Emphasis will be on creating a climate that encourages learning. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6290 Directed Research (formerly 34.629) - Credits: 1-3

The directed research experience provides students with the opportunity to develop a research project with the guidance of a faculty advisor. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6300 Musculoskeletal III Laboratory (formerly 34.631) - Credits: 1

This laboratory course provides the student the opportunity to apply the didactic knowledge gained in the Musculoskeletal Physical Therapy II Lecture through a systematic clinical reasoning approach which focuses on the concept of-regional interdependence. Additionally, specific evidence-based evaluation and functional management techniques for the spine and pelvis will be demonstrated by instructors and practiced by students.

DPTH.6310 Pediatric Physical Therapy Lecture
(formerly 34.631) - Credits: 3

This course focuses on the development of the individual from the prenatal period through adolescence within the context of the individual’s family and cultural background. Emphasis will be on the examination, evaluation, diagnosis and formulation of a physical therapy plan of care for infants, children and adolescents with physical therapy related issues including wellness and prevention of disability. The framework for the course will be based upon principles of development, neural plasticity, motor control, motor learning, pediatric clinical decision making, the WHO ICF, and evidence directed care including clinical practice guidelines. Throughout the course the student will have the opportunity to integrate the course material and synthesize appropriate plans of care using cases.

DPTH.6330 Pediatric Physical Therapy Laboratory
(formerly 34.633) - Credits: 1
Through classroom and clinical laboratory experiences, the student will gain introductory level skill in the examination, evaluation, intervention, and development of a physical therapy plan of care for infants, children, and adolescents who have or are at risk for developing disabling problems requiring physical therapy intervention. Preventive and wellness strategies will also be developed and discussed. Problem solving and evidence directed practice including Clinical Practice Guidelines will be emphasized.

DPTH.6350 Clinical Education II Seminar (formerly 34.635) - Credits: 1
This course is the second in a series of two one-credit weekly seminars. The class will continue to explore the professional issues and application of didactic material in the clinical setting. Clinical education will be examined from the perspective of career development and physical therapy board preparation.

DPTH.6370 Integrating Clinical Practice (formerly 34.637) - Credits: 3
This course will focus on integrating clinical reasoning skills in physical therapy with an emphasis on application of evidence-based research and current concepts of disablement. Students will share clinical experiences focusing on utilization of best practices and Clinical Practice Guidelines.

DPTH.6390 Medical/Surgical - Orthopedics (formerly 34.639) - Credits: 3
Medical Surgical conditions (Orthopedics) presents topics related to the pathology and medical-surgical treatment of musculoskeletal disorders. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6400 Professional Prep in PT (formerly 34.640) - Credits: 3
This course will focus on facilitating the students' transition into the Physical Therapy Profession including successful completion of the professional licensure examination, the National Physical Therapy Exam: Student groups will outline and present review materials for the exam to each other including a list of sources for further study. The faculty facilitator will oversee the development and content of the presentations and supervise practice examinations. Students are guided through reflection in practice, development of a personal professional development plan, a Vision and Mission Statement including continuing education, pro bono and community service and participation in the American Physical Therapy Association. Other topics will include strategies for successful interviewing.

DPTH.6410 Business Skills in Physical Therapy (formerly 34.641) - Credits: 2
This course provides an overview of the operation of physical therapy services. The course will emphasize a micro approach concerning issues and trends related to the delivery of health care and their implications for the management of physical therapy services. Key issues will include facilities design and clinic organization, personnel management, budgeting, and operations management. Topics related to the key issues will include: marketing, quality improvement, utilization review, legal and ethical issues such as sexual harassment, and integration of the Guide to Physical Therapy Practice and the LAMP (Leadership, Administration, Management, and Professionalism) document with respect to these topics. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6420 Health Policy & Admin (formerly 34.642) - Credits: 3
This course explores the social, political, and economic policies that impact the delivery of physical therapy services and health. The course underscores the issues of professionalism, leadership, management, and the advocacy to foster excellence in autonomous practice for the benefit of members and society. The course emphasizes leadership in promoting cultural competence, global health initiatives, social responsibility, effective application of technology, and health services research.

DPTH.6430 Evidence Directed Care (formerly 34.643) - Credits: 3
This course presents the role of evidence in the development and critical analysis of physical therapy clinical practice guidelines and practice recommendations. Students are guided through the process of analyzing, weighing, comparing and integrating sources of evidence. Methods of integrating various forms of evidence that will be specifically covered include literature reviews, meta-analyses, systematic reviews, clinical prediction rules and clinical practice guidelines.

DPTH.6440 Clinical Education Fieldwork II (formerly 34.644) - Credits: 1
This is the continuance of Directed Research experience providing students with the opportunity to complete and present a research project with the guidance of a faculty advisor. All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6450 Physical Interventions III (formerly...
34.645) - Credits: 3

This course introduces the second year physical therapy student to various topics related to specialized physical therapy management of patients. Topics include, but are not restricted to: lower extremity prosthetic and orthotic management, hand orthotic fabrication, inhibitive casting techniques, introduction to ergonomic principles, ergonomic design of seating systems and workstations, wheelchair seating systems, cumulative trauma disorders, work site analysis, functional capacity evaluation, lumbar stabilization exercises, the acute care environment, burn care management, post-mastectomy management, and infection control and standard precaution policies.

DPTH.6460 Complex Cases in Physical Therapy (formerly 34.646) - Credits: 3

This course, which runs concurrently with Clinical Education Experience III (DPTH.6530), is designed to promote evidenced-based practice, intra-professional correspondence, and further socialization into the profession of physical therapy. Students are expected to incorporate evidence based practice in real-time clinical practice whenever possible and speak to the implementation, progress, and outcome(s) via on-line posting of related case studies. Furthermore, students are expected to critically evaluate the degree to which the current evidence supports or conflicts with the common practice intervention. Additionally, students will critically evaluate their classmate’s cases study postings offering feedback regarding the efficacy of treatment as they understand and interpret it from the current literature.

DPTH.6470 PT Interventions III Lab (formerly 34.647) - Credits: 1

All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6480 Service Learning in Physical Therapy (formerly 34.648) - Credits: 3

This three-credit course is designed to serve as a service-learning experience in the final year for doctoral physical therapy students. The course is designed to provide relevant and meaningful service opportunities for culturally competent physical therapy services with a focus on prevention, health promotion, fitness, and wellness to individuals, groups, and communities. The service learning experience will prepare students for active civic participation in a diverse society. Through the use of readings, discussion, reflection and presentations students will gain an understanding what it means to build the capacity of a community and develop the competency skills of an entry level physical therapy practitioner.

DPTH.6500 Clinical Education Experience I (formerly 34.650) - Credits: 3

A ten-week full time clinical education experience designed to integrate basic physical therapy evaluation and treatment procedures with an emphasis on the musculoskeletal and cardiopulmonary systems. Students are directly supervised by licensed physical therapists in acute care and outpatient settings.

DPTH.6510 Sectional Human Anatomy (formerly 34.651) - Credits: 3

Sectional Human Anatomy is a study of the structures of the human body as revealed through Computed Tomographic images. It is a foundational course for the medical physics program.

DPTH.6520 Clinical Education Experience II (formerly 34.653) - Credits: 3

This twelve-week full time experience promotes the development of an autonomous professional through the synthesis and utilization of advanced academic theory in evaluation and treatment. Students are expected to use sound scientific rationale and a problem solving approach in all aspects of patient care. Students are allowed to explore areas of interest in a variety of settings.

DPTH.6530 Clinical Education Experience III (formerly 34.653) - Credits: 3

This terminal, twelve-week, clinical education experience is designed as the final promotion of complete socialization and transition into the profession of physical therapy. Students are expected to function as independently as possible using problem solving processes as a basis for all clinical decision making. Communication, coordination, and consultation with other members of the health care team and responsibility for complete patient management are emphasized.

DPTH.6540 Clinical Education Experience IV (formerly 34.654) - Credits: 3

(Spring, 3rd year) The final full time eight-week clinical experience is designed to promote socialization into the profession of physical therapy. Students are expected to function as independently as possible using the problem solving process as a basis for all clinical decision making. Communication, coordination and consultation with other members of the health care team and responsibility for total client management is emphasized. Settings in pediatrics, neurological rehabilitation, outpatient orthopedics and acute care facilities are appropriate for this experience. All physical
therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6580 Independent Studies (formerly 34.658) - Credits: 3

All physical therapy graduate courses (number 34.) are restricted to PT majors only.

DPTH.6590 Sectional Human Anatomy Laboratory (formerly 34.659) - Credits: 1

Sectional Human Anatomy Laboratory provides training in the recognition of anatomical structures from CT images, and the direct translations among CT images, Body surface features, and cadaveric structures.

DPTH.6600 Directed Research (formerly 34.660) - Credits: 2

Directed Research toward the DPT degree.

EXER.5010 Physiological Dynamics (Formerly 38.501) - Credits: 3

This course will provide intermediate to advanced coverage of physiological dynamics. A myriad of complex dynamics underlie health and disease and represent highly integrated regulatory systems with cycles, oscillations and feedbacks across time and scale. Physiological Dynamics will teach students basic tools for analyzing the dynamics of the physiological systems; and to identify normal dynamics and relate altered dynamics to disease. The course will focus on the interpretation of physiological dynamics in understanding healthy response to exercise, stress, fatigue and disease. Topics will include physiological origins and implications of: the normal electrocardiogram (ECG); common ECG abnormalities, temporal variations in the physiological system (heart rate variability, blood pressure variability, blood flow, pulse transit time); and multi level relationships between components of physiological regulation. A common theme will be the added clinical information associated with understanding the temporal and spatial dynamics of the physiological systems. Temporal dynamics will include both short cycle dynamics (days to weeks) as well as longer range cycles (i.e. the life cycle). Spatial dynamics will include multi level - bidirectional interactions that emerge through cell, organ, system, organism, and environmental scales. There will be an emphasis on the important recurrent feedback loops between human and environment in long-term health trajectories and transitions from health to disease and from acute disturbances to chronic conditions.
Department of Community Health & Sustainability

The UMass Lowell Department of Community Health and Sustainability offers the following graduate programs:

- Master of Science in Health Informatics and Management
- Graduate Certificates Health Informatics and Health Management

Mission

The mission of the department is to prepare individuals to become public health professionals and researchers who work to create a sustainable future. Our approach provides the foundation for the design, implementation, and evaluation of policies, programs, and technologies, with a curriculum and research focus based on the behavioral and social determinants of health. Our programs encompass the areas of Community Health, Health Promotion, Environmental Health, Occupational Health, Health Management, Health Informatics and Health Policy.

Public Health Graduate Program

Program Mission

To advance the health and wellbeing of all communities and individuals in the Commonwealth of Massachusetts and beyond through transdisciplinary:

- Education to prepare diverse public health leaders who can advance health in all policies
- Research that transforms public health science and policy
- Collaborations with diverse communities to attain the highest level of health for all people

The Department of Public Health offers the following graduate programs:

Master of Science in Health Informatics and Management (MS)

- Option in Health Informatics
- Option in Health Management

Master of Science in Work Environment (MS)

- Option in Occupational and Environmental Health
- Option in Occupational Ergonomic and Safety

Doctor of Science in Work Environment (ScD)

- Option in Occupational and Environmental Hygiene
- Option in Epidemiology
- Option in Ergonomics / Safety
- Option in Work Environment Policy
- Option in Cleaner Production and Pollution Prevention

Graduate Certificates

- Health Informatics
- Health Management
- Public Health Studies

Public Health Graduate Program

Master of Public Health (MPH)

- Program Description
- Admissions Requirements
- Option in Dietetics (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Option in Epidemiology (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Public-Health/MPH-Epidemiology.aspx)
- Option in Population Health (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Public-Health/MPH-Population-Health.aspx)
- Option in Healthcare Management (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Public-Health/MPH-HMO.aspx)
- Option in Nutrition (http://www.uml.edu/Catalog/Graduate/Health-Sciences/Public-Health/MPH-Nutrition.aspx)
Program Description
The Master of Public Health program is a 42-credit post-Baccalaureate program with four specialization options: Epidemiology, Healthcare Management, Nutrition and Population Health. The program accepts both full and part-time students and provides students with knowledge essential to the practice of public health on a global scale. Students develop a strong foundation in public health by studying biostatistics, environmental health issues, epidemiology, health policy and management and social and behavioral determinants of health, as well as study in specialization areas so that graduates gain the expertise necessary to address some of the world's most pressing problems.

Graduates of the MPH program will:
- Analyze public health literature and apply evidence-based practices to public health issues.
- Identify, quantify and then promote reduction of the harmful impacts of current and emerging technologies on health.
- Address current public health challenges through multidisciplinary approaches that apply the latest scientific knowledge, collaboration, and creative problem-solving skills.

Admission Requirements
- An application completed online at [www.uml.edu/grad/](http://www.uml.edu/grad/)
- Transcripts from a completed BA or BS degree in any field, or senior-year status, with an overall GPA of at least 3.0.
- Grades of C or better in required, prerequisite college-level courses. These include a minimum one semester of statistics and one semester of either biology or anatomy and physiology. Applicants who are missing prerequisites may be admitted with the provision that they meet with their advisor before or during their first semester and develop a plan of study to complete the prerequisites during the first year.
- Three Letters of recommendation from individuals able to judge an applicant's readiness for graduate study.
- A statement of purpose, typically a 1-2 page document providing information about the applicant's future plans, a description of how the MPH degree fits into these plans and evidence of an applicant's readiness for graduate study.
- GRE score. The GRE requirement may be waived with a prior graduate degree or successful completion of the 12-credit Graduate Certificate in Public Health Studies with a GPA of at least 3.5.

For International Applicants
- TOEFL scores of at least 79 (Internet-based) are required.
- Transcripts from colleges outside the United States must be certified by a credentialing agency such as WES ([www.wes.org](http://www.wes.org)) or CED ([www.cedevaluations.com](http://www.cedevaluations.com)). To receive prerequisite credit for undergraduate courses in statistics, biology or anatomy and physiology, the document must be a course-by-course certification, not simply a general summary evaluation of a degree program.

All other materials required for a completed graduate application package as defined by the Graduate Admissions Office.

Master of Science in Health Informatics and Management

- Program Objectives
- Admission Requirements
- Degree Requirements
- Capstone Project Requirement
- Other Questions

The Health Informatics and Management Program offers a masters degree in the following concentrations:
- Health Informatics
- Health Management

Program Objectives
At the local, regional and national level, our healthcare system confronts new challenges in coping with the many changes in technology, information systems, financing and management. For many health industry professionals seeking career advancement, a Masters Degree is often required. Moreover, according to the Bureau of Labor Statistics, the employment of medical and health services managers is predicted to grow much faster than average through 2022.

The Health Informatics and Management (HI+M) program predominantly enrolls mid-career professionals working within health provider and other health-related organizations. Many students complete a Graduate Certificate before seeking admission to the Masters Degree program, and the Certificate courses are accepted as credits toward the Masters Degree.

UMass Lowell is one of the largest accredited online education providers in New England. The program was developed under a blended learning grant from the Alfred P. Sloan Foundation and its Sloan-C initiative, the HI+M program offers graduate studies in a new blended format that offers the “best of both worlds” combining face-to-face and online classes and provides a more accessible program of study for busy professionals. More recently, our graduate certificate in health Informatics is being offered online and provides students with a flexible opportunity to expand their educational preparations in the area of Health Informatics.

Admission Requirements

1. Official transcript indicating graduation from an accredited baccalaureate institution.
2. Three letters of recommendation addressing academic ability and professional performance.
3. A page-length Statement of Purpose indicating career plans, interests and objectives in pursuing a graduate degree.
4. A professional resume.
5. Acceptable scores on the Graduate Record Examination (GRE). If a student has already completed an HI+M Graduate Certificate program with a grade point average of 3.5 or better, the GRE is not required.
6. TOEFL scores must be submitted if the applicant is a citizen of a non-English speaking country and has not earned an academic degree in the United States. (Minimum score: 79).

Although a background in health is not required for admission, applicants with significant health industry experience are given preference when program capacity is limited. For other applicants, ones academic record and professional work experience are especially important. Applications can be submitted and evaluated at any time. We nevertheless recommend that those seeking admission for the Fall semester have applications complete by May 15, and that those seeking admission for the Spring semester have applications complete by December 15. All application materials go to Graduate Admissions.

Degree Requirements

Thirty-six credits (eleven 3-credit courses, plus a 3-credit Capstone Project) are required to obtain the Masters Degree. The specific course requirements are indicated below, separately for Health Informatics and Health Management. Some course substitutions may be allowed based on prior academic and work experience.

Health Informatics Concentration:

Health Informatics students are required to take the following six courses:
- PUBH.5020 Organizational Behavior in Healthcare
- PUBH.5110 Healthcare Finance
- PUBH.5120 Operations Analysis and Quality Improvement
- PUBH.5140 Healthcare Management
- PUBH.6160 Law and Ethics in Healthcare
- PUBH.7330 Capstone Project

Health Informatics students additionally take the following six Health Informatics courses:
- PUBH.5310 Health Informatics
- PUBH.6070 Healthcare Information Systems
- PUBH.6320 Health Information Systems Planning
- PUBH.6330 Healthcare Database Design
- PUBH.6350 Healthcare Project Management
- PUBH.6380 Strategic Planning in Healthcare and HIT
- PUBH.6390 Electronic Health Record Systems

Health Management Concentration:

Health Management students are required to take the following nine (9) courses:
- PUBH.5020 Organizational Behavior in Healthcare
- PUBH.5060 Quantitative Methods in Healthcare Management
- PUBH.6070 Healthcare Information Systems
Health Management students additionally take three of the following courses as electives:

- PUBH.5150 Applied Health Economics
- PUBH.5270 Planning and Marketing in Healthcare
- PUBH.6260 Leadership in Healthcare
- PUBH.6270 Socioeconomic Inequalities in Health
- PUBH.6320 Health Information Systems Planning
- PUBH.6330 Healthcare Database Design
- PUBH.6350 Healthcare Project Management
- PUBH.6380 Strategic Planning in Healthcare and HIT
- PUBH.6390 Electronic Health Record Systems

Capstone Project Requirement

Near the end of their Masters Degree program, students register for the Capstone Project course and complete an independent study under faculty supervision. The Capstone Project applies concepts and skills learned in the program, and culminates in a substantial business-type report. Many students complete a Capstone related to their work in the field. For students who don’t work in healthcare, Capstone internships can be arranged. All Capstone students present their findings at a semester-end program event that is open to all.

For General Questions or Program-Specific Questions

Sandra Guy-VanAmburgh, MPA, RHIA, CCA, CHPA
(mailto:sandra_guyvanamburgh@uml.edu)
Visiting Professor - Department of Public Health
Phone: 978-934-5437

Master of Science in Work Environment

This program is not accepting new applicants at this time.

Master of Science

- Program Description
- Program Objectives
- Admission Requirements

Course Requirements

- Option in Occupational and Environmental Health
- Option in Occupational Ergonomic and Safety
- Dual Option in Occupational and Environmental Health and Occupational Ergonomic and Safety

Program Description

Our Program provides training and research on the identification, characterization and control of chemical, physical, psychosocial and biological risks associated with work environments as well as in understanding and developing respect for the complex social, political and economic context in which environmental and occupational health problems must be studies and addressed. Our model of research and education integrates a rigorous scientific methodology with practical collaboration with the region’s industry, labor, communities and governments to design safer and cleaner systems of production.

Graduates of the Master of Science program will be prepared to become prevention practitioners in one of two work environment options (occupational and environmental hygiene [OEH] or occupational ergonomics/safety [OES]). A dual option master’s degree that combines these two options is also possible by completing all required courses for both options.

Program Objectives

Work Environment Master’s program is specifically designed to achieve the following educational objectives:

1. Technical Competence: Demonstrate a high level of technical and scientific competence in the application of the fundamentals of recognition, evaluation, control and prevention of occupational and environmental hazards.
2. Analytic Competence: Demonstrate the ability to solve complex problems through observation, literature review, measurement and data analysis.
3. Effective Communication: Utilize effective oral and written communications to interact with technical and lay audiences around occupational and environmental health issues.
4. Effective Teamwork: Work independently and as part of an occupational and environmental health team to address complex problems in occupational and environmental health.
5. Ethical Practice: Understand the moral, ethical, legal and
Admission Requirements

- An application completed online at the Graduate Admissions page (http://www.uml.edu/grad/).
- Transcripts from a completed BA or BS degree in any field, or senior-year status, with an overall GPS of at least 3.0.
- Grades of C or better in required, prerequisite college-level courses. At least one year of college-level math and science (statistics, human physiology or anatomy, organic chemistry and physics highly recommended).
- Three letter of recommendation of individuals able to judge an applicant’s readiness for graduate study.
- A statement of purpose, typically a 1-2 page document providing information about the applicant's future plans, a description of how the MS degree fits into these plans and evidence of an applicant’s readiness for graduate study.
- A professional resume.
- GRE scores. The GRE requirement may be waived with a prior graduate degree or with successful completion of a College of Health Science certificate or completion of 4 required graduate courses with a GPA of ≥ 3.3 (B+).

For International Applicants

- TOEFL scores of at least 79 (internet based) are required.
- Transcripts from college outside the United States must be certified by a credentialing agency such as WES (http://www.wes.org) or CED (http://www.cedevaluations.com). To receive prerequisite credit for undergraduate courses in statistics, biology or anatomy and physiology, the document must be a course-by-course certification, not simply a general summary evaluation of a degree program.

All other materials required for a completed graduate application package as defined by the Graduate Admissions Office.

Accelerated Bachelor’s-Master’s Program

For UMass Lowell undergraduate degree students to continue their studies towards an advanced degree. Please see the Accelerated Bachelor’s-Master’s Program for details.

For Keene State undergraduate degree students to continue their studies towards an advanced degree. We have an articulation agreement with Keene State. Please see the Accelerated Bachelor’s-Master’s Program for details.

Course Requirements

Occupational and Environmental Hygiene (OEH)

With your master's degree in OEH, you'll have the tools to no only keep people healthy, but also productive at work. You'll learn to diagnose exposure problems, develop sampling strategies, and collect and measure samples to diagnose environmental risk factors that threaten worker health and safety. You'll also study how to design and implement more sustainable production systems.


Public Health Core Courses

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<th>Course#</th>
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<tr>
<td>PUBH.5030</td>
<td>Ergonomics and Work</td>
<td>3</td>
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<tr>
<td>PUBH.5510</td>
<td>Work Environment Policy &amp; Practice</td>
<td>3</td>
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<tr>
<td>PUBH.5750</td>
<td>Introduction to Epidemiology</td>
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<tr>
<td>PUBH.6000</td>
<td>Capstone I / Practicum I</td>
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<td>PUBH.6010</td>
<td>Capstone II / Practicum II</td>
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Hygiene Option Courses

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<td>Introduction to Epidemiology</td>
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<tr>
<td>PUBH.6000</td>
<td>Capstone I / Practicum I</td>
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<tr>
<td>PUBH.6010</td>
<td>Capstone II / Practicum II</td>
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Ergonomics and Safety Option Courses

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<tr>
<td>PUBH.5300</td>
<td>Ergonomics and Work</td>
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<td>PUBH.5311</td>
<td>Occupational Biomechanics</td>
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<tr>
<td>PUBH.5400</td>
<td>Occupational Safety Engineering</td>
<td>3</td>
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<tr>
<td>PUBH.6140</td>
<td>Evaluation of Work Environmental Hazards</td>
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Public Health Electives

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<tr>
<td>PUBH.XXXX</td>
<td>Public Health Elective I</td>
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Dual Option in Occupational and Environmental Hygiene and Occupational Ergonomics and Safety

A dual option master's degree that combines these two options is also possible by completing all required courses for both options. This dual option will require a total of 39 credits with no electives. Other dual options are available by combining Occupational and Environmental Hygiene or Occupational Ergonomics and Safety with Occupational and Environmental Epidemiology, Cleaner Production/Pollution Prevention or Work Environment Policy.


Note: Part-Time plans of study can be arranged in consultation with an academic advisor. Full-time plans of study that begin in the spring semester will include the same courses taken in a slightly different order.
Graduate Certificate Programs in Health Informatics and Management

HI+M Certificate Requirements

The Health Informatics and Management (HI+M) program offers four-course Graduate Certificates in three different areas:

1. Health Management
2. Health Informatics

Many students complete one of these Certificates before seeking admission to the HI+M Masters degree program, as the Certificate courses are accepted as credits toward the Masters degree. Moreover, students who complete a Graduate Certificate with a grade point average of 3.5 or better are not required to take the Graduate Record Exam in applying for admission to the MS program.

UMass Lowell is one of the largest accredited online education providers in New England. As developed under a blended learning grant from the Alfred P. Sloan Foundation and its Sloan-C initiative, the HI+M program offers graduate studies in a new blended format that offers the best of both worlds—combining face-to-face and online classes—providing a more accessible program of study for busy healthcare and IT professionals.

Admission Requirements

1. Official transcript indicating graduation from an accredited baccalaureate institution.
2. A one-page statement of purpose indicating career plans, interests and objectives in pursuing a graduate degree.
3. A professional resume.
4. TOEFL scores must be submitted if a citizen of a non-English speaking country and have not earned an academic degree in the United States (Minimum Score: 79).

Although a background in health is not required for admission, applicants with significant health industry experience are given preference when program capacity is limited. For other applicants, one’s academic record and professional work experience are especially important. Applications can be submitted and evaluated at any time. We nevertheless recommend that those seeking admission for the Fall semester have applications complete by May 15, and that those seeking admission for the Spring semester have applications complete by December 15. All application materials go to Graduate Admissions.

Health Management Certificate

The Health Management Certificate is offered primarily as a continuing education opportunity for health industry professionals interested in pursuing career advancement. It teaches core skills required in healthcare management and helps students gauge interest and prospects for continuing with a full 12-course MS program.

Required Courses:

- PUBH.5110 Healthcare Finance
- PUBH.5140 Healthcare Management

Elective Courses (choose two):

- PUBH.5060 Quantitative Methods in Health Management
- PUBH.5020 Organizational Behavior in Healthcare
- PUBH.5310 Health Informatics
- PUBH.6070 Healthcare Information Systems
- PUBH.5120 Operations Analysis and Quality Improvement
- PUBH.5150 Applied Health Economics
- PUBH.6160 Law and Ethics in Healthcare
- PUBH.6250 Health Policy
- PUBH.5270 Planning and Marketing in Healthcare
- PUBH.6260 Leadership in Healthcare
- PUBH.6270 Socioeconomic Inequalities in Health
- PUBH.6320 Health Information Systems Planning
- PUBH.6330 Healthcare Database Design
- PUBH.6350 Healthcare Project Management
- PUBH.6390 Electronic Health Record Systems

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Health%20Management%20-%20%2051.0701-Gedt.html).

Health Informatics Certificate

The Health Informatics Certificate is primarily meant to provide healthcare professionals with the requisite skills and understanding required to support health IT initiatives where they already work.

Required Courses:
Elective Courses (choose two):

- PUBH.6320 Health Information Systems Planning
- PUBH.6330 Healthcare Database Design
- PUBH.6350 Healthcare Project Management
- PUBH.6380 Strategic Planning in Healthcare and HIT
- PUBH.6390 Electronic Health Systems

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Health%20Informatics%20-%2051.0701-Gedt.html)

For General Questions

Sandra Guy VanAmburgh
Department of Public Health
Zuckerberg College of Health Sciences
Email: Sandra_GuyVanAmburgh@uml.edu
Phone: 978-934-5437

Graduate Certificate in Public Health Studies

- Overview
- Admission Requirements
- Required Courses
- Elective Courses

Overview:

The field of public health is ever changing and expanding. It has played a major role in promoting the health of the nation, the world and in extending life expectancy. It is expected that the growing demand for public health professionals will confront a critical shortage in the near future. A four-course, 12 credit Graduate Certificate Program in Public Health Studies is intended for individuals with diverse health, natural science and social science backgrounds who are interested in careers in public health. The courses offered in the certificate program are foundation courses in the MPH program. The certificate is expected to serve as a conduit into the MPH Program for students who are not yet ready for application/admission. The certificate program will enable students to decide whether they should apply to a 42 credit MPH program. The graduate certificate will also provide students in the health care field with the additional course work to advance careers in the area of public health.

Students who successfully complete the Graduate Certificate in Public Health at UMass Lowell with a GPA of 3.3 or higher may waive the GRE requirement if applying to the MPH program. Upon acceptance into the MPH program, the 12 credits from the Graduate certificate in Public Health with a course grade of 3.0 or higher may be transferred into the MPH degree program.

Admission Requirements:

- Baccalaureate degree from an accredited institution with a minimum GPA of 3.0
- Completed Certificate Application form
- Official Transcript from the baccalaureate institution
- Completed undergraduate courses in Statistics and either Biology or Anatomy and Physiology with grades of C or above.
- Citizens of non-English speaking countries who have never earned an academic degree in the United States must submit TOEFL scores.

For more information please contact: Leland Ackerson, Ph.D. at Leland_Ackerson@uml.edu.

Required Courses (3 Credits):

- PUBH.5750 Epidemiology and Biostatistics

Elective Courses (Choose Three 3-credit courses - total of 9 credits):

- PUBH.5021 Public Health Policy
- PUBH.5010 Social and Behavioral Determinants of Health
- PUBH.5061 Environmental Health
- PUBH.5070 Leadership and Management in Public Health

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Public%20Health%20Laboratory%20Sciences%20-%2051.2299-Gedt.html).

Doctor of Science in Work Environment
The UMass Lowell Department of Public Health offers a doctoral program that focuses on occupational and environmental hygiene, ergonomics and safety, epidemiology, work environment policy and cleaner production, pollution prevention.

Admission Requirements

Doctoral training is built upon the substantial didactic training gained in the masters degree programs. To be eligible for admission to a doctoral program, an applicant will need to demonstrate appropriate undergraduate education with adequate preparation in quantitative sciences and a master’s degree in work environment or a related field. He or she will need to provide a minimum of three letters of reference attesting to the ability to perform advanced graduate work and to provide a written statement of career objectives and the relationship of doctoral training to those objectives. Evidence of academic ability must be provided in the form of undergraduate and graduate transcripts detailing an acceptable grade point average (generally a minimum of 3.0, with 3.5 in quantitative sciences). Performance on the Graduate Record Examination Aptitude Test must be at a high level. Discussions and visits with potential faculty advisors are encouraged and an interview may be required.

Academic Advisor

For a doctoral candidate, the primary responsibility for evaluating progress will rest with the students academic advisor along with the Dissertation Committee. Upon matriculation, the student will be assigned an advisor in conjunction with the Graduate Student Coordinator and the student. The advisor must be from among the faculty of the Work Environment Program. The advisor will assist the student in complying with all the university requirements in achieving eligibility for the degree, including selection of courses and aiding in the development of the dissertation.

Requirements for the Doctoral Degree

Degree requirements include: six to eighteen credit hours of courses beyond the masters degree plus twelve to 24 credits of dissertation research for a total of 30 post-master’s credit hours. A student with a masters degree from another institution will need to show knowledge in all subject areas required for the equivalent Work Environment masters degree from the University of Massachusetts Lowell. Courses will be selected to ensure each student has met all the major master’s competencies and is adequately prepared in research methods and background needed for their dissertation. At least two semesters of Advanced Research methods (PUBH.6050) and 1 semester of Work in Progress Seminar (PUBH.6090) are required of all doctoral students. There is no language requirement but each major area may require additional advanced research methods courses. The student will work with a doctoral program advisor to propose a set of courses to meet the requirements and to prepare a preliminary thesis proposal. Following completion of all required course work, the student will be eligible to take a written qualifying examination. The exam will be designed to test the knowledge in the major field. Upon meeting the course and written exam requirements, the student must pass an oral qualifying exam based on his or her written dissertation proposal.

Doctoral Dissertation

The doctoral dissertation will be based on a substantial body of original research carried out by the candidate. The selection of the research topic will be the responsibility of the student in consultation with the academic advisor. The student and advisor will develop a Dissertation Committee of at least 3 faculty members, with at least two from the Department of Work Environment. The committee will review the student’s progress and approve the dissertation. The dissertation will, in general, be in the form of three publishable manuscripts and will include an appropriate literature review and overview of the dissertation research. At a minimum, one of these manuscripts must be submitted to a peer-reviewed journal before graduation. The student is required to give an oral defense of the dissertation before the Committee and other faculty members. The defense is open to the public.

Occupational and Environmental Hygiene

Likely areas of research include: Exposure science and biomarkers, exposure hazards and controls in health care, indoor air & healthy buildings, exposure hazards and controls in nanotechnology, sampling & analytical methods for airborne contaminants, exposure assessment for epidemiology, noise hazard assessment and control, toxic use reduction or integration of sustainable production an occupational hygiene, exposure hazards an controls in construction.

Occupational Ergonomics and Safety

Areas of doctoral research include: Field evaluation of ergonomic and safety exposures and hazard surveillance, biomechanical modeling, psychophysical methods for exposure assessment; technical and social factors in reorganizing work; strategies for injury prevention and control; macroergonomics, evaluation of control measure effectiveness.

Epidemiology

Examples of areas of research in which doctoral work is encouraged include: respiratory epidemiology, injury epidemiology, exposure modeling for epidemiology, occupational disease surveillance, epidemiology and musculoskeletal disease and occupational cancer epidemiology.

Work Environment Policy
Areas of research include: International occupational and environmental health policies, economic impacts of occupational injury and illness, integration of materials policy and health policy, environmental justice, an urban ecology, labor and technology, occupational health and labor/management programs, alternative methods of risk assessment, health and safety impacts of new technologies, management of chemical information, toxic use reduction.

Cleaner Production and Pollution Prevention

Areas of research include: sustainable product design, integrated product policy, green chemistry, product take back, ecological taxes, materials policy, sustainability indicators in the workplace, environmental management systems and integrating occupational health and pollution prevention.

Master of Science in Work Environment - Professional Science Master's (PSM) Options

Applications are no longer being accepted for the PSM in Work Environment program.

Professional Science Masters Options in Work Environment

The Work Environment Profession Science Master’s Options are 36 credits, interdisciplinary, and problem-focused. Graduates learn to recognize, evaluate and control occupational and environmental health and safety issues. Technical preparation in such fields as statistics, toxicology, aerosol physics, analytical chemistry, and biomechanics is taught with direct applications to the identification, control and elimination of health and environmental hazards. Students also learn the dynamics of the workplace; the sociology, political science and economics of systems of production.

The Work Environment PSM options follow the same courses as the current masters degree programs with the addition of a one credit internship for students who do not have substantial professional work experience in their field.

Admission Requirements

The admission requirements are the same as in the current masters degree program:

- Baccalaureate degree from an accredited university or college with a recommended GPA of 3.0 or better.
- Graduate Record Examination Aptitude Test (GRE). For students who graduated from a university in a country where English is not the official language, TOEFL scores should be at least 550 (paper-based), 213 (computer-based), or 79 (internet-based).
- Documentation of good writing ability.
- Prerequisite technical courses (with a grade of C or better) must include: For the Occupational and Environmental Hygiene Program, one semester courses in mathematics (calculus or statistics preferred), general chemistry, organic chemistry, biology and physics. For the Ergonomics &Safety program, one semester courses in mathematics (calculus preferred), biology and physics. For the Epidemiology and Cleaner Production &Pollution Prevention programs, one semester courses in mathematics (statistics preferred) and human biology.
- faculty committee will evaluate each applicant's application materials including GPA, GRE, TOEFL, experience, recommendations and essay. Meeting minimum requirements does not guarantee acceptance. In some cases, applicants who do not meet all entry requirements may be admitted if they have completed 9 credits of Work Environment courses, all with a B+ or better as a non-matriculated student.

Curriculum

STEM Courses (24 credits total)

STEM Required Courses for ALL PSM options (9 Credits):

- PUBH.5030 Toxicology and Health (3 credits)
- PUBH.5250 Introduction to Industrial Hygiene and Ergonomics (3 credits)

STEM Required SPECIALIZATION Courses (15 Credits)

Occupational &Environmental Hygiene

- PUBH.6160 Exposure and Risk Assessment (3 credits)
- PUBH.5400 Occupational Safety Engineering (3 credits)
- PUBH.6140 Evaluation of Work Environment Hazards (3 credits)
- PUBH.6150 Solutions to Work Environment Hazards (3 credits)
- PUBH.6190 Measurement of Chemical Exposures 5 (3 credits)

**Ergonomics and Safety**
- PUBH.5310 Occupational Biomechanics (3 credits)
- PUBH.5400 Occupational Safety Engineering (3 credits)
- PUBH.6380 Methods in Work Analysis (3 credits)
- Plus 2 STEM electives (6 credits)

**Cleaner Production/Pollution Prevention**
- PUBH.5570 Toxic Use Reduction (3 credits)
- PUBH.6100 Exposure Assessment (3 credits)
- PUBH.6590 Cleaner Production Principles (3 credits)
- Plus 2 STEM electives (6 credits)

**Epidemiology**
- PUBH.6820 Applied Epidemiologic Methods (3 credits)
- PUBH.6100 Exposure Assessment (3 credits)
- MATH.5910 Linear Modeling & Regression Methods (3 credits)
- PUBH.6870 Quantitative Models for Public Health (3 credits)
- PUBH.6890 Advanced Regression Modeling (3 credits)

(Other Graduate level courses outside of the Department of Work Environment may be chosen as STEM electives with advisory committee approval.)

**PLUS courses (9 credits total)**

**PLUS Required Course for all PSM Options (3 credits):**
- PUBH.5000 Analytical Context of the Work Environment

**PLUS BUSINESS SPECIALIZATION Courses (6 credits total):**

**Occupational & Environmental Hygiene**
- PUBH.6510 Work Environment Policy and Practice (3 credits)
- 1 PLUS elective (3 credits)

**Ergonomics and Safety**
- PUBH.5420 Human Factors (3 credits)
- 1 PLUS elective (3 credits)

**Cleaner Production/Pollution Prevention**
- PUBH.5500 Environmental Law & Policy (3 credits)
- PUBH.6510 Work Environment Policy and Practice (3 credits)

**Epidemiology**
- 2 PLUS electives (6 credits)

**Approved PLUS Elective Courses:**

**Business of Work Environment:**
- PUBH.5420 Human Factors (3 credits)
- PUBH.5500 Environmental Law & Policy (3 credits)
- PUBH.6400 Macroergonomics (3 credits)
- PUBH.6410 Principles of Accident Causation and Prevention (3 credits)
- PUBH.6430 Healthy Work Organization Design (3 credits)
- PUBH.6510 Work Environment Policy and Practice (3 credits)
- PUBH.6540 Work, Technology and Training (3 credits)

**Business Fundamentals:**
- MKTG.5010 Marketing Fundamentals (3 credits)
- MGMT.5010 Organizational Behavior (3 credits)
- ENTR.6500 Innovation and Emerging Technology (3 credits)
- MGMT.6300 New Product Development (3 credits)
- MKTG.6300 Market Research for Entrepreneurs (3 credits)
- MGMT.6350 Project Management (3 credits)
- FINA.6400 Financing Innovation and Technical Ventures (3 credits)

(Additional PLUS course choices will be available from a list of approved courses provided by the PSM Coordinating Committee to include additional qualified courses from the College of Management and other relevant departments.)
Internship (1 credit)

A Professional Internship is required for students in this program and is expected to be a minimum of 350 hours and have 3-6 month duration. The internship is designed to provide students with an opportunity to obtain real-world experience in business, government agencies, non-profit organizations or research laboratories. Internships or research project experiences will typically take place in industries and government agencies. Research experience can also be obtained at the University or other Research Centers.

To be eligible for the Professional Internship, students will be required to have 1) completed a minimum of 12 credits of STEM courses, 2) completed a minimum of 6 credits of PLUS courses, 3) attained an overall GPA of 3.0 or higher and 4) permission of the Graduate Coordinator. The internship will typically be undertaken in the summer between the first and second years, with continuation into the final year in some cases.

Students that have previous or current professional employment experience may request to waive the internship requirement, however, in these cases, a new project experience will be required that adds to the students current set of skills.

Capstone Experience - Required for all PSM Options (2 credits)

PUBH.6000 (0 credits) and PUBH.6020 (2 credits) are the courses for the Work Environment Capstone. The capstone courses are taken in the second (final) year of the program with PUBH.6000 taken in the Fall and PUBH.6020 in the spring semester.

All students will be required to submit a final written report and give oral presentation on their internship work during the capstone course in their final semester. All post-internship students will participate in this capstone class, as will all professionally employed students who have had the internship waived.

Master of Public Health Gerontology Option

- Introduction
- Graduates of the MPH Gerontology will be prepared to
- Information
- Curriculum

Introduction

Aging, a global phenomenon in the 21st century, has major individual, societal, economic and political consequences. Aging populations increase demands on effective public health systems and social services resulting in the need for public health specialists educated in the field of gerontology. By 2030, one in every five Americans will be 65 years or older. According to the Center for Disease Control "about 80% of older adults have one chronic condition and 50% have at least two". Gerontology is one of the fastest growing disciplines. Students in the MPH Gerontology specialization will be prepared to conduct and evaluate population bases research that is essential to address the important public health concerns of aging societies, both nationally and internationally. As people are living longer and the number of older adults is increasing, a dramatic public health workforce shortage of specialist in aging is predicted in the coming decades. The MPH Gerontology specialization is designed to prepare the next generation of gerontology specialists in the field of aging policy, planning, teaching and research.

Graduates of the MPH Gerontology option will be prepared to:

- Assume leadership positions in aging policy or public health in the public and private sector.
- Recognize, respect and value individual and societal diversity in aging populations.
- Utilize critical thinking skills in applying diverse approaches to addressing aging issues in a diverse society.
- Utilize research strategies to evaluate public health programs for an aging population.

For more information, please contact:

Leland Ackerson, Ph.D. at leland_ackerson@uml.edu

Curriculum

Fall Year 1
19.506 Introduction to Environmental Health
19.575 Introduction to Biostatistics & Epidemiology
PUBH.502 Health Policy and Management

Spring Year 1
PUBH.680 Aging and Society
19.577 Biostatistics for Health Data
PUBH.501 Social an Behavioral Determinants of Health
XX.XXXX Elective

Fall Year 2
PUBH.681 Global Aging and Health
PUBH.682 Epidemiology of Aging
XX.XXXX Elective
PUBH.666 MPH Practicum I

Spring Year 2
PUBH.683 Nutrition and Physical Activity in Aging Populations
33.717 Evaluation Research
PUBH.667  MPH Practicum II

* Part-time plans of study can be arranged in consultation with an academic advisor. Full-time plans of study that begin in the Spring Semester will include the same courses taken in a slightly different order.

Master of Public Health - Population Health Option

- Overview
- Information
- Curriculum

Overview

Health Promotion is the process of applying social and behavioral science principles to education and environmental change that empowers individuals and groups to take control of and improve their own health. MPH Specialists combine knowledge of social and behavioral sciences to create and carry out successful public health interventions to promote population health. The goal of this option is to educate practitioners who have a broad foundation of the fundamental principles of public health with a focus on program planning and evaluation.

The Population Health Option of the MPH program prepares graduates to:

- Find, understand and apply relevant public health literature
- Design and implement programs that improve public health by fostering change in individual behaviors, environmental conditions and social policy
- Evaluate public health programs through data collection and analysis
- Engage individuals and communities in discussion and decision making to clarify shared public health goals

The 6-credit MPH practicum provides students focusing on population health with applied experience in health promotion and disease prevention. Examples include collaborations in planning, implementing and evaluating public health campaigns at federal agencies, state and local health departments, hospital settings, community health centers, social service agencies and non profit public health organizations.

For more information, please contact: Leland Ackerson (mailto:leland_ackerson@uml.edu).

Curriculum Plan

Fall Semester Year 1:

- PUBH.5750 Epidemiology & Biostatistics
- PUBH.5010 Social and Behavioral Determinants of Health
- PUBH.5021 Public Health Policy

Spring Semester Year 1:

- PUBH.5070 Leadership and Management in Public Health
- PUBH.5061 Environmental Health
- PUBH.6860 Program Development & Implementation
- PUBH.6910 Advanced Program Evaluation

Fall Semester Year 2:

- PUBH.6850 Applied Public Health Research & Practice
- PUBH.6871 Health Communication and Technology
- PUBH.6660 MPH Practicum
- XXXX.XXXX Elective

Spring Semester Year 2:

- PUBH.5130 Assessment and Planning in Health Programming
- PUBH.6670 Integrated Practical Learning
- XXXX.XXXX Elective

NOTE: Part-time plans of study can be arranged in consultation with an academic adviser. Full-time plans of study that begin in the Spring Semester will include the same courses taken in a slightly different order.

Master of Public Health Healthcare Management Option

- Overview
- Information
- Curriculum

Overview

At the local, regional and national level, our healthcare system confronts new challenges in coping with the many changes in technology, information systems, financing and management. According to the U.S. Bureau of Labor Statistics, "Employment of medical and health services managers is expected to grow by 22% from 2010 to 2020". The MPH concentration in Healthcare Management will prepare graduates to manage public health programs and organizations. Students will learn...
the conceptual, organizational, personnel and financial skills required for effective, but also compassionate and ethical, work performance.

The current graduate program within the Department of Community Health and Sustainability has achieved regional distinction among students interested in the management of healthcare information systems. The faculty engaged in healthcare management who teach in the program has been an asset to the program and will teach the classes with students who are experienced managers working throughout the healthcare industry and a diverse mix of clinicians, including both NP’s and MD’s will enrich the educational experiences. The existing Heath Informatics and Management program has experienced an increase in the number of international students, many whom are health professionals. This will also enrich the educational experience of the MPH students in the Healthcare Management option.

Graduates with a Master’s degree in public health with an option in Healthcare Management will have advanced education in healthcare finance, law and ethics in healthcare, operations analysis and quality improvement, healthcare management and healthcare information systems. They will be prepared to assume leadership positions.

Graduates of the Healthcare Management Option in MPH program will be prepared to:

- Develop, implement and evaluate public health initiatives
- Assume “hands” management of public health programs and organizations.
- Provide leadership as a thoughtful, analytical and ethical manager within the public health community.
- Support increased efficiency, effectiveness and accountability within the public health workplace.

For more information, please contact: Leland Ackerson, Ph.D., Leland_Ackerson@uml.edu. (mailto:leland_ackerson@uml.edu)

Curriculum Plan

Fall Semester Year 1

- PUBH.5061 Environmental Health
- PUBH.5750 Epidemiology & Biostatistics
- PUBH.5021 Public Health Policy

Spring Semester Year 1

- PUBH.5120 Operations Analysis and Quality Improvement
- PUBH.5070 Leadership & Management in Public Health
- PUBH.5070 Social and Behavioral Determinants of Health
- XXXX.XXXX Elective

Fall Semester Year 2

- PUBH.5060 Quantitative Methods in Healthcare
- PUBH.6070 Healthcare Information Systems
- XXXX.XXXX Elective
- PUBH.6660 MPH Practicum

Spring Semester Year 2

- PUBH.5110 Healthcare Finance
- PUBH.5150 Applied Health Economics
- PUBH.6670 MPH Practicum II

*Part-time plans of study can be arranged in consultation with an academic advisor. Full-time plans of study that begin in the Spring Semester will include the same courses taken in a slightly different order.

Master of Public Health Nutrition Option

- Overview
- Information
- Curriculum

Overview

Public Health Nutrition specialists examine the relationship of nutrition with health problems including obesity, chronic diseases, malnutrition, food insecurity and nutritional deficiencies. Public Health Nutritionists provide nutrition education, conduct research, help to develop health and wellness programs, and deliver many other nutritional services to individuals and populations. Students in the Nutrition option of the MPH program advance their knowledge and skills through a program that emphasizes a broad background in public health and specialized education in nutrition.

The goals of the MPH Nutrition option are to prepare health and nutrition professionals to:

- Identify and prevent risks that contribute to the development of malnutrition;
- Develop strategies and policies to improve food security and reduce obesity;
- Develop programs to improve the nutritional status of diverse population groups;
- Develop effective strategies for advocating for improved...
nutrition;
- Develop and manage wellness programs to promote healthy eating and chronic disease prevention;
- Apply population-based research findings to the development and implementation of nutrition policies and programs in the United State and internationally.

For more information, please contact: Renee Barrile, Ph.D (mailto:renee_barrile@uml.edu).

Curriculum:

Fall Semester Year 1
- PUBH.5061 Environmental Health
- PUBH.5750 Epidemiology & Biostatistics
- PUBH.5021 Public Health Policy

Spring Semester Year 1
- PUBH.5070 Leadership & Management in Public Health
- PUBH.5010 Social and Behavioral Determinants of Health
- NUTR.6020 Community Based Interventions
- XXXX.XXXX Elective

Fall Semester Year 2
- NUTR.6010 Nutrition Assessment
- NUTR.6000 Public Health Nutrition Practice
- XXXX.XXXX Elective
- PUBH.6660 MPH Practicum

Spring Semester Year 2
- NUTR.6040 Nutrition Epidemiology
- XXXX.XXXX Elective
- PUBH.6670 Integrated Practical Learning

NOTE: Part-time plans of study can be arranged in consultation with an academic adviser. Full-time plans of study that begin in the Spring Semester will include the same courses taken in a slightly different order.
PUBH.5000 Analytical Context of the Work Environment (Formerly 19.500) - Credits: 3

An overview course to be taken in the first semester in the Master’s program. Case studies are used to introduce students first to the hazard analysis methods, and second, to the prevention methods of each of the department’s sub-disciplines. Interconnections between exposures and illness/accident development are reviewed at three levels: individual, work organization and society.

PUBH.5010 Social and Behavioral Determinants of Health (Formerly PUBH 501) - Credits: 3

This course provides a foundation for the analysis of social and behavioral influences on public health. Planning, implementation, and evaluation of initiatives designed to improve public health are discussed. The course reviews prominent concepts in the social and behavioral sciences and provides examples of their impact on public health. Psychosocial theories of health promotion and how they inform public health practice are analyzed. Public health competencies in social and behavioral sciences provide a foundation for the course content.

PUBH.5020 Organizational Behavior in Health Care (Formerly 32.502) - Credits: 3

Provides a systems overview of the organizational structure and behavior of individuals in healthcare institutions, along with an examination of the role of managers, clinicians and other leaders. The course applies organizational, behavioral and social science practice and theory to healthcare organizations.

PUBH.5021 Public Health Policy (Formerly PUBH 502) - Credits: 3

The course provides students with a foundation of public health policy and related institutional knowledge required within public health. This course will survey and analyze the health care system in the United States, emphasizing the major issues and trends.

PUBH.5030 Toxicology and Health (Formerly 19.503) - Credits: 3

The course introduces students to the basic principles and mechanisms of toxicology with a focus on occupational and environmental health. Concepts of dose, dose rate, dose-response analysis, and test systems are presented in the context of the toxicology of major organ systems and toxic agents. The course covers toxicology of major organ systems (respiratory, dermal, immunologic, cardiovascular, neurologic, reproductive systems, and cancers), major classes of contaminants (airborne particles, respirable fibers, vapors/gases, heavy metals, organic solvents, pesticides, sensitizers, emerging contaminants), and their mechanisms of action. A review of the necessary human biology and biochemistry of life is also provided.

PUBH.5050 Qualitative Research Methods (Formerly 19.505) - Credits: 3

This course explores and examines non-quantitative methodologies in the social sciences and political economy. The course will discuss hypothesis generation, survey design, research problem design, case studies, ethnographic methods, participatory research methods, content analysis, interviewing techniques and key informant interviews. Doctoral students in work environment policy are particularly urged to take this course. The course will be offered in collaboration with the Department of Regional Economic and Social Development as course 57.592.

PUBH.5060 Quantitative Methods in Health Management (Formerly 32.506) - Credits: 3

The course teaches analytic methods that can be used to improve the decision making of healthcare managers, clinicians and others within the healthcare industry. Students learn the following: the conceptual foundations of quantitative analysis - e.g., what statistics is all about, how to think statistically and how to understand and interpret statistical findings; the importance of quantitative methods in supporting healthcare decision-making and developing evidence-based practices; bivariate and multivariate statistical methods for analyzing data and testing hypotheses; and how to use an industry-standard data analysis and statistical software in developing and reporting analytic findings.

PUBH.5080 Principles and Practices of Biological Safety (Formerly 19.508) - Credits: 3

This course is designed to provide an overview of hazard recognition, evaluation and control of potentially hazardous biological materials. This introduction to the field will cover the potential risks of working with biological materials, the use of engineering, work practices and administrative measures for hazard control and regulations governing the area of biosafety. Requires working knowledge of Microbiology, and permission of Instructor.

PUBH.5100 Fundamentals of Occupational Health (Formerly 19.510) - Credits: 3

This course provides an overview of key topics in the field of occupational health and safety including physical agents and biological and chemical hazards. The measurement and control
of various physical agents are covered, including noise, ionizing and non-ionizing radiation, heat stress and extreme environments. Students will understand the health risks from biological hazards and blood borne pathogens, as well as the regulations and methods of prevention. They will also gain knowledge of hazard communication regulations, material safety data sheet and how to research chemical hazards.

PUBH.5110 Health Care Finance (Formerly 32.511) - Credits: 3

Provides broad exposure to the concepts and practices of healthcare finance and healthcare financial management. Teaches a practical understanding of basic healthcare financial issues, financial reporting and analysis, and provider payment structures. The course enables students to read, analyze and use healthcare financial information in today’s healthcare environment.

PUBH.5120 Operations Analysis for Quality Improvement (Formerly 32.512) - Credits: 3

This course teaches a multi-disciplinary approach to operations analysis, process redesign and quality improvement in healthcare. Students study the history, development and principles of quality improvement in healthcare; how quality improvement processes have been used in various healthcare settings; the tools and processes used in quality improvement; how to structure and implement a quality improvement program; and how to collect, analyze and interpret quality improvement data.

PUBH.5140 Healthcare Management (Formerly 32.514) - Credits: 3

This course provides a framework for addressing management problems in healthcare organizations, providing an overview of how healthcare institutions are organized and governed, the role of the management, physicians, nurses and other clinical and support staff in these organizations, and the management systems designed for their efficient and effective operation.

PUBH.5141 Aerosol Science (Formerly 19.514) - Credits: 3

Basic properties of airborne particles, with particular regard to properties important to health. Includes basic properties of gas-borne particles, uniform particle motion, particle collection mechanisms, filtration, particle sampling, respiratory deposition, particle statistics, electrical properties, and optical properties. Course includes lectures and laboratory.

PUBH.5150 Applied Health Economics (Formerly 32.515) - Credits: 3

Students study basic economic concepts and how they are applied to healthcare and gain a broad familiarity with the health economics and related health services research literature, as well as experience using economics to analyze health policy issues.

PUBH.5160 Laboratory Environmental Health and Safety (Formerly 19.516) - Credits: 3

This course is designed to provide an overview of hazard recognition, evaluation and control in laboratory environments. This introduction to the field will cover the potential risks of working with chemicals, radioactive materials, animals and biological materials. It will also introduce the use of engineering, workpractices and administrative measures for hazard control and regulations governing the area of laboratory safety.

PUBH.5210 Introduction to Industrial Hygiene (Formerly 19.521) - Credits: 2

PUBH.5230 Introduction To Ergonomics (Formerly 19.523) - Credits: 2

PUBH.5250 Industrial Hygiene and Ergonomics (Formerly 19.525) - Credits: 3

A survey course covering introductory topics in ergonomics and industrial hygiene. Ergonomics topics include work measurement, anthropometry, biomechanics, psychosocial stress and work reorganization, special emphasis is placed on the recognition and control of work-related musculoskeletal disorders. Industrial hygiene topics will cover the identification, measurement, and control of chemical and physical hazards in the work environment including principles of air sampling and analysis, ventilation and other control technologies, and the use of personal protective equipment with special attention to respiratory and hearing protection.

PUBH.5270 Planning and Marketing in Healthcare (Formerly 32.527) - Credits: 3

The course examines the history, principles and methodologies of health services planning and marketing. Students learn how to develop various types of health plans (e.g., community and regional, strategic, business and marketing plans). They also learn about the research process and data resources required to support health services planning and marketing. Practical approaches to health care problems are studied using case analysis of actual healthcare projects and programs.

PUBH.5300 Ergonomics and Work (Formerly 19.530) - Credits: 3
An overview of the scientific basis for design of the workplace
to optimize physical and mental interaction of workers with
machines, tools, and work methods. Topics include work
measurement, anthropometry, biomechanics, work physiology,
cumulative trauma disorder and information presentation and
processing.

PUBH.5310 Health Informatics (Formerly 32.531) -
Credits: 3
The course provides healthcare professionals with a conceptual
and practical understanding of information and
communication systems, and how they are used. It also
addresses the systems analysis, development and
implementation challenges in optimizing today’s complex
healthcare systems designs to improve both use and clinical
outcomes. Students learn the theory, techniques and systems
used for transforming clinical data into information useful for
decision-making. The current and future role of the health care
informatics professional is discussed.

PUBH.5311 Occupation Biomechanics (Formerly
19.531) - Credits: 3
The anatomical and physiological basis of human motor
capabilities. Quantitative models are developed to explain
muscle strength performance, motion control, physical fatigue,
and acute and chronic musculoskeletal trauma, particularly
static link models of lifting and other manual activities.
Application to the evaluation and design of various tasks and
occupations.

PUBH.5320 Occupational Biomechanics Laboratory
(Formerly 19.532) - Credits: 3
A laboratory presentation of the biomechanical basis for
understanding and predicting human motor capabilities using
bioinstrumentation. Computerized data acquisition,
electromyography and load cells for strength measurement are
examples of the equipment used in this lab. Particular emphasis
is placed on the evaluation of occupational activities.

PUBH.5330 Intervention Research (Formerly 19.533) -
Credits: 3
This course covers the design, implementation and evaluation
of interventions to reduce risk factors for poor health and
related outcomes. Topics include the use of casual diagrams to
identify possible intervention points; logic models for program
evaluation; and design of formal evaluation research studies.
Selected scientific articles will be used to illustrate topics
covered in the lectures. Each student will select a public health
problem of interest and develop a case study over the course of
the semester.

PUBH.5400 Occupational Safety Engineering
(Formerly 19.540) - Credits: 3
The purpose of this course is to introduce students to the
principles of safety hazards in the work environment. This
course is primarily designed to emphasize the safety aspects of
the hazards at work. It begins with the historical development
of occupational safety and health and progressively examines
the fundamentals of recognition, measurement, evaluation, and
control of occupational safety hazards.

PUBH.5420 Human Factors (Formerly 19.542) -
Credits: 3
The functional processes of human systems in the workplace
that affect psychosocial health and productivity. Review of
associations between work design principles and effects on
human well-being, learning, and performance. Human
perceptive, cognitive, metabolic, and social-psychologic
limitations. Human-machine interactions affecting “stress” and
learning at the level of individuals and of groups. Introduction
to “healthy” job redesign, “conducive production”, and
measurement strategies. Principles applied through practical
design problems.

PUBH.5490 Sustainable Housing Development and
Land Use: Policy and Practice (Formerly 19.549) -
Credits: 3
Housing is fundamental to the quality of life in communities,
and housing policies shape the availability of this fundamental
good. This course will examine the economic, environmental,
social, and cultural factors that shape housing and its
sustainability. Overall housing and land use policy in the
United States will be summarized, with students learning of the
ways in which housing policy impacts communities, states, and
regions. The course will then give students a detailed
understanding of the process through which housing is
developed and the role the market, government, funders,
workers, and housing consumers play in influencing the
creation and development of housing. The course will highlight
the ways in which current housing development policy and
practices are not sustainable, and will examine more recent
efforts to establish standards and practices that enhance
sustainability. Students will learn how to take a housing project
through the various stages, such as project conceptualization,
market analysis, design, site acquisition, financing,
construction, and occupancy. While the course focuses on the
U.S. context, students will learn of international efforts to
achieve greater sustainability in housing. The course will
provide students with both practical and theoretical knowledge
of housing and land use policy and development practices.
Case studies of actual projects will be presented.
PUBH.5500 Environmental Law (Formerly 18/19.527) - Credits: 3
The large body of law, which has developed since the early 1960's, is examined in considerable detail. Federal laws relating to the environment, particularly with the Environmental Protection Agency and the Occupational Safety and Health Acts. State and local laws and ordinances are discussed where pertinent.

PUBH.5510 Work Environment Policy (Formerly 19.551) - Credits: 3
PUBH.5550 Comparative Enviromental (Formerly 19.555) - Credits: 3
Human social and productive activities often harm the natural environment. Environmentally related health problems will become more prominent and put additional stress on industrial, as well as transitional and developing nations. A sustainable world is one that provides not only for environmental viability but also economic health, social justice and political participation. This course is designed to explore the dynamics and interactions of social, economic and political factors that aid or impede a community’s ability to contribute to global environmental sustainability. The course will be offered in collaboration with the Department of Regional Economic and Social Development as course 57.518.

PUBH.5560 Analyzing Peace Violence and War (Formerly 19.556) - Credits: 3
This course examines the political, and social factors that cause violence and war, together with the possibilities for peaceful citizen action and constructive solutions to violence and conflicts. Different arenas of conflict are discussed, ranging from workplaces, families and communities, to nations, to the world.

PUBH.5570 Toxic Use Reduction (Formerly 19.557) - Credits: 3
Toxic Use Reduction (TUR) is a new approach to hazardous waste management and environmental protection. Rather than addressing chemical contamination as waste (after its generation), to be managed through permits and emission regulations, TUR focuses on chemicals while still in production. In Massachusetts, firms are required to prepare plans demonstrating how they will reduce or eliminate the use of toxic chemicals. The course is organized as a set of discussions and case studies from the real-life program.

PUBH.5590 Conflict Resolution (Formerly 19.559) - Credits: 3
Conflict Resolution gives students an understanding of the main issues and solutions involved in community level conflict resolution; e.g., in neighborhoods, workplaces, and other institutions. It develops students’ skills in practicing conflict resolution and/or evaluating programs in the field of dispute resolution. It is important to understand why conflict happens and how to resolve conflict.

PUBH.5674 Water, Sanitation, and Public Health - Credits: 3
This course introduces students to the critical role of water and water sanitation in protection of public health. The course will provide an overview of the basics of water treatment systems and the role of local public health professionals in water preservation. Students will be introduced to the importance of water and the global water crisis; the basic principles of water hydrology and the connection between surface and ground water; water chemistry, microbiology and common contaminants in water supplies (nutrients, pathogens, and chemicals); water and waste water treatment and protection systems (including storm-water runoff, pools and beaches), their functioning, regulation, and testing; and the emerging issues in water protection, such as hydrofracking. Meets Core Curriculum Essential Learning Outcome for Critical Thinking & Problem Solving (CTPS).

PUBH.5750 Epidemiology and Biostatistics - Credits: 3
Epidemiology is the study of the distribution and determinants of disease in human populations, and the risk factors associated with diseases. This course provides an introduction to epidemiology and the associated biostatistical methods that constitute the principal quantitative methods for disease prevention. Topics include: measures of disease frequency, measures of central tendency and spread, rates and risks, precision and validity, bias, simple linear regression, and the important study designs (population surveys, cohort, case-control and cross-sectional studies).

PUBH.5770 Biostatistics for Health Data - Credits: 3
This is a practical course in biostatistical methods for health research. Emphasis is placed on developing an understanding of the use and interpretation of standard biostatistical methods. Topics include probability and sampling distributions, regression and ANOVA, methods for analyzing rates and proportions, power and sample size calculations. Students will gain experience in using a statistical software package to apply and expand their data analysis skills.

PUBH.5790 Disability Outcomes and Interventions
This course will address the epidemiology of disability outcomes through a mix of didactic presentation and critical discussion of the literature, covering both observational and intervention studies. Qualitative research methods will also be highlighted in terms of how they can enrich the study hypotheses, construct measures, etc. The first half of the course will cover observational studies of individual and environmental risk factors for disability outcomes, including features of both the workplace and the community. Then we will describe the key design features of clinical trials to evaluate interventions, again at both the individual and the organizational levels. Interspersed with lecture material, selected observational and intervention studies from the peer-reviewed scientific literature will be evaluated with respect to study design, methodologic rigor, and adequacy of statistical analysis.

PUBH.5910 Co-Op Internship CPT (Formerly 19.591) - Credits: 0-1
Practical training course for students to perform CPT.

PUBH.5980 Thesis Review (Formerly 19.598) - Credits: 1

PUBH.6000 Practicum/Capstone I (Formerly 19.600) - Credits: 3
This is the first course in a two-semester sequence that provides the opportunity to apply practical skills through a culminating practice experience for students in the Master's programs in Work Environment and Public Health. The course is designed to provide students with the opportunity to examine an interdisciplinary problem in depth and propose a solution to the problem by applying technical knowledge and skills obtained in their program to a real world issue. The product will be a report and a public presentation of the project.

PUBH.6010 Practicum/Capstone II (Formerly 19.601) - Credits: 3
This is a second course in a two-semester sequence that provides the opportunity to apply practical skills through a culminating practice experience for students in the Master's programs in Work Environment and Public Health. The course is designed to provide students with the opportunity to examine and interdisciplinary problem in depth and propose a solution to the problem by applying technical knowledge and skills obtained in their program to a real world issue. The product will be a report and a public presentation of the project.

PUBH.6030 Global Development and Health (Formerly PUBH.603) - Credits: 3
This course discusses global health efforts in relationship to human health and quality of life. Using a case methodology, this course will enable students to analyze complex health and development challenges in the less-developed world, and propose and evaluate interventions that address challenges. Topics include maternal and child health, nutrition, infectious and noninfectious diseases, natural disasters, sanitation and health inequality. Access to health care in developing and developed countries will be analyzed. The concept of positive deviance will also be explored.

PUBH.6040 Geographic Information Systems (GIS) for Health (Formerly PUBH.604) - Credits: 2
Geographic information systems (GIS) are of growing importance for analyzing health and environmental data. GIS is a spatial analysis system for the organization, storage, retrieval, and analysis of public health and many other types of data. The course will provide an overview of spatial analysis of data of importance to environmental and public health issues and students will analyze implications of spatial data analysis for public health.

PUBH.6040L Geographic Information Systems (GIS) for Health Lab (Formerly PUBH.604L)

PUBH.6050 Advanced Research Methods in Work Environment (Formerly 19.605) - Credits: 3
An advanced seminar focused on developing research skills needed for understanding the causes of health and safety hazards in the work environment as well as their solutions. The seminar topics will vary each semester, depending on the research fields of the students enrolled as well as the expertise of the participating faculty members. The goal is to provide depth in theory, background literature, state of the art measurement tools, and research methods at a level appropriate to students undertaking independent research. All doctoral students are required to take two semesters of this seminar.

PUBH.6070 Healthcare Information Systems (Formerly 32.607) - Credits: 3
This is the introductory, first-recommended course in health informatics. It provides a broad-ranging overview of the healthcare information systems industry, its history, recent developments and continuing challenges, and a practical understanding of healthcare information systems acquisition and implementation. Topics include meaningful use, EMR, CPOE, and health information exchange.
PUBH.6090 Work in Progress Seminar (Formerly 19.609) - Credits: 3
This seminar course provides a forum for doctoral students (and advanced master's students) to discuss their research with their peers and the faculty in a supportive interdisciplinary community. Doctoral trainees from all Work Environment fields are required to present their work in progress to their peers. Although all doctoral students must register for this seminar for credit in one semester during their career, they are expected to attend and present regularly while they are in the research and writing phase of their doctorate.

PUBH.6100 Exposure Assessment (Formerly 19.610) - Credits: 3
Concepts of quantification of occupational exposures (chemical and physical hazards) for purpose of correlating health effects with exposures. Topics discussed include reasons for conducting exposure assessment, sampling methods, sampling strategies (for epidemiology, compliance, control), and statistical considerations. Principles are illustrated through a series of case studies.

PUBH.6110 Physical Properties of Aerosols (Formerly 19.611) - Credits: 3
A seminar covering aspects of aerosol science not discussed in 19.514 but necessary for the completion of research projects involving aerosols. Topics covered include the electrical, thermal, and optical properties of aerosols, particle agglomeration, evaporation and condensation, and the generation and measurement of test aerosols. Course will consist of lectures and laboratory sessions.

PUBH.6120 Exposure Data Analysis (Formerly 19.612) - Credits: 3
An advanced seminar covering statistical considerations for exposure sampling and data analysis. Topics include sampling data distributions; the effects of averaging time, autocorrelation, multiple task jobs and limit of detection samples on the sampling distribution; the use of linear models to examine between and within worker variability in exposure; the determination of homogeneous exposure groups; the development of multiple regression models to predict exposure levels and evaluate exposure determinants; and methods of model development, interpretation and validation.

PUBH.6130 Environmental Epidemiology (Formerly PUBH.613) - Credits: 3
An advanced course in modern epidemiologic methods as applied to physical and chemical hazards in the environment.

Students read and critique some of the classic studies that have led to recognition of the effects of the environment on health, as well as some current topics of intense and active research. Major topics covered include: air pollution and lung disease, water pollution and infectious disease, ionizing radiation and cancer, outbreak investigation for foodborne infectious agents, lead poisoning, and endocrine disruption. Through reading the literature, students strengthen their skills in study design and analysis, while learning about important aspects of environmental health.

PUBH.6131 Design and Evaluation Of Ventilation Systems (Formerly 19.613) - Credits: 3
A seminar intended for students pursuing research involving industrial ventilation system design and evaluation. It covers material not included in 19.518, such as recent theoretical models which describe system performance, design of systems for high-temperature operation, trouble-shooting techniques, and advanced instrumentation techniques. Course consists of lectures and laboratory sessions.

PUBH.6140 Evaluation of Work Environment Hazards (Formerly 19.614) - Credits: 3
This course provides the work environment professional with a systematic method of evaluating chemical, ergonomics and work organizational hazards in the field. Basic industrial processes and their potential hazards are reviewed. Approaches for evaluation of indoor air quality are covered. Worksite surveys of hazards and control technologies and the evaluation of existing health and safety programs are implemented through a series of workplace walkthrough visits in a variety of industries. Team work skills are developed and utilized to produce professional final reports and presentations that cover rankings of worksite hazards and recommendations.

PUBH.6150 Solutions for Work Environment Hazards (Formerly 19.615) - Credits: 3
Techniques for controlling exposure to airborne contaminants. Basic controls include substitution, ventilation, isolation, administrative controls, and personal protective equipment. Special focus is placed on Toxic Use Reduction (TUR) and Pollution Prevention strategies.

PUBH.6160 Law and Ethics in Healthcare (Formerly 32.616) - Credits: 3
This course presents and overview of legal and ethical issues facing managers and providers in health care. It provides students with a foundation of health law and ethics and reviews health care legal and ethical situations and dilemmas. The goals are to provide students with practical knowledge of
health law and ethics and their application to the real world of health care.

PUBH.6161 Exposure and Risk Assessment (Formerly 19.616) - Credits: 3

This course covers quantitative and qualitative approaches to the development of sampling strategies. Statistical considerations in the quantification of occupational exposures are covered. Assessment of dermal exposures and the use of biomarkers for exposure assessment are also a focus of this class. An introduction to the methods of risk assessment will also be covered.

PUBH.6180 Risk Management and Training (Formerly 19.618) - Credits: 3

This course will introduce models of health and safety management with a focus on communication with management and employees. Development of effective worker training programs will be covered. The methods and policy implications of quantitative risk analysis and assessment will be introduced and cases discussed.

PUBH.6191 Measurement of Chemical Exposure (Formerly 19.619) - Credits: 3

Basic properties of airborne particles, with particular regard to properties important to health. Sampling and analysis methods used in the evaluation of occupational exposures to aerosols, gases, vapors. Direct reading instrumentation, calibration and data processing. Integrated sampling methods and chemical analysis of organic and inorganic compounds will be covered in class and lab.

PUBH.6200 Advanced Exposure Assessment (Formerly 19.620) - Credits: 3

An advanced seminar covering exposure assessment for studies of acute and chronic respiratory disease, pharmacologic modeling for exposure assessment and the design of models to evaluate the role of production process factors in determining workplace airborne exposures. The course assumes a prior background in epidemiology and biostatistics as well as industrial hygiene and toxicology.

PUBH.6210 Nanomaterials: Exposure, Health and Safety (Formerly 19.621) - Credits: 3

This course presents a comprehensive overview of environmental health and safety issues of nanotechnology, with focus on biologically based exposure assessment and control. Methods based on biology, toxicology, and knowledge of disease mechanisms are presented for identifying and quantifying nanoscale materials exposures found in occupational/environmental setting and consumer products and for designing exposure assessments for the study of health effects. This course is needed to fill a gap in the current curriculum offerings and to assist the various researchers in understanding possible risks associated with diverse nanotechnologies. The course will include introductory lectures, paper critiques, and laboratory sessions.

PUBH.6220 Biomarkers in Occupations and Environment (Formerly 19.622) - Credits: 3

PUBH.6230 Skin Exposure to Chemicals (Formerly 19.623) - Credits: 3

This new course, the only of its kind in the occupational &environmental hygiene program in the country, will discuss the significance of occupational environmental and household skin exposure to chemicals, skin exposure assessment and regulatory aspects. The course will address important topics, such as physiology and metabolism of normal skin, skin absorption of a variety of chemicals, including solids and nanomaterials, factors affecting skin permeation, permeability of compromised skin barrier integrity, skin sampling methods, skin-lung interactions and prevention of skin exposure, through a mix of didactic presentations and critical discussion of the scientific peer-reviewed literature. Each session will start with a presentation on the topic, followed by guided discussions of realistic, but provocative, scenarios. As laboratory space and instrumentation becomes available in the near future, a laboratory component will be added to the course to emphasize major sampling techniques and illustrate/visualize skin permeation of chemicals.

PUBH.6250 Health Policy (Formerly 32.625) - Credits: 3

This course provides students with a basic framework for health policy analysis and examines major aspects of U.S. health policy. Detailed consideration and discussion focus on the relationship of national policy to the planning, implementation and funding of healthcare services. The course covers topics such as the healthcare policy environment in the U.S., government-funded healthcare through Medicaid and Medicare, and the Massachusetts healthcare reform.

PUBH.6260 Leadership in Healthcare (Formerly 32.626) - Credits: 3

The purpose of this course is to encourage students to carefully analyze their leadership style and skills within the context of health care. The course includes the study and application of leadership theories, concepts, and skills. Students will also assess their own leadership potential through the completion of readings, personal and leadership self-assessments, values
exploration, and leadership skill exercises.

**PUBH.6270 Socioeconomic Inequalities in Health**  
(Formerly 32.627) - Credits: 3

The course explores the relationship between social and economic justice and public health. Focusing primarily on the U.S., the forces that either establish and exacerbate or prevent socioeconomic inequities will be analyzed to understand the intricate links between social, behavioral, physical, and biological determinants of health. Several theoretical orientations will be reviewed in order to better understand how each frames research and public health strategies that have been used to address health inequalities. Students will be able to competently articulate the relationships between social and health inequalities. They will be able to explain the strengths and limitations of different theoretical orientations to these issues and frame the policy needs to positively reduce health disparities.

**PUBH.6300 Research Design for Ergonomics**  
(Formerly 19.630) - Credits: 3

Procedures for conducting research on ergonomics (human factors, biomechanics, etc.). Experimental design alternatives, field research, survey research, considerations of data collection and reduction, sequential design procedures, and ethical use of human subjects.

**PUBH.6320 Health Information System Planning**  
(Formerly 32.632) - Credits: 3

A course examining contemporary healthcare information system requirements and focusing on the design, implementation, and modification of these systems. Actual or hypothetical health system related projects are used to support the theoretical framework.

**PUBH.6321 Advanced Biomechanics**  
(Formerly 19.632) - Credits: 3

A course in advanced biomechanical modeling methods, covering three dimensional static models, optimization methods and dynamic models. Special emphasis will be placed on biomechanical models of the hand. Time will also be dedicated to reviewing current developments in the scientific literature.

**PUBH.6330 Healthcare Database Design**  
(Formerly 32.633) - Credits: 3

A practical approach to the design, and development of a relational database with an emphasis on healthcare. Analyzing the requirements of the database proceeds to the design of the structure of the relational database, which is then developed in a Relational Database Management System (RDBMS). Microsoft Access is used as the RDBMS platform.

**PUBH.6350 Healthcare Project Management**  
(Formerly 32.635) - Credits: 3

A graduate level course providing a comprehensive foundation for project management as it applies to healthcare. Students will be introduced to the theory and concepts of project management, and the tools to manage projects with a specific focus on health information technology.

**PUBH.6380 Strategic Planning in Healthcare and HIT (Health Information Technology)**  
(Formerly 32.638) - Credits: 3

A graduate-level course introducing healthcare professionals to strategic planning for the information systems organization. Skills learned in this course will enable the student to work effectively with and support the information systems planning effort and assure business alignment.

**PUBH.6381 Methods In Work Analysis**  
(Formerly 19.638) - Credits: 3

Criteria for selection of an approach to ergonomic job analysis depend on the combination of exposures (micro- and macro-level ergonomic stressors) observed to be present as well as the analytical goal. Many ergonomic analysis techniques are based on traditional industrial engineering approaches (time-motion study and work sampling), applied to the identification and evaluation of potential risks to workers' health. A variety of methods, both observational and instrumentational, will be discussed; laboratory sessions will permit hands-on application of several of these for critical evaluation.

**PUBH.6390 Electronic Health Record Systems**  
(Formerly 32.639) - Credits: 3

The course addresses Electronic Health Records (EHR) integration with patient care flow, clinical decision making and patient engagement, as well as clinical quality reporting. The students also learn core EHR functions. The course uses industry-leading EHR software as a learning tool to demonstrate how electronic health record technologies are used in a clinical setting.

**PUBH.6400 Macroergonomics: A comprehensive approach to Job and Organizational Design**  
(Formerly 19.640) - Credits: 3

The purpose of this course is to introduce students to the
Macroergonomics field. Macroergonomics, also known as the third generation of ergonomics, is a top-down sociotechnical systems approach to the design of organizations, work systems, and jobs. The goal of macroergonomics is a fully harmonized work system at both the macro- and micro-ergonomic level which results in improved productivity, job satisfaction, health and safety, and employee commitment.

**PUBH.6430 Health Work Organization Design**  
(Formerly 19.643) - Credits: 3

Rationales for prevention; determinant of job change feasibility, classic and alternative work organization theories, alternative productivity conceptions, health and growth assessment strategies, conducive work processes, work-group based re-design processes, communicative and network-oriented processes, organization-level change process, product redesign, occupational and political strategic issues.

**PUBH.6510 Work Environment Policy**  
(Formerly 19.651) - Credits: 3

This course provides an overview of occupational safety and health policy in the U.S. It focuses on the legal context, especially on OSHA, but also provides an analytical framework for examining the role of social, economic and political factors in the recognition and control of occupational hazards.

**PUBH.6540 Work, Technology and Training**  
(Formerly 19.654) - Credits: 3

This course examines the broader issues of the impact of technology on the work environment and on workers. Topics include technology and craft work, Taylorism and the development of mass production methods, labor in the "factory of the future", skill-based automation, shop floor programming, and other issues in technology policy. The course is offered in collaboration with the Department of Regional Economic and Social Development as 57.503.

**PUBH.6550 Introduction to Environmental and Natural Resource Economics**  
(Formerly 19.655) - Credits: 3

This course introduces students to the economic and policy aspects of environmental quality and natural resource issues. The course also incorporates relevant work-environment related issues. Simple and complex models are used to blend economic theory with environmental facts. Students will learn to derive policy insights form theoretical constructs. The primary objective is to show how the basic principles in economics can play a valuable role in analyzing and evaluating critical environmental issues and help in determining policy guidelines. Standard benefit cost of efficiency criteria will be applied to a wide variety of environmental, work-environment and natural resource problems. In attempting to do so we shall also emphasize how difficult it is to model actual environmental problems in the real world. We shall draw upon the basic tools of environmental and health economics to discuss current policy issues and questions that policy makers confront in practice. Graduate students in work environment will be required to do an economic analysis of an occupational health and safety intervention.

**PUBH.6580 Clean Product Design**  
(Formerly 19.658) - Credits: 3

This advanced seminar will provide an introduction to clean product design and management which includes the use of lifecycle thinking, eco-design concepts, materials analysis, inherent product safety, recycling and reuse, produce take back, and design for the environment. As background, the seminar will cover renewable resources, bio-based materials and green chemistry solutions and conclude with a consideration of new forms of sustainable consumption.

**PUBH.6590 Cleaner Production**  
(Formerly 19.659) - Credits: 3

This course will explore the rapidly expanding developments in cleaner production methods and policies. The course will focus on new directions in environmentally conscious manufacturing and product design in Europe. The subject will cover topics ranging from European demonstration projects, environmental auditing, cleaner technology assessment, eco-efficiency models, water and energy conservation, sustainable product design, eco-design and life cycle assessment, product take-back and extended product life, full cost accounting, industrial ecology, environmental management systems and ISO 14000. Special emphasis will be given to new information data sources and an introduction to new cleaner production methods software.

**PUBH.6660 MPH Practicum**  
(Formerly PUBH.666) - Credits: 3

This practicum requires students to apply theories and principles from coursework in a public health setting. The practicum is a planned, supervised and evaluated practice experience under the supervision of a qualified preceptor. Students meet regularly on campus in a seminar with a faculty member who oversees the practicum experience.

**PUBH.6670 Integrated Practical Learning**  
(Formerly PUBH.667) - Credits: 3

This course is designed as a culminating experience for students in the MPH program. Students will demonstrate the mastery of a body of public health knowledge and achievement of the
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The population will be discussed. Policies and programs to address the well-being of the aging contemporary society will be analyzed. Effective public health family, work and religion impacting the aging population in income and educational opportunities. Changing context of gender, sexual orientation, socio-economic disparities, and social construction of old age influenced by race/ethnicity, course will use a life course perspective of aging to examine the impact of social structure and institutions on older adults. The affect ing individuals, society, and social institutions and the

This course will focus on the study of aging as a social process affecting individuals, society, and social institutions and the impact of social structure and institutions on older adults. The course will use a life course perspective of aging to examine the social construction of old age influenced by race/ethnicity, gender, sexual orientation, socio-economic disparities, and income and educational opportunities. Changing context of family, work and religion impacting the aging population in contemporary society will be analyzed. Effective public health policies and programs to address the well-being of the aging population will be discussed.

This course focuses on concepts, principles, and methods of epidemiological research in the study of population aging. Interpretation of the relevance of epidemiological findings to the public health of older populations will be examined. Theoretical and methodological issues in conducting epidemiological research with an aging population will be analyzed.

An advanced course in modern epidemiologic methods as applied to occupational health risks and interventions. Students read and critique numerous studies in the field, and learn the particular methods and difficulties of conducting epidemiologic studies in the work environment. Major topics covered include: causal inference in epidemiology, point and interval estimation for cohort and case control studies, exposure assessment for epidemiology, multivariate linear and logistic models for control of confounding.

This course will provide an overview of the relevance of global aging to public health in high-income, emerging economies, and low-income countries. The course will examine the global perspective of public policy issues related to the aging of the world population. Topics include: demographic trends, global burden of disease, health systems design and caregiving models, social insurance programs, age-friendly cities, cross-cultural perspectives on aging, social change and aging, and public policy responses driven by a global aging population.

This seminar will cover the basics of how to structure and write an article for a peer-reviewed journal. Participants will bring at least one article from their own field that can serve as a model, as well as a sample of their own writing (can be a course paper or other draft manuscript). Both peer and instructor feedback will help to inform revisions of the draft.
PUBH.6780 Occupational Respiratory Disease Epidemiology (Formerly 19.678) - Credits: 3

Advanced course on the methods and content of research on occupational respiratory disease with focus on the appropriate use of spirometry, symptom questionnaires, and chest radiography in cross sectional and longitudinal studies. Reviews pathophysiology, prevalence, latency considerations and diagnosis of both acute and chronic respiratory disease caused or exacerbated by work. Special attention is devoted to the impact of the healthy worker selection effect in respiratory epidemiology studies.

PUBH.6790 Psychiatric Diseases and Work (Formerly 19.679) - Credits: 1

This course will explore the relationships between mental health and psychiatric diseases and working life. Both the impacts of mental illness on work, as well as the effects of work and the work environment on mental health will be covered. By the end of the semester, students will understand: basic psychiatric terminology, and the different psychiatric syndromes in relation to their clinical symptomatology and long term prognoses; how to assess those syndromes using epidemiologic screening tools; and the current state of the art on the impact of working conditions on mental diseases and mental health, and the impact of these on working life.

PUBH.6800 Introduction To SAS (Formerly 19.680) - Credits: 0-1

This course is designed for researchers who will be doing data analysis using SAS. No prior programming experience is necessary, though familiarity with and general experience in use of a PC (DOS and Windows) is required. The course covers topics including: basics of SAS, reading raw data and existing SAS data sets, modifying data, combining data sets, basic statistical procedures, sorting, summarizing, and printing data.

PUBH.6820 Applied Epidemiology Methods (Formerly 19.682) - Credits: 3

A second level course in modern epidemiologic methods. This course is designed for those planning to work in public health or healthcare. Emphasis is placed on the design and conduct of field studies. Students read the current literature, and learn the particular methods and difficulties of conducting epidemiologic studies in the work environment. Major topics covered include: casual inference in epidemiology, point and interval estimation for cohort and case control studies, exposure assessment for epidemiology, control of confounding, cross-sectional and longitudinal study designs.

PUBH.6830 Risk Assessment (Formerly 19.683) - Credits: 3

This course will review both the methods and policy implications of risk assessment in the development of occupational and environmental standards. Students will conduct risk assessments on real problems, and study important cases in which these methods have been used in setting public policy.

PUBH.6831 Nutrition & Physical Activity in Aging Populations (Formerly PUBH 683) - Credits: 3

The course will explore the relationships between mental health and psychiatric diseases and working life. Both the impacts of mental illness on work, as well as the effects of work and the work environment on mental health will be covered. By the end of the semester, students will understand: basic psychiatric terminology, and the different psychiatric syndromes in relation to their clinical symptomatology and long term prognoses; how to assess those syndromes using epidemiologic screening tools; and the current state of the art on the impact of working conditions on mental diseases and mental health, and the impact of these on working life.

PUBH.6840 Musculoskeletal Epidemiology (Formerly 19.684) - Credits: 3

An advanced course on methods and content of research on work-related musculoskeletal disorders. Reviews pathophysiology, diagnosis, prevalence, latency and surveillance issues. The key literature is examined with attention to study design, quality of exposure assessment, control of bias and adequacy of statistical analysis.

PUBH.6850 Applied Public Health Research and Practice - Credits: 3

The focus of this course is to provide students with advanced skills necessary to collect quantitative and qualitative data for public health research and practice. Students will learn quantitative methods including questionnaire development, survey planning, data collection, data coding and data management. The course will prepare students to design, conduct, analyze and interpret qualitative research. Strategies for mixed methods research in social and behavioral sciences will be discussed.

PUBH.6860 Program Development and Implementation - Credits: 3

This course is designed to equip students with the knowledge and skills necessary to systematically develop, implement and sustain public health programs and interventions. The course utilizes implementation science, evidence based approaches and
 theoretical frameworks, to promote the adoption and integration of evidence-based practices, interventions and policies in community, health care and other public health settings.

PUBH.6870 Quantitative Models for Public Health - Credits: 3

Emphasis in this course is placed on understanding the underlying assumptions of quantitative models and on gaining an intuitive understanding of the most common modeling procedures. The types of models covered will be those frequently used in the analysis of health and environmental data, for applications such as analysis of survey research, quantitative risk assessment, and pharmacokinetics. Methods to be studied include ordinary least squares, the method of maximum likelihood, Monte Carlo methods, systems of ordinary difference equations, and basic simulation techniques. There will be a diverse set of readings, frequent computer exercises to be worked either individually or in groups, and a final project.

PUBH.6871 Health Communication and Technology - Credits: 3

Students will explore the theories and practice of communication in public health, with a particular emphasis on the role of technology in sharing public health information. The impact of social and environmental factors on the success of health messages, and the relevance of social media and other technology to positively impact issues in population health will be analyzed. The strategic and ethical use of media in developing and implementing effective public health communications is a focus of the course. The targeting of health communication campaigns to populations for the purpose of influencing behaviors and health policy will be examined.

PUBH.6880 Research Synthesis Environmental Health Policy (Formerly 19.688) - Credits: 3

Introduces students to methods used to synthesize, evaluate, and present environmental, epidemiologic, and other scientific data for environmental health policy. Through presentation of a variety of existing methods, case studies, guest lectures, and group projects, students will develop an understanding of the complexities and issues involved in evaluating and synthesizing scientific information for public policy. The course will examine methods for using both quantitative and qualitative research findings.

PUBH.6890 Advanced Regression Modeling (Formerly 19.689) - Credits: 3

This course will cover introductions to several regression methods used in epidemiology to model exposure-response relationships. Topics include simple and multivariate linear regression, logistic regression, Poisson regression, and survival analysis (Cox model). We will introduce other advanced methods such as mixed models, propensity scores and principal component analysis as time allows.

PUBH.6900 Critical Review Health Regulations (Formerly 19.690) - Credits: 3

Course designed to explore the practical applications of epidemiologic methods to the setting of actual standards. Students gain experience in distinguishing minor from major design and analysis flaws. Course is presented as a seminar with four case studies and problem analysis.

PUBH.6950 Chemical Process/Sustainability (Formerly 19.695) - Credits: 3

This course surveys the basis of chemical engineering process design and fundamentals of unit operations. The student will be able to understand the basics of chemical engineering design methods for the purpose of enhancing sustainability of chemical production processes.

PUBH.7010 Independent Study: Industrial Hygiene (Formerly 19.701) - Credits: 3

Advanced topics in industrial hygiene, exposure assessment or exposure control not offered in the regular curriculum. Topics may vary from year to year.

PUBH.7020 Independent Study: Industrial Hygiene (Formerly 19.702) - Credits: 1

Advanced topics in industrial hygiene, exposure assessment or exposure control not offered in the regular curriculum. Topics may vary from year to year.

PUBH.7030 Independent Study: Ergonomics (Formerly 19.703) - Credits: 3

Advanced topics in biomechanics, work physiology, occupational safety or human factors not covered in the regular curriculum. Content may vary from year to year.

PUBH.7040 Independent Study: Ergonomics (Formerly 19.704) - Credits: 1

Advanced topics in biomechanics, work physiology, occupational safety or human factors not covered in the regular curriculum. Content may vary from year to year.
PUBH.7080 Independent Study: Epidemiology
(Formerly 19.708) - Credits: 1

Advanced topics in occupational epidemiology, design and confounding, exposure-response modeling, or surveillance not covered in the regular curriculum. Content may vary from year to year.

PUBH.7090 Independent Studies: Occupational Epidemiology (Formerly 19.709) - Credits: 1

Advanced topics in occupational epidemiology, design and confounding, exposure-response modeling, or surveillance not covered in the regular curriculum. Content may vary from year to year.

PUBH.7110 Independent Study: Industrial Hygiene
(Formerly 19.711) - Credits: 1-3

Advanced topics in industrial hygiene, exposure assessment or exposure control not offered in the regular curriculum. Topics may vary from year to year.

PUBH.7120 Independent Study: Industrial Hygiene
(Formerly 19.712) - Credits: 1-3

Advanced topics in industrial hygiene, exposure assessment or exposure control not offered in the regular curriculum. Topics may vary from year to year.

PUBH.7130 Independent Study: Ergonomics (Formerly 19.713) - Credits: 3

Advanced topics in biomechanics, work physiology, occupational safety or human factors not covered in the regular curriculum. Content may vary from year to year.

PUBH.7150 Independent Study: Work Environment Policy (Formerly 19.715) - Credits: 3

Advanced topics in work environment policy, risk perception, risk communication and management, regulatory affairs or labor-management programs not covered in the regular curriculum. Content may vary from year to year.

PUBH.7170 Independent Study: Epidemiology
(Formerly 19.717) - Credits: 3

Advanced topics in occupational epidemiology, design and confounding, exposure-response modeling, or surveillance not covered in the regular curriculum. Content may vary from year to year.

PUBH.7190 Independent Study: Clean Production
(Formerly 19.719) - Credits: 3

Advanced topics in clean production, pollution prevention, and environmental protection efforts. Not offered in the regular curriculum. Topics may vary from year to year.

PUBH.7210 Selected Topics: Industrial Hygiene
(Formerly 19.721) - Credits: 1-3

PUBH.7230 Selected Topics: Ergonomics (Formerly 19.723) - Credits: 3

PUBH.7250 Epidemiologic Theory (Formerly 19.725) - Credits: 1-3

An advanced seminar in epidemiologic theory. The goal of the course is to develop each student's own theoretical perspective on the field to ground practical problems of study design and analysis. Students read a major text in modern chronic disease epidemiology as well as relevant papers, and discuss and evaluate the perspectives of different authors. Topics include: causality, study designs, measures of disease frequency, measures of association, statistical inference, biases, and confounding.

PUBH.7270 Sel Top: Epidemiology (Formerly 19.727) - Credits: 3

PUBH.7280 Sel Top: Work Env Policy (Formerly 19.728) - Credits: 3

PUBH.7290 Selected Topics: Clean Production
(Formerly 19.729) - Credits: 3

PUBH.7330 Capstone Project (Formerly 32.733) - Credits: 3

Near the end of one's Master's Degree program, students register for Capstone Project and complete an independent study under faculty supervision. The Capstone Project applies concepts and skills learned in the program. It involves research and development, and culminates in a substantial (20 pages or more) business-type report. Many working professionals develop projects related to work assignments. Students are also required to present their Capstone Projects to students, faculty and alumni at a semester-end student recognition event.

PUBH.7331 Graduate Project (Formerly 19.733) - Credits: 3

Advanced research project required of all master's degree candidates in the ergonomics, industrial hygiene, occupational epidemiology and work environment policy concentrations.
PUBH.7350 Independent Study: Policy (Formerly 19.735) - Credits: 3
PUBH.7360 Graduate Project - Work Environment (Formerly 19.736) - Credits: 6
PUBH.7370 Independent Study: Epidemiology (Formerly 19.737) - Credits: 3
PUBH.7390 Graduate Project - Work Environment (Formerly 19.739) - Credits: 9

Advanced research project required of all master’s degree candidates in the ergonomics, industrial hygiene, occupational epidemiology and work environment policy concentrations.

PUBH.7430 Master’s Thesis Research (Formerly 19.743) - Credits: 3
PUBH.7590 Doctoral Dissertation/Work Environment (Formerly 19.759) - Credits: 1-9

Minimum of 18 semester hours of graduate courses at an acceptable level; approval of a written proposal outlining the extent and nature of proposed research work.

PUBH.7610 1-Credit Continued Graduate Research (Formerly 19.761) - Credits: 1

1-Credit Continued Graduate Research course is for students with less than one year to defend or complete program. Part of reduce course load program for international students.

PUBH.7630 Continued Graduate Research (Formerly 19.763) - Credits: 3
PUBH.7700 Directed Readings: Epidemiology Biostatistics (Formerly 19.770 - Credits: 3
PUBH.7750 Capstone/Thesis Review (Formerly 32.775) - Credits: 1
PUBH.7760 Curricular Practical Training (CPT) (Formerly 32.776) - Credits: 0-1

An internship, practicum or other type of employment that is either required by the students academic program or an experience for which a student receives academic credit. To be eligible the student must be in legal F-1 status and have been enrolled full-time for one academic year. CPT work experience must be in the students field of study and contain a curricular component.

PUBH.9990 Intercampus Graduate Research

This course will allow doctorate students to remain active while they are taking courses/research at the other UMASS campuses.
School of Nursing

The UMass Lowell Solomont School of Nursing at offers the following graduate programs:

- Doctoral Program (Ph.D.)
- Post-Master’s Doctorate in Nursing Practice (DNP) Program
- Master’s - Doctor of Nursing Practice Fast Track Program ([http://www.uml.edu/Catalog/Graduate/Health-Sciences/Nursing/Post-Masters-Doctorate.aspx](http://www.uml.edu/Catalog/Graduate/Health-Sciences/Nursing/Post-Masters-Doctorate.aspx))
- Master’s of Science in Nursing
- Bachelor’s-Master’s Program ([https://www.uml.edu/catalog-AY18/pdf/Undergraduate.pdf](https://www.uml.edu/catalog-AY18/pdf/Undergraduate.pdf))

Philosophy

The philosophy of the Solomont School of Nursing reflects beliefs regarding person, environment, health, nursing and education. People have unique, individual qualities and basic needs for respect, worth and recognition of personal dignity. They have the right to make choices and establish goals, which influence and are influenced by the environment. Health is a dynamic state of physiological, psychological, social and spiritual well-being. Nursing is a health care discipline guided by professional standards of care to support individuals, families, groups and communities in the promotion of health throughout the life span.

Education is a self-actualizing, creative, lifetime endeavor involving values clarification, progressive systematic inquiry, critical analysis and judgment. The bachelor’s nursing program incorporates a liberal education with generalized preparation in professional nursing. The masters program is predicated upon a baccalaureate nursing education and prepares individuals as advanced practice nurses. The doctoral program builds on both the generalized preparation in professional nursing and the specialist preparation at the masters level to prepare nurse scholars in health promotion.

Master of Science in Nursing

The UMass Lowell School of Nursing offers a master’s program in nursing that emphasizes depth of knowledge and excellence in nursing in two areas of specialization: Adult-Gerontological Nursing and Family Health Nursing.

- Program Outcomes
- Admission and Degree Requirements
- Degree Pathway
- Areas of Specialization

Description of Program

The objectives of the masters program curriculum are to provide advanced practice nursing education which focuses on:

1. Health promotion of individuals, families and groups from diverse populations;
2. Management of health problems in collaboration with client, families, and health professionals;
3. Leadership in the profession; and

The graduate program is designed for a four-semester, two-calendar year schedule, although part-time study is possible. Within each major area of specialization all students are prepared with knowledge and skills necessary for leadership in a variety of settings. Methods of inquiry, research and scholarly techniques are integral parts of the curriculum.

Program Outcomes

The masters degree program educates graduates who are prepared to:

1. Practice in the advanced nursing role of the specialty
2. Collaborate with clients, peers, and other health professionals
3. Demonstrate leadership in the profession of nursing.

Admission and Degree Requirements

Requirements for the master’s program are:

- A baccalaureate degree with a major in nursing from an accredited program,
- An undergraduate scholastic average of 3.0 or better,
- Official transcripts, from all of your previous degree coursework (Associates and Bachelors in Nursing) as well as any completed or in progress graduate courses.
- An introductory course in statistics. Course grade must be on transcripts.
License to practice nursing in the Commonwealth of Massachusetts. Out of state RN licenses are accepted for application review, but all accepted students will need to obtain Massachusetts License prior to practicum courses.

Experience working as an RN prior to enrolling in Advanced Health Assessment and subsequent Specialty courses.

A resume, summarizing educational and professional nursing experience and any other related honors, special skills or certifications.

Three letters of recommendation preferably from nursing faculty, supervisors or nurse leader in your organization. All recommendations should be sent to graduate admissions using the link and if addendum documents are attached they should be on hospital/school/agency letterhead and signed by the author of the recommendation. Recommendation should address your academic ability and professional qualifications as well as your potential for success in a graduate NP program.

Written Statement: A goal statement that briefly highlights relevant work history and immediate and long term professional goals as an advanced-practice nurse. Goal statements should be congruent with the specialty tracks offered at UMass-Lowell (FNP or AGNP) and demonstrate an understanding of the scope of the advanced practice nurse in ambulatory, long term care settings.

Computer literacy with WORD, email, internet searches and electronic learning platforms and programs.

Completed application and fees.

GRE’s are not required fro the MS program

A minimum of 42 credits of course work is required for graduation with an MS for all students. A research project or a thesis is an option but not required for graduation.

Students may be admitted for part-time study. Part-time students must meet the same admission requirements for graduate study as full-time students. Part-time students will meet with their assigned advisor and plan a schedule for their program of studies. All admitted students are advised to contact their assigned advisors for program of study recommendations and to register for courses during University advisement periods (April and November).

Transfer of credits for non-matriculated students: The maximum number of credits that can be transferred from non-UMass Lowell programs is 6 credits. Prospective students can take up to an additional 6 credits from UMass Lowell prior to matriculation and can be applied to the MS degree.

Those taken at another accredited institution may be transferred if appropriate to the MS degree program in nursing and after approval by the faculty of record for the UMass Lowell course and the petition signed by the Graduate Coordinator. To qualify for transfer, the course must have been taken within 5 years prior to the date of matriculation. Transfer of credits may not be granted for Advanced Health Assessment, Specialty Courses or Specialty Practicum courses.

Admission is competitive. Admission is competitive and only completed applications will be reviewed. It is the responsibility of the applicant to check their electronic admission file for completion of checklist items. Applications are accepted on a Rolling Admission basis for the Fall and Spring matriculation. Full-Time Students are generally admitted to the Fall Semester and can complete the degree in 2 years (4 semesters). Part-Time students can complete the degree in 3-5 years. Please seek advice from Valerie King Coordinator of the MS/NP program for appropriate courses to take as a non-matriculated student. Upon admission, these courses can be transferred via petition.

Additional Information

The following health and professional documentation is required upon admission: Current CPR certification, RN nursing license, required immunizations (or titers indicating immunity) influenza, Hepatitis B, MMR, Tdap, varicella, PPD; and recent health exam by health care provider. In addition, every student must be cleared by CORI (Criminal Offender Record Information). Students who cannot provide this information will be unable to complete required clinical practicum.

Degree Pathway for full time option*

Semester I

- NURS.6000 Theoretical Foundations for Nursing (3 credits)
- HSCI.5500 Human Development &Pathophysiology (3 credits)
- NURS.6510 Advanced Health Assessment and Diagnostic Reasoning (3 credits)
- TOTAL: 9 credits

Semester II
This specialty focuses on promoting health of young adults age 13 and up, adults and older adults during the process of normal aging and identifying and treating common health problems. Students develop advanced skills in communicating with young adults, adults and older adults, health assessment, health teaching and nursing intervention and evaluation. Students are prepared as nurse practitioners and eligible to sit for the adult gerontological primary care nurse practitioner certification exam.

**Specialty Courses:**
- NURS.6500 Family and Adult-Gerontological Advanced Practice Nursing I
- NURS.6130 Adult-Gerontological Nursing Practicum I
- NURS.6110 Adult-Gerontological Nursing II
- NURS.6140 Adult-Gerontological Nursing Practicum II
- NURS.6120 Adult-Gerontological Nursing III

**Family Health Nursing**
- Family Health Specialty Track Degree Pathway Full Time Information (https://www.uml.edu/docs/MS%20in%20Nursing%20Degree%20Pathway%20FNP%20Track%20Full%20and%20Part%20Time%20October%202015_Final_tcm18-231675.pdf) (pdf)
- Family Health Track Degree Pathway Part Time Information (https://www.uml.edu/docs/MS%20in%20Nursing%20Degree%20Pathway%20FNP%20Track%20Full%20and%20Part%20Time%20December%202015_tcm18-232575.pdf) (pdf)

This specialty focuses on facilitating the health practices of families during the process of normal development and identifying and treating common health problems across the life span. Students develop advanced skills in communicating with families, health assessment, health teaching and nursing intervention and evaluation. Students are prepared as nurse practitioners and are eligible to sit for the family nurse practitioner certification exam.

**Specialty Courses:**
- NURS.6500 Family and Adult Gerontological Advanced Practice Nursing I
- NURS.6630 Family Health Nursing Practicum I
Ph.D. in Nursing Program
The Doctor of Philosophy in Nursing Program at UMass Lowell is a research-focused doctoral degree in nursing with a focus in health promotion. The focus in health promotion allows students to acquire cutting edge knowledge in the field of health promotion, a top priority in the nation. The executive program model uses a cohort system, which allows students to progress through the program together, either part-time or full-time. Students generally attend core nursing courses once/month on a Saturday; the remaining course modules are conducted online. Graduates will advance knowledge in the fields of nursing and health promotion at the individual, family and community level.

Requirements include:
1. B.S. degree in nursing with a minimum G.P.A. of 3.3
2. A masters degree in Nursing or health-related field with a minimum GPA of 3.3
3. A current Massachusetts R.N. license or eligibility (International students may waive this requirement but must have an equivalent nursing degree and will be evaluated on an individual basis)
4. An official transcript of all previous academic records (both graduate and undergraduate)
5. Official GRE score results, taken within the past 5 years.
6. A personal statement about the applicants interest in the program that includes professional goals
7. Three letters of recommendation from individuals who can assess the applicants potential for doctoral work
8. A recent Curriculum Vitae
9. International students must submit evidence of an equivalent undergraduate program in nursing and masters program in nursing or related field.
10. International students must submit an acceptable TOEFL or IELTS score.

NOTE: GREs are required. Completion of a graduate course in statistics is strongly recommended; Writing examples are also highly recommended to accompany the personal statement.

The Ph.D. Admissions Committee is chaired by the Ph.D. Program Director and comprised of at least one other faculty member who teaches in the graduate program. The Admission Committee will interview applicants and make the final decision. There are three types of decisions:

1. Accept
2. Accept with conditions, or
3. Deny

The application process is described as follows:

- The applicant logs onto Graduate Admissions website to obtain all required application forms and documents.
The applicant completes the application form online and pays the fee.

- The applicant submits documents online to Graduate Admissions Office as they are ready.
- The Graduate Admissions Office notifies the Director of Ph.D. Program in Nursing once the application is complete.
- The Ph.D. Admissions Committee reviews all applicants to determine candidates to interview.
- The Ph.D. Admissions Committee conducts interview for those who passed the initial review.
- The Ph.D. Admissions Committee makes a decision and submits it to Graduate Admissions.
- The applicant receives a letter from Graduate Admissions for either acceptance or denial.

Degree Requirements

The doctoral program in nursing with a focus in health promotion requires a total of 48 semester credits beyond the masters degree. Students may enroll full or part-time. Part-time students are expected to enroll with their cohort for a minimum of 2 courses/semester in the first two years. A sample program of studies for full and part time students includes:

Sample Course of Study (Full Time) - Degree Pathway (https://www.uml.edu/docs/PhD%20in%20Nursing%20Degree%20Pathway%20Full%20and%20Part%20Time%20October%202015-Final_tcm18-248375.pdf)

Sample Full Time Plan of Study - UMass Lowell Ph.D. Nursing Program

**Fall Semester Year 1**

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Name</th>
<th>Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURS.7010</td>
<td>Philosophy of Science (weekend blended format; 1 Saturday/month with 3 online modules)</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7020</td>
<td>Theoretical Foundations of Health Promotion (blended)</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7070</td>
<td>Epidemiology in Health Promotion (online)</td>
<td>3</td>
</tr>
</tbody>
</table>

Total: 9 credits

**Spring Semester Year 1**

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Name</th>
<th>Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUBH.5770</td>
<td>Introduction to Biostatistics (evening on campus)</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7300</td>
<td>Quantitative Research Methods and Grantsmanship ONLINE</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7160</td>
<td>Qualitative Methods (blended)</td>
<td>3</td>
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</table>

Total: 9 credits

**Summer Semester Year 1**

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Name</th>
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</thead>
<tbody>
<tr>
<td>XXXX.xxxx</td>
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</table>

Total: 3 credits

**Fall Semester Year 2**

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Name</th>
<th>Cr.</th>
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</thead>
<tbody>
<tr>
<td>PUBH.6890</td>
<td>Advanced Regression Modeling (evening on campus)</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7310</td>
<td>Health Promotion Research (blended)</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7130</td>
<td>Curriculum and Teaching in Nursing (blended)</td>
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</tr>
</tbody>
</table>

Total: 9 credits

**Spring Semester Year 2**

<table>
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<tr>
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<tbody>
<tr>
<td>NURS.7060</td>
<td>Measurement (blended)</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7390</td>
<td>Mentored Research Experience (web)</td>
<td>3</td>
</tr>
<tr>
<td>Qualifying Examination</td>
<td></td>
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Total: 6 credits

**Fall Semester Year 3**

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Cr.</th>
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</thead>
<tbody>
<tr>
<td>NURS.7070</td>
<td>Epidemiology in Health Promotion (online)</td>
<td>3</td>
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</tbody>
</table>

Total: 9 credits

**Total: 48 credits**
Course# | Course Name | Cr.
--- | --- | ---
NURS.7530 | Dissertation Credits (Proposal Hearing) | 6

Spring Semester Year 3

Course# | Course Name | Cr.
--- | --- | ---
NURS.7530 | Dissertation Credits | 6

Fall and Spring Semester Year 4

Course# | Course Name | Cr.
--- | --- | ---
NURS.7530 | Dissertation Credits (Dissertation Defense) | 3-6

TOTAL PROGRAM CREDITS: 48

Sample Course of Study (Part Time)

Sample Part Time Plan of Study - UMass Lowell Ph.D. Nursing Program

Fall Semester Year 1

<table>
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<td>NURS.7010</td>
<td>Philosophy of Science (weekend blended format; 1 Saturday/month with 3 online modules)</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7020</td>
<td>Theoretical Foundations of Health Promotion</td>
<td>3</td>
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Total: 6 credits

Spring Semester Year 1

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<tr>
<td>PUBH.5770</td>
<td>Introduction to Biostatistics (evening on campus)</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7360</td>
<td>Quantitative Research Methods and Grantsmanship ONLINE</td>
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Total: 6 credits

Summer Semester Year 1

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<tbody>
<tr>
<td>-</td>
<td>Elective</td>
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Total: 3 credits

Fall Semester Year 2

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</table>

Total: 6 credits

Spring Semester Year 2

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<tr>
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<th>Course Name</th>
<th>Cr.</th>
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</thead>
<tbody>
<tr>
<td>NURS.7160</td>
<td>Qualitative Methods</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7060</td>
<td>Measurement OR NURS.7370 Advanced Qualitative Methods</td>
<td>3</td>
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</table>

Total: 6 credits

Fall Semester Year 3

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<tbody>
<tr>
<td>NURS.7310</td>
<td>Health Promotion Research</td>
<td>3</td>
</tr>
<tr>
<td>NURS.7130</td>
<td>Curriculum and Teaching in Nursing(online)</td>
<td>3</td>
</tr>
</tbody>
</table>

Total: 6 credits

Spring Semester Year 3

<table>
<thead>
<tr>
<th>Course#</th>
<th>Course Name</th>
<th>Cr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURS.7390</td>
<td>Mentored Research Experience - Qualifying Examination</td>
<td>3</td>
</tr>
</tbody>
</table>

Fall and Spring Semester Year 4

| Course# | Course Name | Cr. |
**Doctorate in Nursing Practice (DNP) Program**

**About the Program**

Our DNP program educates advanced practice registered nurses and nurse leaders who seek to develop or expand their leadership roles in the health care system. With the knowledge and skills acquired through UML’s DNP program, our graduates will be prepared to propose solutions to improve patient care and health care outcomes. This is achieved through an interdisciplinary curriculum which provides nurses with knowledge and skills in evaluation research, health policy, organizational leadership, an financing, evidence-based practice and health care informatics. Our DNP graduates will have a positive impact on the health care system by using an evidence-based approach to improve health care delivery.

By enriching our DNP program with content on cultural competency, DNP graduates are prepared to reduce health care disparities for culturally diverse and underserved populations. Our graduates will also have advocacy skills that are essential in influencing governmental and organizational policy decisions.

The degree pathway in the Post-Masters DNP Program will be 3 academic years part-time in length. Full-Time study is available. Courses are delivered in a combination of online and blended formats. Both full-time and part-time degree pathway are available.

**Entry Options:**
- Post Master’s DNP
- Fast Track MS to DNP

**Post-Masters Doctorate of Nursing Practice Program**

**Specific application requirements include:**
- Program application submitted to the Graduate Admissions office
- MS in Nursing with APRN preparation with national certification as an APRN or board eligible for certification OR MS in Nursing with a current RN license
- Prior official transcripts from undergraduate and graduate programs
- Three letters of recommendation (one academic recommendation preferred)
- Interview with nursing faculty
- Minimum cumulative GPA of 3.0 on a 4.0 scale in a nursing Masters degree program, 3.3 GPA preferred.

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**Nursing Qualifying Examination**

The qualifying examination is designed to determine the student’s ability to analyze and synthesize conceptual, theoretical and methodological knowledge as it pertains to health promotion within a substantive research area. The examination provides a method of assessment to ascertain if the student is ready to advance to the dissertation stage. It consists of two written publishable papers, that are focused on: a concept or theory; a systematic review on a specific topic related to the student’s research area; or a paper related to research methods. Both papers will be original, critical evaluations that relate to the student’s identified research area. Students are eligible to complete the qualifying examination after completion of all of the core courses (33 credits).

**Dissertation**

Dissertation planning may be initiated in the first year, but formal work begins following successful completion of the Nursing Qualifying Examination and all course work. At this time a Dissertation Committee is formed to direct the student’s research. The dissertation requirement is designed to demonstrate that the student has acquired a substantial body of knowledge related to the selected field of study, has developed the ability to use appropriate data analysis methods, and has contributed to the advancement of nursing knowledge related to health promotion. The student’s dissertation work must be original and represent a unique contribution to the literature.

**Contact:**

Barbara Mawn, Ph.D., RN (mailto:barbara_mawn@uml.edu)
Ph.D. Program Director
113 Wilder Street, Suite 200 Lowell MA 01854
Office Location: Health and Social Science Building, Room 200
978-934-4485
• Written narrative of professional goals
• 500 Master’s or Post-Master’s practicum hours
• Resume
• TOEFL if appropriate

Priority application deadline is April 1. Admission is competitive. Applications received after that date will be reviewed on a space available basis.

Post MS DNP Curriculum

- Degree Pathway Information
  (https://www.uml.edu/docs/PATHWAY%20PT_tcm18-229932.pdf)

Fast Track MS to DNP Curriculum

- Degree Pathway Information
  (https://www.uml.edu/docs/PATHWAY%20FT_tcm18-229933.pdf)

Contact

Susan Parker, DNP, APRN, GNP-BC
(mailto:susan_parker1@uml.edu)
Phone: 978-934-4685

Graduate Certificates in Nursing

At this time the Graduate Certificates in Nursing are on hold.
NURS.5220 Independent Study Health Promotion (Formerly 33.522) - Credits: 1-3

Health Promotion gerontological clinical practicum is designed to be taken as a co-requisite to 33:611 Gerontological Nursing II didactic, in which the student focuses on comprehensive assessment and diagnosis of health problems in older adults with complex, multi-system health issues. Students utilize evidence-based research to design, implement and evaluate intervention strategies to promote optimum functioning and wellness. Pharmacological and complementary therapies are applied. Client teaching is included.

NURS.5520 Social, Cultural and Policy Issues in Health Care (Formerly 33.552) - Credits: 3

This course links health and illness to other central domains of life: gender, kinship, and culture within the context of the family, community and the current health care system. It draws on concepts from the social, health, and policy sciences to critically examine factors relating to health and health-seeking behaviors across the life course. Ethical dimensions of health policy formation and implementation are analyzed.

NURS.5530 Scholarly Writing - Credits: 2

This course provides an overview of, and introduction to the concepts and skills of scholarly writing as it pertains to scientific reports and papers. Course topics will include scientific literature searches, organizations of research papers and reports, ethical and authorship considerations, and steps in critiquing one’s own and others’ writing. Course objectives will be accomplished by reading and critiquing professional writing, creating original written work, and integrating feedback to improve work.

NURS.5540 Palliative and End of Life Nursing Care (Formerly 33.554) - Credits: 3

Through didactic, discussion and field experiences, participants in this course explore research and theory related to death, dying, grief, bereavement, and end-of-life-care throughout the lifespan. Personal, professional, cultural, and ethical barriers and facilitators to the provision of palliative care will be examined using a holistic approach. Comfort and restorative care will be considered within the context of the family and the community in a variety of settings where palliative care is provided.

NURS.5580 Geropsychiatric and Mental Health Nursing (Formerly 33.558) - Credits: 3

The focus of this course is on the nursing care of older adults with psychiatric and mental health problems. This course promotes a holistic approach to mental health care of older adults within the community and long-term care setting. Nursing implications of psychopharmacology, behavioral, and complementary interventions will be discussed. Community resources for older adults with psychiatric and mental health problems will be explored.

NURS.5590 Advanced Pharmacology (Formerly 33.559) - Credits: 3

This nursing course focuses on clinical pharmacology and the mechanisms of drug action which determine therapeutic efficacy in clinical practice. Content includes basic pathophysiology, clinical pharmacology and monitoring parameters and standards of practice. Emphasis is given to implications of patient safety, patient diversity and patient teaching.

NURS.6000 Theoretical Foundations for Advanced Nursing Practice (Formerly 33.600) - Credits: 3

Course focuses on the analysis, critique, and application of theory as a basis for advanced practice nursing. Relationships among theories, research, and nursing practice are emphasized.

NURS.6010 Research for Evidence-Based Practice (Formerly 33.601) - Credits: 3

Course focuses on the critique of research studies for the purpose of determining implications for evidence-based practice. The research process will be applied to researchable nursing problems. The role of frameworks, ethics, research designs, sampling theory, and measurement strategies are emphasized.

NURS.6020 Clinical Psychopharmacology (Formerly 33.602) - Credits: 3

This survey course aims to educate advanced practice nurses for safe and effective prescribing practices in the treatment of psychiatric illnesses. The course utilizes a symptom management framework that integrates concepts from normative psychobiology with pathophysiology of the psychiatric diseases. From this perspective, emphasis is placed on gaining a fundamental understanding of the hypothesized compliment between the pathophysiologic basis of the disease state and mechanism of action of the drug treatment as a basis for rational selection of pharmacologic treatment. Current standards of practice and treatment algorithms are emphasized in helping the student to develop a working knowledge of psychopharmacology for the practice arena.

NURS.6040 Directed Study: Multiple Topic - Credits: 4
NURS.6100 Adult Gerontological Nursing I (Formerly 33.610) - Credits: 4

The focus of this course is on the advanced practice nursing role in the holistic assessment and management of health problems of the adult and older adult within a family and community context. Evidence-based strategies to prevent and treat common health problems and to maintain and promote health through the application of advanced knowledge, theory, relevant research and critical decision making are emphasized. Community resources, pharmacological therapies, and complementary strategies are addressed.

NURS.6110 Adult Gerontological Nursing II (Formerly 33.611) - Credits: 4

The focus of this course is on health promotion and biopsychosocial well-being of young, middle aged and older adults from diverse cultures. Utilizing current scientific research, physical/natural sciences, social sciences, and the humanities, implications for advanced nursing interventions and health policy are identified. Principles of pharmacology and pharmacological therapies, and complementary therapies are addressed.

NURS.6120 Adult/Gerontological Nursing III (Formerly 33.612) - Credits: 4

This capstone course builds on the adult/gerontological nursing curriculum of the previous three semesters. Issues related to health care policy and legislation relative to their impact on the role of the nurse practitioner within primary care are analyzed. Advanced knowledge of the management of complex health issues is integrated in nursing practice. Transition to the role of the advanced practice nurse is examined and actualized through an intensive, precepted, clinical experience.

NURS.6130 Adult Gerontological Nursing Practicum I (Formerly 33.613) - Credits: 3

This course focuses on comprehensive assessment and diagnosis of health problems in adults and older adults with complex, multi-system health issues. Students utilize evidence-based research to design, implement and evaluate intervention strategies to promote optimum functioning and wellness. Pharmacological and complementary therapies are applied. Group leadership, client and peer teaching are included.

NURS.6140 Adult-Gerontological Nursing Practicum II (Formerly 33.614) - Credits: 3

The focus of this course is on promotion of biopsychosocial well-being of adults and older adults through comprehensive assessment of health, the diagnosis of age-related changes and health problems, and the design, implementation and evaluation of pharmacologic and complementary intervention strategies. The application of scientific knowledge, theory and research findings to clinical practice is emphasized.

NURS.6500 Family and Adult-Gerontological Advanced Practice Nursing I - Credits: 4

Focus is on the advanced practice nursing role in the holistic assessment and management of health problems of the adolescent, adult, and older adults, within a family and community context. Evidence-based strategies are applied to the prevention, treatment, and management of acute and chronic health problems. Health promotion and maintenance are emphasized through the application of advanced knowledge, theory, research, and critical decision-making. Community resources, pharmacological therapies, and complementary strategies are integrated throughout the course.

NURS.6510 Advanced Health Assessment and Diagnostic Reasoning (Formerly 33.651) - Credits: 3

This course focuses on the development of advanced critical thinking and clinical judgment skills through comprehensive health assessment. Health promotion and health maintenance content, including relevant research findings are utilized to evaluate health status and to evaluate health risk among individuals and groups. Age, gender, and cultural variations in health and implications for advanced practice are included. Advanced practice health assessment skills are developed and refined.

NURS.6600 Family Health Nursing I (Formerly 33.660) - Credits: 4

Focus is on the advanced practice-nursing role in the holistic assessment and management of health problems of the family across the lifespan within a family and community context. Evidence-based strategies to prevent and treat common health problems and to maintain and promote health through the application of advanced knowledge; theory, relevant research and critical decision-making are emphasized. Community resources, pharmacological therapies, and complementary strategies are addressed.

NURS.6610 Family Health Nursing II (Formerly 33.661) - Credits: 4

The focus of this course is on health promotion and management of common health issues pertaining to woman and to infants, children, and adolescents. Based on current scientific research, students develop skills in analyzing data, differential diagnosis, and developing holistic plans of care that address the health promotion, illness prevention, and primary
care needs of a wide-variety of client populations.

NURS.6620 Family Health Nursing III (Formerly 33.662) - Credits: 4

This capstone course builds on the family nursing curriculum of the previous three semesters. Issues related to health care policy and legislation relative to their impact on the role of the nurse practitioner within primary care are analyzed. Advanced knowledge of the management of complex health issues is integrated into nursing practice. Transition to the role of the advanced practice nurse is examined and actualized through an intensive, precepted, clinical experience.

NURS.6630 Family Health Nursing Practicum I (Formerly 33.663) - Credits: 3

The focus of this course is on the advanced practice-nursing role in the holistic assessment and management of health problems of the family across the lifespan within a family and community context. Evidence-based strategies to prevent and treat common health problems and to maintain and promote health through the application of advanced knowledge, theory, relevant research and critical decision-making are emphasized. Community resources, pharmacological therapies, and complementary strategies are addressed.

NURS.6640 Family Health Nursing Practicum II (Formerly 33.664) - Credits: 3

This course focuses on health promotion, illness prevention, and treatment through the comprehensive assessment and management of common health issues of infants, children, adolescents and woman in the context of family and social environments. Application of theory, knowledge, and research findings to clinical practice is emphasized. The utilization of current clinical technologies is introduced.

NURS.6770 Thesis Review (Formerly 33.677) - Credits: 1

NURS.6890 Scholarly Project/Capstone (Formerly 33.689) - Credits: 3

This capstone project affords the student the opportunity for further knowledge development in an area of interest and learning need. The faculty-guided experience involves the development of a scholarly project which may involve a number of options: a scholarly review of the literature in a specific area; development of clinical teaching materials related to some dimension of sleep and/or sleep disorders; or a translational research project whereby a body of current research is interpreted for application to practice. The project will be negotiated with the faculty of record to meet the objectives of the course.

NURS.7010 Philosophy of Science (Formerly 33.701) - Credits: 3

This course provides doctoral students in nursing with philosophical perspectives in science, the nature of knowledge and its development, nursing knowledge development and philosophical underpinning to theory development, methods in scientific inquiry.

NURS.7020 Theoretical Foundations of Health Promotion (Formerly 33.702) - Credits: 3

Study of the multidisciplinary theories, which direct or have the potential to direct inquiry in health promotion. Course content is derived from nursing, anthropology, psychology, sociology, economics, medicine and management.
Credits: 3
The study of highly specific content area related to the student’s dissertation topic. Course objectives and projects are jointly designed by student and faculty member. No more than 1 independent study is acceptable as cognate credit.

NURS.7160 Qualitative Methods (Formerly 33.716) - Credits: 3
The study of predominating qualitative methodology in the health sciences literature. Emphasis is on phenomenology, ethnography, life history/narrative, critical incidents, grounded theory, case study, and associated methodologies.

NURS.7170 Evaluation Research (Formerly 33.717) - Credits: 3
This course focus is on the basic concepts of evaluation research and their application to education, health and social programs. Specific design and analytic approaches that effect quality evaluation research will be reviewed. Students will design a mock evaluation study. Prerequisites: Completion of a graduate level research methods course.

NURS.7180 Directed Study (Formerly 33.718) - Credits: 1-4
NURS.7300 Quantitative Research Methods and Grantsmanship (Formerly 33.730) - Credits: 3
This course introduces students to strategies and methods in research including an analysis of theoretical and empirical links, operationalization of concepts, research design, and ethics in behavioral research. Students will identify appropriate funding sources and complete a research grant application.

NURS.7310 Health Promotion Research (Formerly 33.731) - Credits: 3
This course focuses on interdisciplinary health promotion research that targets diverse individuals, families, groups, and communities/society. Students will identify and analyze ethical issues, philosophical and conceptual underpinnings, measurement principles and major gaps in current knowledge in nursing and health promotion. Students will critique research approaches to health promotion studies and propose a research study in a topic relevant to health promotion.

NURS.7330 Graduate Project - Nursing (Formerly 33.733) - Credits: 3
Course focus is on application of the nursing research process. The student actively engages in at least two aspects of research under the guidance of a faculty mentor. The course product has practical implications for nursing practice.

NURS.7370 Advanced Qualitative Methods (Formerly 33.737) - Credits: 3
This course will focus on the in-depth historical and philosophical underpinnings of qualitative research. The student will examine and critique various analytic qualitative methods. The student will complete a project incorporating qualitative analysis using a qualitative software program.

NURS.7380 Mentored Research Experience (Formerly 33.738) - Credits: 3
In this course students participate in a mentored research experience. Opportunities are provided for the application of research skills using an interdisciplinary approach. Students conduct health promotion research and undertake a leadership role in the dissemination of culturally competent scholarship to improve nursing and health promotion practice.

NURS.7390 Mentored Research Experience (Formerly 33.739) - Credits: 3
In this course, students participate in a mentored research experience. Students actively contribute as a member of a research study that will contribute to scientific knowledge. Opportunities are provided for the application of research skills and the dissemination of research with an emphasis on an interdisciplinary approach. This course also includes a monthly seminar, which focuses on ethical underpinnings, cultural considerations and disparities in health research.

NURS.7430 Master's Thesis - Nursing (Formerly 33.743) - Credits: 3
Course focus is on the application of the full research process to a topic relevant to nursing practice and/or health outcomes. The student is expected to propose, conduct and defend the study under the guidance of a designated faculty thesis committee.

NURS.7530 Doctoral Dissertation (Formerly 33.753) - Credits: 1-6
A structured series of sequenced seminars which guides students through dissertation proposal development, defense, collection and analysis of data. The first seminar concludes with the development of Chapters I and II of the dissertation; the second seminar concludes with defense of the proposal; and the third seminar culminates in the development of discussion and conclusions of the dissertation effort.
NURS.7560 Doctoral Dissertation (Formerly 33.756) - Credits: 6
A structured series of sequenced seminars which guides students through dissertation proposal development, defense, collection and analysis of data. The first seminar concludes with the development of Chapters I and II of the dissertation; the second seminar concludes with defense of the proposal; and the third seminar culminates in the development of discussion and conclusions of the dissertation effort.

NURS.7590 Doctoral Dissertation (Formerly 33.759) - Credits: 9
A structured series of sequenced seminars which guides students through dissertation proposal development, defense, collection and analysis of data. The first seminar concludes with the development of Chapters I and II of the dissertation; the second seminar concludes with defense of the proposal; and the third seminar culminates in the development of discussion and conclusions of the dissertation effort.

NURS.7610 Continued Grad Research (Formerly 33.761) - Credits: 1
Continued Grad Research

NURS.7630 Continued Graduate Research (Formerly 33.763) - Credits: 3
NURS.7690 Continued Graduate Research (Formerly 33.769) - Credits: 9
NURS.7700 Evidence Appraisal (Formerly 33.770) - Credits: 3
In this course the student will explore the role of the DNP in evaluating evidence to inform practice. The student will also identify a critical issue or influential trend within the health care system that impacts health care delivery. Methods relevant to reviewing, analyzing, synthesizing, and applying evidence from the scientific literature will be discussed. Models of systematic reviews of the literature will be explored and implemented. Decisions will be made relative to the student's topical area of interest and identification of the Scholarly Project Chair.

NURS.7710 Advanced Nursing Leadership and Management (Formerly 33.771) - Credits: 3
This course consists of a seminar and leadership experience. The seminar will explore the major concepts in leadership and management and their application in the health care setting.

The role of DNP will also be discussed in terms of leadership in the health policy, education, and clinical settings. A leadership project will be completed by the end of the semester.

NURS.7720 Scholarly Project Implementation (Formerly 33.772) - Credits: 3
In this course, the student will implement the Scholarly Project according to DNP Scholarly Project guidelines. Building on the previous semesters; course work and proposal design, students will meet in seminar every other week on campus to share progress on the project and to discuss issues related to implementation. Seminars will serve to guide students through the phases of the scholarly project implementation and evaluation.

NURS.7730 Evidence Dissemination, Advocacy & Policy (Formerly 33.773) - Credits: 3
This course will include a weekly seminar. The students will complete the scholarly project by undertaking dissemination activities. The student will analyze policies influencing DNP practice and quality, cost, and access to health care and participate in the policy making process.

NURS.7740 Scholarly Project Design (Formerly 33.774) - Credits: 3
In this course, the student will design and present the Scholarly Project proposal. Students will meet biweekly with the scholarly project chair to develop the DNP scholarly project using knowledge acquired in previous course work. Students will complete a University of Massachusetts Lowell Institutional Review Board application that considers ethical and cultural issues related to the scholarly project.

NURS.7750 DNP Practicum (Formerly 33.775) - Credits: 3
In this course the student will be involved in individualized practical experiences to assist in meeting doctoral competencies. The foci may include direct clinical care practicum, or non-clinical practicum experiences with populations, systems, organizations, and/or policy.

NURS.7770 Independent Study: Practicum in Nursing Education (Formerly 33.777) - Credits: 3
In this independent study practicum students will apply knowledge of curriculum and teaching in nursing in an educational setting under the mentorship of a nursing faculty member. Students will actively engage in curriculum development, evaluation and refinement, course preparation, classroom and clinical teaching, and student evaluation.
nurse educator role will be explored.

NURS.7930 Cooperative Education (Formerly 33.793)
- Credits: 1
Kennedy College of Sciences

The UMass Lowell Kennedy College of Sciences fosters critical and creative thinking for future solutions to environmental, economic and human problems, while helping students to develop the capacity to respond to a changing world.

A wide range of ongoing research and project opportunities exist within the various degree programs, and interdisciplinary study is emphasized. Graduates of these programs are heavily recruited both regionally and nationally by industry and governmental agencies.

Faculty in the Kennedy College of Sciences
(https://www.uml.edu/Sciences/faculty-list.aspx)

NOTE: links to department catalog section at bottom of this page.

Graduate Programs Offered

**Master of Science (MS)** - degree awarded in the following fields:

- Biological Science
- Biotechnology Option
- Professional Science Master's Options (Applied Biotechnology, Biosafety, Environmental Biotechnology, Project Management for Life Sciences)
- Chemistry
- Computer Science
- Environmental Studies
- Atmospheric Sciences (Concentration)
- Marine Sciences and Technology
- Professional Science Master's Option (Coastal and Ocean Administration, Science and Technology)
- Mathematics
- Applied Mathematics Option
- Mathematics for Teachers Option
- Probability and Statistics Option
- Scientific Computing Option
- Professional Science Master's Option (Industrial Mathematics)
- Physics
- Optical Sciences Option
- Radiological Sciences and Protection

- Professional Science Master's Option (Radiological Protection)

**Doctor of Philosophy (PH.D.)** - degree awarded in the following fields:

- Chemistry
  - Biochemistry Option
  - Environmental Studies Option
  - Green Chemistry Option
- Computer Science
  - Bio/Cheminformatics Option
  - Mathematical Science Option
- Marine Sciences and Technology
- Physics
  - Applied Mechanics Option
  - Atmospheric Sciences Option
  - Energy Engineering Option
  - Radiological Sciences Option
- Polymer Science
  - Polymer Science/Plastics Engineering Option

Links to Department Sections in This Graduate Academic Catalog:

- Biological Sciences
- Chemistry
- Computer Science
- Environmental, Earth & Atmospheric Sciences
- Marine Sciences and Technology
- Mathematical Science
- Physics & Applied Physics
- Radiological Sciences and Protection
Department of Biological Sciences

The following degree programs are available:

- Doctor of Philosophy in Biomedical Engineering and Biotechnology (Interdisciplinary)
- Doctor of Philosophy in Chemistry Biochemistry Option (see full description in Chemistry section) (Interdisciplinary)
- Doctor of Philosophy in Marine Science and Technology (Interdisciplinary)
- Master of Science in Marine Science and Technology (Interdisciplinary)
- Master of Science in Biological Sciences - Professional Science Master’s Options: Applied Biotechnology, Biosafety, Environmental Biotechnology, Project Management for Life Sciences
- Master of Science in Biological Sciences
- Master of Science in Biological Sciences - Biotechnology Option
- Graduate Certificates: Biotechnology and Bioprocessing, Environmental Biotechnology, Molecular and Cellular Biotechnology

Facilities

The Departmental research and teaching instrumentation includes an array of centrifuges (ultraspeed, superspeed, microfuges), electrophoresis equipment (prep and analytical for proteins and nucleic acids, sequencing, isoelectric focusing, pulsed-field), PCR thermal cyclers, HPLC perfusion and other chromatography equipment; UV-visible and fluorescence spectrophotometers, scintillation spectrometers, various microscopes (transmission EM, fluorescence, confocal, inverted phase), microinjection apparatus, flow cytometer, Coulter counter, speed vac, electroporator, microtiter plate reader, fermenters, laminar-flow hoods, and numerous incubators, baths, and ovens for cell growth and temperature-controlled reactions. The facilities include dark rooms, X-ray facility, temperature-controlled plant and animal cell culture incubation chambers and walk-in rooms, and animal quarters. Labs and offices have Internet access and extensive computer facilities such as computerized image processing and microdensitometry. A new bioinformatic computational lab containing 20 new Dell and PC computers and several iMac stations has recently been opened within the department. Highly specialized equipment in the Center for Advanced Materials in the Chemistry Department, such as transmission and scanning electron microscopes, scanning tunneling-atomic force microscope, secondary ion mass spectrophotometers, and X-ray diffractometers, are available for faculty and student research.

Faculty Research Interests

The graduate faculty in the Department of Biological Sciences are actively engaged in research in the following areas: bioinformatics, biochemistry, molecular biology, cell biology, immunology, neurobiology, developmental biology, tumor cell biology, biogeochemistry, and applied environmental microbiology.

Master’s Programs in Biology

The Department of Biological Sciences offers two major tracks to a Master’s degree.

The Master of Science in Biological Sciences, and the Master of Science in Biological Sciences - Biotechnology Option provide the advanced study and training necessary to conduct independent research at a professional level and to be successful in today's competitive academic and industrial research markets. Students in the program will be encouraged to explore quantitative approaches to the solution of problems in the basic and applied biological sciences. Depending on their career goals, students may choose either research or course work options within the Department, or from the interdisciplinary Biotechnology option. All candidates for the master’s degree are expected to demonstrate sufficient knowledge and skills to pursue independent and creative research activities.

The Professional Science Master’s Program (PSM) combines traditional training in biological sciences with additional preparation in areas outside of biology, such as project management and discipline-specific courses, to provide students with a broader expertise useful for attaining positions in private-sector companies. A thesis is not required, but each student must participate in a professional internship.

Four Professional Science Master’s options are available:

- Applied Biotechnology
- Biosafety
- Environmental Biotechnology
- Project Management for Life Sciences

Entrance Requirements and Procedures

Applications for the Master of Science, including the Biotechnology Option, are considered twice per year, with deadlines for receipt of applications of October 15 and January 10 for the following Spring and Fall semesters, respectively.
Entering graduate students are expected to have a sound preparation in the biological sciences, chemistry, physics, calculus, and statistics. A student found deficient in any of these areas may be required, during the first year, to take appropriate courses to eliminate the deficiencies. If the student has not had a biochemistry course, BIOL.519 should be taken for graduate credit. The departmental Graduate Coordinator helps plan the entering students programs of study, acquaints them with research opportunities in the department, and assists in selecting research advisors.

Applications for the Professional Science Master’s program (PSM) are accepted year round, but it is recommended that complete applications be submitted several months before expected matriculation. Similarly to the MS degree described above, applicants are expected to have a strong background in biological science.

Applications and information for admission to the MS and PSM programs can be found at the Graduate Admissions website.

Degree Requirements

A minimum of 30 semester hours of graduate level work is required for the Master of Science degree in Biological Sciences (Note: the PSM options in Biological Sciences require 37 credits. See the Professional Science Master’s section for details). The student has a choice of three options: thesis, project, or non-thesis. Minimal core requirements for all options include 1 semester (3 credits) of Professional Communication in Science and Technology BIOL.604, completion of Biochemistry BIOL.519 or an approved equivalent and 12 credits of formal course work selected from departmental electives (exclusive of thesis, project, problems, or other directed studies). The remaining 16 credits may be satisfied by additional electives within the department (thesis, project, problems, or more course work), by transfer credit for approved graduate level biological sciences courses taken at other accredited institutions (9 credit maximum), or by graduate courses taken in related disciplines within the University (e.g., bioinformatics, chemistry, environmental sciences, chemical engineering, radiological sciences; 8 credit maximum). There is no formal language requirement. Students whose professional goals are to continue on for the Ph.D. degree, or who plan to seek employment in academic or industrial research laboratories as technicians or junior scientists are strongly advised to choose the thesis or project option in order to successfully compete for such positions. Students in the non-thesis option should endeavor to select courses with accompanying laboratories whenever possible.

Thesis Option

In choosing this option, the student concentrates on an in-depth, independent, scholarly investigation of a contemporary biological problem. Credit is allowed for 6-12 semester hours of M.S. Thesis Research. After consulting with the research advisor, the student selects two additional faculty members (one of whom must be from within the Department) to serve as members of the Thesis Committee. The student presents to the Committee a proposal of intended research and obtains the Committee’s approval of the research topic. After completing the written thesis, the student gives an oral presentation of his results to the Thesis Committee.

Project Option

The project option is designed for independent laboratory investigations of a more limited nature than the thesis option. Generally, a project is completed in one or two semesters and credit is given for 3 or 6 semester hours of M.S. Project (no more than 6 credits will be allowed).

Non-Thesis Option

This option offers course work in breadth and depth, and may be of special interest to secondary school science teachers and individuals already employed in academic, hospital, or industrial laboratories. The non-thesis option may be completed during the day on a full-time basis or in late-afternoon or evening sessions on a part-time basis. However, since not all day courses are available in the evening sessions, a part-time student’s progress toward the M.S. degree will depend not only on his/her available time and abilities, but also on the scheduling of electives. In some instances, with the consent of a faculty member, an evening student may elect the thesis or project option.

Professional Experience

Credit (BIOL-5000; 3cr) may be requested by individuals who present satisfactory evidence (in the form of a written statement from their current supervisor) of engaging in at least one year of full-time experience in secondary school science teaching, or in an academic, hospital, or industrial laboratory setting.

Professional Communication in Science and Technology

Each student is required to complete one semester of Professional Communication in Science and Technology (BIOL.604; 3 credits) in Biology.

Master of Science in Biological Sciences - Biotechnology Option

This option is more structured than the M.S. in Biological Sciences program described above. The core curriculum offers extensive hands-on experience in current techniques and instrumentation. Field trips and seminars afford students an opportunity for interaction with the biotechnology industry. Students are encouraged to conduct research in one of the
recognized areas of biotechnology or to present an innovative application of technology or engineering principles to a biological problem of economic interest. The nature and extent of the investigation will determine its degree credit value. Those who enter the program having already completed some of the core courses, or who already have extensive laboratory experience, may consult with an advisor to design a course of study appropriate to their needs. A variety of biotechnology-related electives are available.

Core Requirements Biotechnology Option

- BIOL.5190 Biochemistry I
- BIOL.5210 Techniques in Biochemistry
- BIOL.6040 Professional Communication in Science and Technology

Any 3 Required Laboratory courses from the following list:

- BIOL.5290 Recombinant Protein Production
- BIOL.5340L Genomics Laboratory (taken concurrently with BIOL.5320)
- BIOL.5690L Molecular Biology Lab
- BIOL.5890 Practical Protein Crystallography
- BIOL.5760 Cell Culture
- BIOL.5950L Immunology Laboratory (taken concurrently with BIOL.5930)

Recommended Electives Biotechnology Option

- CHEN.5350 Cell and Microbe Cultivation
- CHEN.5450 Isolation and Purification
- CHEN.5550 Biopharmaceutical GMP and Licensing
- CHEN.5860 Biotechnology Processing Projects Laboratory
- BIOL.5720 Virology
- BIOL.7330L Projects Laboratory
- BIOL.7330 M.S. Project in Biology

Up to 9 credits of coursework may be taken in other departments. The sum of core and elective courses must total at least 30 credits.

Professional Science Master’s

The curriculum requires students to complete: 2 core courses (Biochemistry I and Professional Communication in Science and Technology) common to all options; 1-2 core courses specific to the option that allow for specialization; additional electives within and outside the Biology Department that permit flexibility in meeting the students employment needs and interests; 2 advanced courses specific to the option; and a 1 credit Professional Internship that can be completed during a summer session or either academic semesters. The total minimum credit requirement for each option is 37.

Applied Biotechnology Professional Science Master’s (PSM) Option

Core Biology Requirements - Applied Biotechnology PSM Option

- MGMT.6350 Project Management (offered by the College of Management)
- BIOL.5190 Biochemistry
- BIOL.5210 Biochemical Techniques
- BIOL.5420 Cell Biology or
- BIOL.5600 Stem Cell Biology
- BIOL.5760 Cell Culture
- BIOL.5670/5690L Molecular Biology/Laboratory
- BIOL.5930/5950L Immunology/Laboratory
- BIOL.6040 Professional Communication in Science and Technology

Additional Biology Courses - Applied Biotechnology PSM Option (3 credits minimum)

- BIOL.5410 Topics in Cell Biology
- BIOL.5400 Advances in Plant Biology
- BIOL.5820 Cancer Biology
- BIOL.5420 Cell Biology
- BIOL.5800 Developmental Biology
- BIOL.5040 Environmental Microbiology
- BIOL.5900 Human Neurobiology
- BIOL.5600 Stem Cell Biology
- BIOL.5720 Virology

Advanced Biotechnology/Interdisciplinary Courses - Applied Biotechnology PSM Option (6 credits minimum)

- MATH.5860 Applied Statistics or
- PUBH.5750 Introduction to Biostatistics and Epidemiology
- CHEN.5860 Biotechnology Processing Project Laboratory
- CHEN.5550 Biopharmaceutical GMP and Licensing
- CHEN.5350 Cell and Microbe Cultivation
Professional Internship Applied Biotechnology PSM Option (1 credit)

Biosafety Professional Science Master’s (PSM) Option

Core Requirements - Biosafety PSM Option

- PUBH.5250 Recognition of Work Environment Hazards: Introduction to Occupational and Hygiene Ergonomics
- PUBH.5730 Bioaerosols in Health and Biodefense
- BIOL.5190 Biochemistry
- BIOL.6040 Professional Communication in Science and Technology

Additional Biology Courses - Biosafety PSM Option (18 credits)

- (Graduate, BIOL.XXXX)

Advanced Biosafety/Interdisciplinary Courses - Work Environment/Rad Science (choose 6 credits)

- PUBH.5090 Hazardous Waste Site Worker and Emergency Training Response
- PUBH.5030 Toxicology and Health
- PUBH.5040 Introduction to Radiological Sciences
- PUBH.5150 Principles and Practices of Biological Safety
- PUBH.5160 Laboratory Environmental Health and Safety

Professional Internship Biosafety PSM Option (1 credit)

Environmental Biotechnology Professional Science Master’s (PSM) Option

Core Requirements Environmental Biotechnology PSM Option

- MATH.5860 Applied Statistics or
- PUBH.5750 Introduction to Biostatistics and Epidemiology
- BIOL.5040 Environmental Microbiology
- BIOL.5190 Biochemistry
- BIOL.5210 Biochemistry Techniques
- BIOL.5670/5690L Molecular Biology/Lab
- BIOL.6040 Professional Communication in Science and Technology

- MGMT.6350 Project Management (offered by the College of Management)

Advanced Environmental Biotechnology/Interdisciplinary Courses (choose 14 credits)

- CIVE.5670 Environmental Aquatic Chemistry
- CIVE.5680 Environmental Fate and Transport
- CIVE.5780 Biological Wastewater Treatment
- CIVE.5950 Hazardous Waste Site Remediation
- BIOL.5050/5070L Bioinformatics Lecture/Lab
- BIOL.5230 Biology of Global Change
- BIOL.5400 Advances in Plant Biology
- BIOL.5420 Cell Biology
- BIOL.5570/5590L Advanced Invertebrate Zoology Lecture/Lab
- BIOL.5600 Stem Cell Biology
- PUBH.5730 Bioaerosols in Health and Biodefense
- BIOL.5760 Cell Culture

Professional Internship Environmental Biotechnology PSM Option (1 credit)

Project Management for Life Sciences Professional Science Master’s (PSM) Option

Core Requirements Project Management for Life Sciences PSM Option

- MGMT.6350 Project Management (College of Management)
- BIOL.5190 Biochemistry
- BIOL.6040 Professional Communication in Science and Technology

Additional Biology Courses Project Management for Life Sciences PSM Option (choose 21 credits)

- (Graduate, BIOL.XXXX)

Advanced Management Courses Project Management for Life Sciences PSM Option (choose 6 credits)

- PLAS.5900 Survey of Intellectual Property
- FINA.6400 Financing Innovation and Technology Ventures
- MKTG.6300 Market Research for Entrepreneurs
• ENTR.6500 Innovation and Emerging Technologies
• ENTR.6550 Corporate Entrepreneurship
• ENTR.6810 New Venture Implementation
• MGMT.6300 New Product Development
• MGMT.6400 Building and Managing Entrepreneurial Teams
• ENTR.6800 New Venture Planning

Professional Internship Project Management for Life Sciences PSM Option (1 credit)

Doctoral Degree Programs in Biology

I. Doctor of Philosophy Degree Program
(Ph.D. in Chemistry-Biochemistry Option)

The Department of Biological Sciences and the Department of Chemistry have developed a program in Biochemistry which results in the award of a Ph.D. in Chemistry. For a full discussion of program requirements, see the section on biochemistry in the Chemistry Department.

II. Doctor of Philosophy Degree Program in Biomedical Engineering & Biotechnology

The department of Biological Sciences offers a Doctorate in Biomedical Engineering and Biotechnology. For a full description of the program, see the five-campus program.

III. Doctor of Philosophy in Marine Science and Technology

An indisciplinary program is offered through the UMass Intercampus Graduate School (IGS). Students graduating with a M.S. or Ph.D. degree from IGS receive a joint degree from the University of Massachusetts Amherst, Boston, Dartmouth, and Lowell. The degree programs are fundamentally grounded in a broad, integrated, interdisciplinary approach to the study of marine sciences and technology. Students located at the four participating campuses are required to complete "core" courses selected from the natural and social sciences to equip them for interdisciplinary studies and research before focusing upon an area of concentration. For a full description of the program, see Marine Science and Technology.

Bachelor’s-Master’s Program

Outstanding undergraduates may pursue an accelerated course of study leading to the BS and MS degrees in Biological Sciences.

How to apply and program information information

Graduate Certificates in Biological Sciences

• Biotechnology and Bioprocessing
• Environmental Biotechnology
• Molecular and Cellular Biotechnology

Admission Criteria:

Prospective students will be required to complete a simplified application and provide their undergraduate transcript indicating that they hold a baccalaureate degree in a relevant natural science or engineering field. Applicants with degrees from institutions outside the USA are encouraged to have their credentials evaluated by one of the local evaluation companies. A minimum undergraduate GPA of 3.0 (4 point scale) is preferred. Close attention will be paid to grades in relevant science and engineering courses. GREs are not required.

Please note that a Graduate Certificate, while below a full Masters degree, is not a remedial graduate program. Students must demonstrate the ability to complete graduate level work to be accepted into a graduate certificate program. As such, if an applicant was denied acceptance into a graduate degree program due to academic deficiencies, then acceptance into the certificate program is unlikely.

Requirements for Completion of Certificate:

• Students must complete all certificate requirements (core and electives).
• The program must be completed within five years.
• Students must have a minimum grade point average of 3.0 with not more than one course with a grade below ?B (note a B- is considered below a B).
• All other University requirements apply, including deadlines and fees.

Transferability:

Courses may not be applied to a certificate if already applied to
another certificate and vice versa. However, credits earned towards a certificate may be applied to a Masters or Doctoral degree program in an appropriate discipline. Note that acceptance into a Graduate Degree Program is separate from acceptance into a Graduate Certificate Program.

Biotechnology and Bioprocessing

Biological Sciences and Chemical & Nuclear Engineering departments (Interdisciplinary)

Carl Lawton, Ph.D., 978-934-3158, Carl_lawton@uml.edu

The certificate is intended for students who hold a baccalaureate degree in science, engineering, health, or related disciplines. The courses emphasize biological and engineering principles, process concepts and the application of these to process design and improvement. Courses deliberately cross disciplinary boundaries and emphasize teamwork in a multidisciplinary environment as well as a result-oriented, document-driven approach to efficient project completion.

Required Courses:

- CHEN.5350 Principles of Cell and Microbe Cultivation (3 credits)
- CHEN.5450 Isolation and Purification of Biotech Products (3 credits)

Plus Two Electives from the following:

- CHEN.5550 Biopharmaceutical Regulatory Compliance (3 credits)
- CHEN.5380 Advanced Separations in Biotechnology (3 credits)
- CHEN.5860 Biotechnology Processing Projects Laboratory (3 credits)
- CHEN.5480 Engineering Process Analytics
- CHEN.5500 Biomedical Applications of Nanotechnology
- A technical elective with the approval of the Coordinator (3 credits)

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Biotechnology%20and%20Bioprocessing%20-%2026.0101-Gedt.html).

Environmental Biotechnology

Biological Sciences, Chemistry, Civil & Environmental Engineering departments (Interdisciplinary)

Rick Hochberg, Ph.D. (mailto:rick_hochberg@uml.edu), 978-934-2885

Environmental biotechnology refers to the application of biological technologies to monitor, understand, and remediate environmental problems. This certificate combines courses that explore the ecological impact of anthropogenic environmental change with courses that provide training in current biological technologies that can be brought to bear on environmental problems. Recent advances in biotechnology are providing new avenues for investigating biologically mediated environmental processes, many of which were inaccessible using traditional approaches. New biological technologies are being developed to mitigate environmental problems. These include the biological remediation of pollutants, biological treatment of wastewater and drinking water, source tracking of microbial pathogens, and mitigation of toxic algal blooms. As environmental resources are increasingly strained and new biological technologies with the potential to improve our environment become available, the demand for professionals with training in environmental biotechnology will continue to increase.

Required Courses (choose two):

- BIOL.5230 Biology of Global Change
- CIVE.5780 Biological Wastewater Treatment

Elective courses (choose six to eight credits):

- CHEM.5800 Advanced Analytical Biochemistry
- CHEM.5140 Advanced Analytical Chemistry
- CHEM.5260 Chromatography
- CIVE.5670 Environmental Aquatic Chemistry
- CIVE.5680 Environmental Fate and Transport
- CIVE.5950 Hazardous Waste Site Remediation
- BIO.5670 Recombinant DNA Techniques
- BIO.5690L Recombinant DNA Techniques Laboratory

Total: 12-14 credits

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information (https://www.uml.edu/gainful-employment/Environmental%20Biotechnology%20-%2026.1305-Gedt.html).
Molecular & Cellular Biotechnology

Biological Sciences and Chemical Engineering departments
(Interdisciplinary)

Contact: Rich Hochberg, Ph.D.
(mailto:rick_hochberg@uml.edu), 978-934-2885

The Graduate Certificate in Molecular and Cellular Biotechnology provides students with training in this growing field. Over the years, an ever-increasing demand for manipulation of DNA and analysis in cultured cells in most aspects of funded research has created a growing need in the job market.

Certificate Program: The Certificate consists of five courses, with four core courses and one related elective (14 credits total).

All students must hold a baccalaureate degree in a relevant natural science or engineering field; at least one year of college-level biology, genetics and biochemistry also is required.

Required Courses: (4 courses, 11 credits)

- BIOL.5670 Molecular Biology Lecture (3 credits)
- BIOL.5690L Molecular Biology Lab (2 credits)
- BIOL.5420 Cell Biology (3 credits) OR BIOL.4600 Stem Cell Biology (3 credits)*
- Cell Culture (BIOL.5760; 3 credits) +

* Students may take both Cell Biology and Stem cell Biology, in which case one will count towards the core and the other as the elective.
+ Either Cell Biology or Stem Cell Biology can be used to satisfy the pre-requisite for Cell Culture.

Elective courses (students choose one 3 credit course from the following list):

- BIOL.5190 Biochemistry I*
- BIOL.5410 Topics in Cell Biology
- BIOL.5420 Cell Biology (if not taken as core)
- BIOL.5600 Stem Cell Biology (if not taken as core)
- CHEN.5350 Cell & Microbe Cultivation
- CHEN.5450 Isolation & Purification

*Biochemistry I is a pre-requisite for Molecular Biology and Cell Biology, but still may be used to satisfy the certificate requirements.

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Molecular%20and%20Cellular%20Biotechnology%20-%2026.9999-Gedt.html).
BIOL.5000 Professional Experience (Formerly 81.500) - Credits: 3

3 Credits will be given to individuals who present evidence of having at least one full year of current experience in an academic, hospital, or industrial laboratory setting, or in secondary school science teaching.

BIOL.5050 Bioinformatics - Credits: 3

Lectures cover the biological and computational basis of approaches to sequence alignment, gene detection, protein structure prediction, phylogenetic inference, analysis of microarray gene expression data, gene mapping, comparative genomics, genome evolution and genome maps. A term paper, seminar or poster presentation may be required.

BIOL.5060L Environmental Microbiology Laboratory (Formerly 81.506) - Credits: 1
BIOL.5070 Bioinformatics Lab - Credits: 1

Computer-based analysis exercises and independent projects designed to showcase the capabilities and limitations of available computational tools used in genome research. Results of comparisons and evaluation of available methods will be summarized in lab reports.

BIOL.5080 Cell Biology for Teachers (Formerly 81.508) - Credits: 3

This online course will examine the structure and function of cells and the regulation of cellular processes characteristics of living organisms. Students will explore the complexity of the eukaryotic cell and gain an understanding of the mechanisms of cellular control and regulation. Course activities will make connections to state frameworks and national standards, and lead to the development of grade-appropriate curriculum materials for use in the elementary and middle school classroom. Class activities will include discussions, quizzes, lesson plans, web reviews, current events, and a final project.

BIOL.5090 Photobiology (Formerly 81.509) - Credits: 3

Biological process involving light in plants and animals. Topics include mechanisms of light absorption, energy transduction, light reactions in photosynthesis, functions of color in flowering plants, visual systems and structural and pigment coloration in animals, pigmentation in animals affecting camouflage and reproductive strategies. In addition, the genetics involved in responses to light such as photoperiods, circadian rhythms, and seasonal cycles will be covered.

BIOL.5130 Invertebrate Zoology II (Formerly 81.513) - Credits: 3

An in depth exploration of the deuterostome phyla with a focus on anatomy, ecology and evolution of the lophophorates, Echinodermata, Chaetognatha, Hemichordata and Chordata. Includes readings from the primary literature.

BIOL.5150L Invertebrate Zoology Lab II (Formerly 81.515) - Credits: 1

The laboratory study of live and preserved specimens of invertebrate animals with a focus on anatomy and functional morphology.

BIOL.5170 Vertebrate Animals in Biological Research (Formerly 81.517) - Credits: 3

Vertebrate Animals in Biological Research: History, Protocols, Regulations and Techniques is a lecture, discussion, and techniques based course to cover the principles of vertebrate animal research in biology. This course covers topics ranging from the history of animal research, ethics, regulations, institutional compliance, experimental design, research techniques, disease models, and animal welfare during research. The course will involve literature review and discussions regarding all topics being covered as well as the creation of an IACUC protocol. The protocol will then be reviewed in a mock IACUC meeting. There will also be hands on portions involving research techniques using training analogues and familiarization with animal research tools.

BIOL.5190 Biochemistry I (Formerly 81.519) - Credits: 3

Primarily for M.S. students in biological sciences. Lecture and text assignments on the subjects of protein, carbohydrate, lipid, enzyme and membrane biochemistry will be supplemented with research journal readings.

BIOL.5200 Biochemistry II (Formerly 81.520) - Credits: 3

This course will focus on protein dynamics where students will gain facility with thermodynamics of protein folding/misfolding, catalysis, kinetics and binding equilibria as they apply to proteins and other molecules in biological systems. The central theme of this course is that living systems can be understood in terms of the fundamental principles defining the structure and energetics of biological molecules. Attention will be given to quantitative aspects of enzyme kinetics and molecular binding. Examples of how these principles apply to the understanding and treatment of human disease will be discussed.
BIOL.5210L Biochemistry Techniques (Formerly 81.521) - Credits: 2
Biochemistry Required of M.S. students in the Biotechnology Option. Emphasis on common techniques and instrumentation employed in modern research laboratories.

BIOL.5230 Biology of Global Change (Formerly 81.523) - Credits: 3

BIOL.5260 Evolutionary Biology (Formerly 81.526) - Credits: 3
Lectures deal with the patterns and processes of biological evolution. Covers the history of evolutionary thought, the evidence for evolution, the generation and maintenance of population-level variation, natural selection, adaptation, sexual selection, speciation, phylogenetics, molecular evolution, the fossil record and extinctions. In addition to lecture and textbook material, the course surveys classic and contemporary primary literature from evolutionary biology. A written paper and/or seminar presentation will be required.

BIOL.5280 Molecular Biotechnology: Recombinant Protein Production (Formerly 81.528) - Credits: 3
Proteins are major targets of Pharmaceuticals, and are themselves increasingly used as therapeutics. However both basic research and the pharmaceutical industry depends on availability of purified proteins that are often difficult to isolate from native sources. In this lecture course, students will learn basic and advanced theoretical background in expression and purification of recombinant proteins. It will cover a variety of expression systems, including prokaryotic and eukaryotic cells. The course will also address traditional and new methods in recombinant protein purification. Furthermore, students will be introduced to some downstream applications such as crystallization screens and biochemical/biophysical studies. Student will choose a term project for oral and written presentation.

BIOL.5290 Recombinant Protein Production Techniques (Formerly 81.429 & 81.529) - Credits: 4
This course introduces students to the principles and practice of recombinant protein expression and purification’s. Proteins are major targets of pharmaceuticals, and are themselves increasingly used as therapeutics. However both basic research and pharmaceutical industry depends on availability of purified proteins that are often difficult to isolate from native sources. This course will provide both didactic and laboratory instruction. It is comprised of a series of lecture and laboratory exercises, with an emphasis on practical techniques and hands-on experience of recombinant protein purification. The course will cover a variety of expression systems, including prokaryotic and eukaryotic cells, and address traditional and new methods in protein purification.

BIOL.5320 Genomics (Formerly 81.532) - Credits: 3
This course surveys the field of genomics, examining current technologies and their biological applications. Lectures cover genome organization, genome sequencing and annotation, functional genomics, evolutionary genomics, transcriptomics, proteomics and the role of bioinformatics in organizing and interpreting genomic data. Students will be expected to submit written papers and to make oral presentations.

BIOL.5340L Genomics Laboratory (Formerly 81.534) - Credits: 1
A series of molecular laboratory and computer-based bioinformatics exercises providing practical experience in the collection and analysis of genomic-level data.

BIOL.5370 Biology and Evolution of Arthropoda (Formerly 81.537) - Credits: 3
A detailed examination of phylum Arthropoda from developmental, ecological, genetic, morphological and paleontological perspectives. Specific topics include arthropod origins and relationships to proto-arthropods, the evolution of segmentation, and current perspectives on relationships within the phylum.

BIOL.5390L Biology and Evolution of Arthropoda (Formerly 81.539) - Credits: 1
An exploration of protoarthropod and arthropod diversity using live and preserved specimens of the major taxa including Tardigrada, Onychophora, Chelicerata, Crustacea, Myriapoda and Hexapoda. Students will learn to collect, dissect, identify, handle and care for live specimens.

BIOL.5400 Advances in Plant Biology (Formerly 81.540) - Credits: 3
Topics covered are similar to those considered in 81.440. However, students are required to complete a more in-depth review of a current research topic in plant biology and will conduct additional reading and writing assignments.

BIOL.5410 Topics in Cell Biology (Formerly 81.541) - Credits: 3
Structure and function of the cell: a) cellular membranes, b) transport mechanisms, c) motility, d) excitable cells, and e) energy transduction mechanisms. May be repeated for credit.
when content varies.

**BIOL.5420 Advanced Cell Biology (Formerly 81.542) - Credits: 3**

This is an advanced course in cell biology. In this course we will examine different areas of eukaryotic cell biology including: membrane structure and function, cell adhesion, intercellular communication, signal transduction, chemotaxis, receptor-mediated endocytosis and intracellular trafficking. Mechanisms underlying relevant human diseases will also be discussed. Upon completion of the course the student will have a strong understanding of cell biology, develop critical thinking processes, proficiency in scientific reading and how to communicate material succinctly.

**BIOL.5470 Evolution in Context for Teachers (Formerly 81.547) - Credits: 3**

This course empowers life science teachers of all levels with the skills and knowledge to more effectively foster student understanding of evolution by natural selection. By exploring evolution in multiple contexts, the Darwinian framework for how life evolved (and continues to evolve) are presented in an interactive and engaging manner. Teachers learn to use virtual resources to enhance their students learning while digging deep into some of the most profound and interesting science conducted in the last 100 years. Evolution in context makes the science of evolution come alive in a real and relevant manner. From the historical and scientific to the environmental and political, Teachers will learn about evolution in ways they never imagined.

**BIOL.5480 Form Feeds Function in Vertebrate Evolution - Credits: 3**

This course will provide you with a solid comparative knowledge of how vertebrates including humans have evolved, focusing on how anatomy (form) feeds function (physiology, biomechanics) in movement biology (cardiorespiratory, sensing, locomotion, feeding). It is only by understanding our evolutionary history that you understand e.g. how vertebrates became Olympian movers, how humans became bipedal, why we use parts of the ancestral jaw to hear, and how we avoid choking when we swallow. Such knowledge is key for medical and veterinary school, but will also support you in biomedical and biotechnology fields as well as in various general science disciplines. This course emphasizes modes of thought, including the differences between evidence and inference, and between correlation and causality.

**BIOL.5490L Biology of Muscle - Credits: 4**

This course takes integrative approaches to exploring architecture, physiology and mechanics of vertebrate skeletal muscle as the main driver of movements in organisms including humans. Combining presentations and discussions of important publications with simple experiments and report-writing, the course hones a specialist-level understanding of how the organ structure is constructed, how cell-level phenomena govern contraction, how the nervous system controls muscle function, how muscle contractions are constrained by physics, and how muscle as an organ structure is able to mitigate those constraints. We will also build and use actuators inspired by muscle function.

**BIOL.5520 Quantitative Physiology (Formerly 81.552) - Credits: 3**

**BIOL.5570 Metazoan Parasitology (Formerly 81.557) - Credits: 3**

An introduction to the diversity of metazoans (animals) that parasitize humans, livestock, other animals (both vertebrate and invertebrate), and plants. Lectures emphasize the morphology, form and function, physiology, systematics, evolution, lifecycles and pathogenesis of several major parasitic groups.

**BIOL.5590L Metazoan Parasitology Laboratory (Formerly 81.559) - Credits: 1**

The purpose of the laboratory is to provide students an opportunity to identify and work with a variety of parasites that we discuss in lecture. We will work with preserved specimens, slide material, necropsies, and live specimens. Students will learn how to identify parasites and appreciate where they live in the vertebrate body.

**BIOL.5600 Stem Cell Biology (Formerly 81.560) - Credits: 3**

The molecular and genetic characteristics of stem cells and their developmental potential will be explored. Lectures and readings will cover the development of embryonic, fetal and adult stem cells, and will examine their use in treating human disorders receiving widespread attention, including neurodegenerative diseases, heart disease, spinal cord injury and leukemia. The ethical, legal and social implications of stem cell research will also be discussed. Additional library investigation and a term paper or seminar will be required.

**BIOL.5611 Electron Microscopy (Formerly 81.561) - Credits: 3**

**BIOL.5620 Cardiovascular Physiology (Formerly 81.562) - Credits: 3**

This course will focus on human cardiovascular physiology in
normal and diseased states. The objective of Cardiovascular Physiology is to reinforce the concept that the cardiovascular system can be understood in terms fundamental biophysical and cellular physiological principles. Quantitative aspects will be reinforced with problem sets in the accompanying lab course 81.563. Key concepts in the course will be placed in a medical context showing the underlying physiological concepts that lead to disease states such as: altered blood pressure, heart failure, valvular disease and arrhythmias.

BIOL.5630L Cardiovascular Physiology Lab (Formerly 81.563) - Credits: 1
Cardiovascular Physiology Lab is designed to supplement Cardiovascular Physiology 81.562. The objective of the course is to teach cardiovascular system function using problems sets as well as clinical and pathophysiological examples.

BIOL.5670 Molecular Biology (Formerly 81.567) - Credits: 3
A study of the principles and specialized techniques of cloning, purifying, and manipulating recombinant DNA molecules.

BIOL.5690L Molecular Techniques (Formerly 81.569) - Credits: 4
Laboratory experiments and independent projects designed to illustrate current techniques and instrumentation used in genetic engineering. Included are restriction mapping, cloning, plasmid purification, blot hybridization, and DNA sequencing. Students are introduced to computer software utilized for DNA sequence analysis and manipulation.

BIOL.5720 Virology (Formerly 81.572) - Credits: 3
A study of bacterial, animal, and plant viruses, including viral structure, modes of replication, biochemistry of the infected cell, genetic properties, and viral oncogenesis. Emphasis is on virus-cell interaction at the molecular level.

BIOL.5760 Cell Culture (Formerly 81.576) - Credits: 4
A series of lecture and laboratory exercises that will focus on the in vitro culture and analysis of multiple cell type commonly used in biomedical research laboratories. The lecture component will review methodologies used to establish immortalized cell lines, medium component for specific cell types, and techniques for genetically manipulating and analyzing cell lines. The laboratory exercises will emphasize the mastery of sterile techniques used to grow both established cell line and primary cultures, and molecular tools used for introducing recombinant genes and for analyzing cell growth and differentiation.

BIOL.5800 Developmental Biology (Formerly 81.580) - Credits: 3
An in depth discussion of contemporary topics related to reproduction and embryogenesis. Lecture material is supplemented with reading assignments in a recently published textbook and current literature taken from research journals. Emphasis is on the dynamic nature of the interactions between developing cells as well as the events that occur during fertilization, implantation and the development of the mammalian embryo which lead to birth. Students examine how studies with nonmammalian model systems such as Drosophila and Xenopus have enhanced our knowledge of mammalian development. Among the topics discussed are the role of adhesion molecules, HOX genes, apoptosis, hypomethylation of genes, axis formation and hormonal control of differentiation. Class participation is expected. Critical scientific reading and thinking is encouraged by having students present to the class published original research papers on topics of current interest in the field of developmental biology.

BIOL.5810L Developmental Biology Lab - Credits: 1
This course provides hands on experience in current methods and model systems used to investigate questions in developmental biology. Students will be exposed to a wide variety of embryonic systems, including intensively studied genetic model systems (e.g. C. elegans, zebrafish, mouse) and others with well-established experimental attributes (e.g. chick, sea urchin). Analytical and experimental techniques used to explore invertebrate and vertebrate development include embryological manipulation, molecular and cell biology approaches. Conceptual topics include cell specification and differentiation, pattern formation, morphogenesis, and comparative embryology. This lab supplements the Developmental Biology lecture (BIOL.5800).

BIOL.5820 Cancer Biology (Formerly 81.582) - Credits: 3
A study of the genes and proteins implicated in the cause of human cancer and discussion of the complex behaviors of cancer cells that differ from their normal counterparts in human tissue. Lectures and original research papers will be used.

BIOL.5840 Comparative Vertebrate Embryology - Credits: 3
A comparative study of vertebrate embryological development focusing on the morphological development (e.g., Differentiation of tissues, organs, and systems) of vertebrates. Evolutionary relationships of the classes of vertebrates will be investigated through their anatomy. This course builds on...
concepts taught in Developmental Biology, providing more detailed analysis of tissue development in a comparative context.

**BIOL.5880 Structural Biology (Formerly 81.588) - Credits: 3**

Structural basis of the molecular biology of cells and the regulation of cellular processes will be discussed. This course will cover the fundamental knowledge about protein, nucleic acid and membrane structure in relation to central systems in biology. Topics to be discussed include structural enzymology, macromolecular assemblies for replication, transcription, translation, membrane proteins, signal transduction, cell motility and transport, cell-cell interactions, the immune system, and virus structure. Students will choose a recently published primary research article for an oral presentation, and will lead a class discussion on that topic.

**BIOL.5890 Practical Protein Crystallography (Formerly 81.589 & 81.489) - Credits: 4**

This course provides grounding in the principles and practice of protein x-ray crystallography. The course will be unique in format and provide both didactic and laboratory instruction. It is comprised of a series of lecture and laboratory exercises, with an emphasis on practical techniques and hands-on experience of modern protein crystallography. The course will cover the fundamental knowledge about x-ray physics, instrumentation and geometrical diffraction, protein crystallization, macromolecular data collection and processing, phase estimation and improvement, model building and refinement, and model assessment. Students will also be given a recently published structural paper for writing a report on the subject.

**BIOL.6010 Graduate Seminar Biology (Formerly 81.601) - Credits: 3**

Assists students in developing effective writing and speaking skills required for preparation of publishable scientific manuscripts and presentations. The importance of clear, concise writing style and delivery of presentations to both research, scientists and non-scientists is emphasized. Guest speakers discuss commercialization of technology, intellectual property, and electronic literature searches/citation. Experimental design, statistical analyses, research grant preparation, and poster presentations are also reviewed. Outside readings are used to critically evaluate contemporary issues related to disclosure, conflict of interest, publishing ethics, biosecurity, and electronic science collaborations/team research.

**BIOL.6660 Selected Topics in Molecular and Cellular Biology (Formerly 81.666) - Credits: 3**

Topics will focus on the central dogma of molecular Biology (DNA to RNA to protein) and how they relate to the structure and function of the cell. Course material will be taken directly from the current, primary literature with emphasis on student presentations and discussion. Multidisciplinary groups will select topics of interest to present to the class, and topics will vary by semester depending on student interests. Student groups will be expected to organize presentations into background and discussion sections and will lead class discussions.

**BIOL.7070 Internship Biology (Formerly 81.707) - Credits: 1**

Internship or co-op.

**BIOL.7080 Graduate Course Review (Formerly 81.708) - Credits: 1**

Internship or co-op.

**BIOL.7100 Supervised Instruction in Undergraduate Biology Education - Credits: 1-3**

Graduate students will assist with the preparation of course materials, teaching and/or grading in selected courses offered by the Department of Biological Sciences. Students will be expected to work well independently, while also working under the supervision of a faculty mentor. Through these activities, the student will learn about materials used, as well as teaching and learning techniques implemented in undergraduate biology education. Required for the MS in Biological Sciences option: Education, Communication, and Outreach.

**BIOL.7210 Special Problems In Biology (Formerly 81.721) - Credits: 1-3**

**BIOL.7310L M.S. Project in Biology (Formerly 81.731) - Credits: 1-9**
BIOL.7430 Master’s Thesis - Biology (Formerly 81.743) - Credits: 1-9
BIOL.7530 PhD Dissertation Biochemistry (Formerly 81.753) - Credits: 1-9
BIOL.7590 PhD Dissertation Biochemistry (Formerly 81.759) - Credits: 9
BIOL.7690 Continued Graduate Research (Formerly 81.769) - Credits: 9
Department of Chemistry

The following graduate programs are offered:

- **Doctor of Philosophy in Chemistry** Specializations include: Analytical, Inorganic, Organic, Physical Option in Biochemistry, Option in Environmental Studies, Option in Polymer Science or Polymer Science/Plastics Engineering
- **Master of Science in Chemistry** Specializations include: Analytical, Biochemical, Inorganic, Organic, Physical, Polymer Science
- **Master of Science in Chemistry - Professional Science Master's (PSM) Options** Chemistry and Polymer Science, Pharmaceutical Biochemistry
- **Graduate Certificates** Chemistry

The Department of Chemistry at University of Massachusetts Lowell offers both the Master’s Degree in Chemistry and the Doctor of Philosophy Degree in Chemistry. The options and specializations allow interdisciplinary study and involve interaction between chemistry and other departments at the University of Massachusetts Lowell.

Overall Departmental Entrance Requirements:

1. A Bachelor’s Degree in Chemistry or a related discipline (which requires a solid base in Chemistry).
2. An Undergraduate GPA of 3.0 (or its equivalent).
3. A minimum combined score of 310 on the GRE. (A score of 315 for polymer science applicants).
4. A minimum TOEFL of 30 (for international students whose native language is not English).
5. Students not meeting these requirements are invited to enroll in the Graduate Certificate Program and reapply.

**Master's Programs in Chemistry**

Specializations are offered in analytical, biochemistry, inorganic, organic, physical chemistry, and polymer science. This program provides opportunity for advanced study and research training in chemistry, both general and specialized. Provision also is made for the student to elect certain advanced subjects in related fields of mathematics, physics, and engineering.

The Department of Chemistry also offers two Professional Science Master’s Options in Chemistry (one in chemistry and polymer science and the other in pharmaceutical biochemistry) which have different requirements than those outlined below.

**Credit Requirements (Thesis Option)**

A minimum of 30 credits is required for the Master of Science degree in Chemistry, with 18 credits being earned in courses; and 12 credits earned in graduate research. Of the 18 course credit minimum, exclusive of research, a minimum of 15 credits must be taken in chemistry. The remaining course credits (3 or more) may be taken in chemistry or in related fields such as physics, mathematics, biology or engineering. Credit normally is not allowed for 400 level subjects in chemistry except for those designated in the catalog or approved by a student’s advisor. Each graduate program in chemistry must include at least three advanced subjects from three of the following areas: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, physical chemistry, or polymer chemistry, unless such requirements have been met previously and approved by the department.

**Requirements**

**Specialization in Analytical Chemistry**

- CHEM.5140 Advanced Analytical Chemistry

and two courses of the following:

- [CHEM.5230 Organic Reaction Mechanism]
- CHEM.5680 Structural Analysis
- CHEM.5260 Chromatography
- CHEM.5320 Advanced Physical Chemistry
- CHEM.5500 Biochemistry I
- CHEM.5430 Modern Inorganic Chemistry
- CHEM.5800 Advanced Analytical Biochemistry

**Specialization in Biochemistry**

- CHEM.5500 Biochemistry
- CHEM.5510 Biochemistry II

and any three courses of the following:

- CHEM.5680 Structural Analysis
- CHEM.5140 Advanced Analytical Chemistry
- CHEM.5260 Chromatography
- CHEM.5230 Organic Reaction Mechanisms
- CHEM.5320 Advanced Physical Chemistry
• CHEM.5380 Biochemical Mechanisms
• CHEM.5600 Advanced Physical Biochemistry
• CHEM.5670 Advanced Computational Chemistry
• CHEM.5690 Advanced Bioinformatics
• CHEM.5800 Advanced Analytical Biochemistry

Specialization in Inorganic Chemistry
• CHEM.5430 Modern Inorganic Chemistry
• CHEM.5320 Advanced Physical Chemistry
• CHEM.5230 Organic Reaction Mechanisms
and two courses of the following:
• CHEM.5140 Advanced Analytical Chemistry
• CHEM.5500 Biochemistry I
• CHEM.5510 Biochemistry II

Specialization in Organic Chemistry
• CHEM.5230 Organic Reactions, Mechanisms
• CHEM.5240 Organic Synthesis
• CHEM.5680 Structural Analysis
and at least two courses from the following:
• CHEM.5320 Advanced Physical Chemistry
• CHEM.5500 Biochemistry I
• CHEM.5430 Modern Inorganic Chemistry
• Specialization in Physical Chemistry
• CHEM.5310 Statistical Thermodynamics
• CHEM.5320 Advanced Physical Chemistry
• CHEM.5130 Spectroscopy
• CHEM.5230 Organic Reaction Mechanisms
• CHEM.5430 Modern Inorganic Chemistry
• CHEM.5400 Chemical Kinetics

Specialization in Polymer Science
Required: select from the following courses:
• POLY.5030 Advanced Polymer Science I
• POLY.5040 Advanced Polymer Science II
• POLY.5050 Polymer Preparation and Characterization
• CHEM.5680 Structural Analysis
• POLY.5530 Organic Chemistry of Macromolecules
• CHEM.5320 Advanced Physical Chemistry
• CHEM.5230 Organic Reaction Mechanisms
Although the design of the academic program is the responsibility of the student’s advisory committee, the following listing provides recommended courses for program development.

First Semester Subjects
• POLY.5030 - Advanced Polymer Science I
• POLY.5050 - Polymer Preparation and Characterization
• CHEM.5680 - Structural Analysis
• POLY.5530 - Organic Chemistry of Macromolecules
• POLY.6070 - Polymer Science Seminar
• POLY.7010 - Graduate Research in Polymer Science
• POLY.5490 - Physical Chemistry of Macromolecules
• CHEM.5230 - Organic Reaction Mechanisms

Second Semester Subjects
• POLY.5040 - Advanced Polymer Science II
• POLY.5120 - Properties of Bulk Polymers
• POLY.6020 - Polymer Science Seminar
• POLY.7020 - Graduate Research in Polymer Science
• CHEM.6720 - Surface and Colloid Chemistry
• CHEM.5240 - Organic Synthesis
• PLAS.5230 - Plastics Processing Techniques

Seminar Requirement
Each semester the student is required to attend and participate in the chemistry seminar/colloquium program CHEM.6010, 6020, 6030 and 6040. In addition, a master’s candidate is required to present one seminar.

Thesis Advisory Committee
An advisory committee should be selected jointly by the student and advisor at the earliest possible opportunity. A minimum of three (3) faculty members are required for the master’s thesis committee. The student’s advisor will serve as the chairperson of this advisory committee. The purpose of this committee is twofold. First, it will be responsible for ascertaining that the student’s research was conducted and presented in final form, in a professional and acceptable manner. Perhaps of more importance, the committee will serve in an advisory capacity during the course of the research
project. In this spirit it is recommended that the student convene a meeting of the selected committee prior to starting his/her research. The purpose of this meeting is to informally present an outline of the proposed research project.

**Non-Thesis Masters in Chemistry (NTMC)**

This program provides opportunity for advanced study in chemistry that must include at least three of the following areas: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, physical chemistry, or polymer chemistry.

**Credit Requirements**

The NTMC degree requires 30 credits (10 courses). The following NTMC requirements must be met:

1. A total of 18 course credits (CHEM or POLY prefix) must be taken within the Chemistry Department at University of Massachusetts Lowell.
2. The remaining credits may be satisfied by either additional CHEM or POLY courses or by transfer of up to 12 credits from a closely related program at a domestic university, including University of Massachusetts Lowell.

**Note:** Students who wish to pursue the NTMC degree who currently hold a B.S. or B.A. degree in chemistry or a related science, but do not have previous laboratory experience, may be required to take up to three undergraduate chemistry laboratory courses to ensure that they have sufficient laboratory skills upon completion of their NTMC degree.

**Doctoral Programs in Chemistry**

**Doctor of Philosophy (Ph.D.) in Chemistry**

**Specializations:**
- Analytical
- Organic
- Physical

**Options:**
- Ph.D. Option in Biochemistry
- Ph.D. Option in Environmental Studies
- Ph.D. Option in Polymer Science and Polymer Science/Plastics Engineering

**Analytical, Inorganic, Organic and Physical Chemistry**

The doctoral program in chemistry is designed to provide students with a background in advanced course work and chemical laboratory techniques that will prepare them to carry out, under the guidance of experienced scientists, an original, independent investigation that will lead to an acceptable contribution to the body of contemporary knowledge.

**Plan of Program**

The doctoral degree normally requires four years of study beyond the bachelor’s degree or a minimum of two to three years beyond the master’s degree. The plan of study pursued by each student is dependent on individual requirements and is developed through a conference with the Advisory Committee (or with his or her temporary advisor). The initial part of the student’s program, normally completed at the end of two years of study, is devoted to formal course work. The first year is usually given to subjects in the major branches of chemistry in preparation for area (candidacy) examinations. The second year is devoted primarily to advanced subjects in a special field of concentration. The second and final part of the program is devoted principally to research leading to the doctoral thesis. However, the student is encouraged to begin research as early as possible in the program of study.

**Research Tools Requirements**

These research tools may be a second foreign language, a computer language, a statistics course or another skill acceptable to both the Graduate Coordinator and the research advisor of the student. The language(s) selected may not include the native language of a student’s country of origin. Students in all Ph.D. programs may fulfill this requirement by 1) two foreign language courses; 2) one foreign language and a research skill course or 3) two research skill courses. The Language Requirement may be met by completion of a two-semester undergraduate course sequence in French, German, Japanese or Russian with an average grade of B or better. The Research skill requirement may be met by taking courses in programming and/or Statistics.

**Credit Requirements**

Of the 45 minimum credit requirements, a minimum of 27 credits in course work, exclusive of thesis and seminar, is required with at least 18 to be taken in chemistry. The remaining course credits (9 or more, with a student’s Advisory Committee having the authority to add 6 additional credits to the minimum in special situations) may be taken in chemistry or in a related field such as biology, physics, mathematics or engineering. Credit is not normally allowed for undergraduate subjects in chemistry except for those so designated in the catalog. Research credits would then make up the remainder of the 45 credit requirements. Planning the program of courses with the student is the responsibility of a student’s Advisory Committee.

**Course Requirements**

Each student in any of the Ph.D. programs in Chemistry shall
take both an advanced course in Physical Chemistry and Organic Chemistry and two courses from Advanced Inorganic, Advanced Analytical, Biochemistry, or Polymer Chemistry unless such requirements have been met previously. Since each division (Analytical, Biochemistry, Organic and Physical) has its own specific course requirements, a student intending to specialize in one of these areas is encouraged to meet with the coordinator of that program.

A. Course Requirements (Ph.D.): Analytical Chemistry Specialization

27 Credits in course work are required. They are:

- CHEM.5140 Advanced Analytical Chemistry
- CHEM.5230 Organic Reaction Mechanisms or
- CHEM.5680 Structural Analysis
- CHEM.5320 Advanced Physical Chemistry
- CHEM.5340 Quantum Chemistry
- CHEM.5430 Modern Inorganic Chemistry
- CHEM.5500 Biochemistry I
- CHEM.5800 Advanced Analytical Biochemistry

Note: With the exception of CHEM.5140, Advanced Analytical Chemistry, one of the following courses may be substituted but only with the permission of the student’s faculty advisor and the analytical coordinator. Of the remaining 15 credits at least 6 must be in chemistry. The approval of the advisor and analytical coordinator are required for non-chemistry courses. Such courses must be justified as being relevant to the student’s course of study.

Course Requirement (Ph.D.): Organic Chemistry Specialization

Required Courses:

The remaining course requirements may be fulfilled by selecting courses from the list above or from graduate courses offered by other departments.

- CHEM.5230 Organic Reaction Mechanisms
- CHEM.5240 Organic Synthesis
- CHEM.5320 Advanced Physical Chemistry
- CHEM.5680 Structural Analysis

Additionally, at least three courses shall be selected from subject areas such as Materials Chemistry, Polymer Sciences, Biochemistry, Physical Chemistry, Analytical Chemistry, unless such requirements have been met previously.

- CHEM.5660 Nanomaterials and Nanostructures
- CHEM.6720 Surface and Colloid Chemistry

The remaining course requirements may be fulfilled by selecting courses from the list above or from graduate courses offered by other departments at UML.

C. Course Requirements (Ph.D.): Physical Chemistry Specialization

Required courses:

- CHEM.5320 Advanced Physical Chemistry
- CHEM.5230 Organic Reaction Mechanisms
- CHEM.5430 Modern Inorganic Chemistry
- and a choice from the following:
  - CHEM.5130 Spectroscopy
  - CHEM.5140 Advanced Analytical Chemistry
  - POLY.5030 Advanced Polymer Science I

Written Area Examinations

Upon admission to the Ph.D. program the student must pass exams in his/her major area of specialization. The method of conducting these area exams is designated by the staff in each field of specialization, as follows:

Analytical Chemistry

The area examinations for analytical chemistry will consist of a series of six (6) examinations. The first will be a qualifying examination used to test the students general knowledge of Analytical Chemistry. The student will have two opportunities to pass the qualifying examination with a score of 5.0 out of 10.0 points. This qualifying exam will be administered at the beginning and end of the area exams. The area examinations will be offered annually, commencing in October and administered at monthly intervals. A minimum of 6.0 out of a
possible 10.0 points is required for each individual examination and a total of at least 30.0 out of a possible 50.0 points is required for the successful completion of the Written Area Examination. Failure to perform adequately may resulting the student being required to complete a master’s degree. Continuation towards the Ph.D. degree will be considered on a Case-by-case basis.

**Organic Chemistry**
Organic students take comprehensive examination consisting of consist of a written and an oral component, taken at the beginning of the second academic year of study (third semester). The exam will focus on the student’s own research. The written document should include the following sections: abstract, comprehensive literature review, experimental design and methods, results to date, future plans, and references, following the style and format of ACS publications. The oral exam will consist of a presentation by the student, followed by examination by the committee members. The questions raised by the committee members can be related to the student’s research, and can also be general chemistry and organic chemistry knowledge that are expected from the student. the oral exam is closed to the public. The student must pass both the written and the oral parts of the cumulative examinations in order to advance to the Ph.D candidacy.

**Physical Chemistry**
By the third year of graduate study, a Ph.D. student in physical chemistry must take a comprehensive examination. This is an all day written examination with questions designed to test the student’s physical chemistry background, and ability to set up models and solve them mathematically. The student has two chances to pass the comprehensive examination.

**Research Proposal**
As part of the area examination(s) a Ph.D. candidate must present an oral defense of an original research proposal within 3 months of completing the written area examinations although a specific program may require the proposal to be presented at an earlier date. With the aid and advice of the Advisory Committee the student selects a suitable subject for investigation, completes a literature review, outlines the method of approach, and suggests possible results and conclusions. The oral defense of this proposal is conducted by the student’s Advisory Committee with other faculty members in attendance. The proposal is defended by the end of the semester following completion of area exams. The topic of the proposal cannot be closely related to or contained within the thesis project.

**Chemistry Seminar**
During each year of residence the student is required to attend and participate in CHEM.6010,6020, Chemistry Seminar, and CHEM.6030,6040, Chemistry Colloquium. Each doctoral student is required to present two seminars.

**Candidacy for the Doctorate in Chemistry**
To be admitted to candidacy for the doctorate, a student must:

1. Satisfy the 27 course credit requirement, with a minimum Grade Point Average of 3.0.
2. Pass the area examinations, which includes completion of a research proposal.
3. Fulfill the research tools requirements.
4. Inform the graduate coordinator in writing that the above requirements have been completed.

**Interdisciplinary Ph.D. Option in Biochemistry**
This program provides chemistry graduate students with both in-breadth class work in BioChemistry and in-depth thesis research. Emphasis is on the application of modern techniques and concepts of physical and chemical science to the solution of problems of current interest in biology and medicine.

**Admission Requirements and Removal of Undergraduate Deficiencies**
Admission to the program requires demonstration of an acceptable B.S., B.A., or M.S. degree in chemistry, biology, biochemistry or other related science. Students will be expected to have completed two semesters each of general, organic and physical chemistry as well as introductory biology. Deficiencies must be removed by enrolling in the corresponding undergraduate course during the first year in the program.

**Academic Standards for Retention in the Biochemistry Program**
The graduate student is expected to maintain an average of 3.0 or better in all his/her graduate-level courses. All other department requirements must also be met.

**Research Tools Requirement**
These requirements have been described above.

**Degree Requirements**
There are 45 credits required for the Ph.D. in Chemistry, Biochemistry Option. A total of 27 of these must be in formal courses while the remaining 18 will be accrued in Doctoral Dissertation. Of the 27 required hours of graduate course work, the Biochemistry Program requires that 15 hours are in the specific courses delineated below:

- CHEM.5500 Biochemistry I
- CHEM.5510 Biochemistry II
- CHEM.5600 Advanced Physical Biochemistry
- CHEM.5670 Computational Biochemistry
- CHEM.5700 Protein Biochemistry

12 credits of approved (5000-7000 level courses that support the student’s research focus from approved graduate courses in the Biological Sciences, Chemistry, Biomedical and Nutritional Sciences, or Chemical Engineering Departments. Course
selection should be made in consultation with the student’s research advisor. Below is a list of possible course elective courses.

- CHEM.5140 Advanced Analytical Chemistry
- CHEM.5260 Chromatography
- CHEM.5430 Modern Inorganic Chemistry
- CHEM.5630 Chemistry of Natural Products
- CHEM.5690 Advanced Biocheminformatics
- CHEM.5700 Advanced Protein Chemistry
- CHEN/BIOL.5350 Principles of Cell and Microbe Cultivation
- CHEN/BIOL.5450 Isolation and Purification of Biotech Products
- BIOL.5670/5690 Recombinant DNA Techniques
- BIOL.5760/5780 Cell Culture
- BIOL.5930 Immunology
- MLSC.5060 Biochemistry of Lipids
- MLSC.5520 Advanced Clinical Biochemistry Seminars

During each semester in residence all full-time students must participate in a seminar course and attend one seminar each week, as required by the Chemistry Department. The student is required to present two one-hour presentations during his/her residence.

Research

A. Initiation of Research and Research Advisor Selection Procedure
The dissertation research of each graduate student may be initiated at any time but not later than the end of the second semester in the program. The student is advised to make serious efforts, prior to the summer following his/her first entrance to the program, to initiate faculty research interviews and attempt to identify the area of his/her research interest and particular research group which may be suitable for pursuing his/her research goals.

B. Examination Committee
The examination committee will be composed of four faculty members chosen after consultation by the student with his/her research advisor at least two of these members must be from the Department of Chemistry faculty.

Examinations

A. Comprehensive Exam
Students are required to successfully complete a Comprehensive Exam based on the 5 core courses by the end of their second year in the program. This exam consists of two parts and students are expected to have satisfactory performance on both sections. Section I consists of a series of questions derived from their course material. Section II is based on current literature and is focused on a particular series of papers that are provided to the students a month before the exam.

B. Oral Research Proposal must be presented during their 5th semester. This proposal based on their dissertation work and is to follow the format outlined in the proposal guidelines. A written copy of the proposal must be submitted to their dissertation committee one week prior to their public examination. Examination committees for the ORP consist of four full-time faculty or professionals. Two members of the committee must be members of the Chemistry department and the other two members of the committee must have a Ph.D. in Biochemistry or the equivalent. Successful completion of the Original Research Proposal defense will advance students to candidacy in the Biochemistry Ph.D. Program. Students will have two opportunities to complete this exam. If the combination of the written and oral presentation is not at the level of a Ph.D. candidate, as judged by the committee, a student will be provided a second opportunity to satisfactorily complete the exam. At the committee’s discretion, a student may be asked to only repeat the written or oral portion of the exam. This must be done by the student’s sixth semester or they will not be advanced to Ph.D. candidacy.

Admission to Candidacy for the Doctorate
To be admitted to candidacy for the doctorate, a student must:

1. Complete all required courses with necessary grade point average. There is an absolute minimum cumulative grade point average (GPA) requirement of 3.0 for all graduate work. At the end of the first semester, if a student is found to be below the minimum GPA, a written warning will be issued. If the cumulative GPA is not raised to 3.0 or higher by the end of the second semester in residence, the student will automatically be dropped from the Ph.D. program but allowed to continue toward a master’s degree in Biochemistry with the approval of the graduate committee. While completing the M.S., a candidate must have a minimum GPA of 3.0 and maintain that GPA throughout the remainder of his or her career. Upon successful completion of the Master of Science degree, the student may reapply for admission to the doctoral program. Each case will be reviewed on an individual basis. Students reentering the Ph.D. program will then satisfy all the requirements for the degree including passing the comprehensive examination, presentation of their...
research proposal, and completion of their research and dissertation defense. Seminar presentations and course work accomplished to complete the master’s degree will, of course, be cumulative.

2. Pass the Cumulative Exam.
3. Fulfill the research tools requirement.
4. Successfully present and defend the Oral Research Proposal by the end of the fourth semester of full time study.
5. Present two seminars.
6. Secure written approval of his/her research advisor and the chemistry graduate coordinator. When these requirements have been fulfilled, the Biochemistry Graduate Committee will recommend that the graduate coordinator of the Department of Chemistry notify the Registrar’s Office to place the student on the list of candidates for the Ph.D. degree. Admission to candidacy in no way guarantees the granting of the degree.

Ph.D. Option in Environmental Studies

This graduate program is designed as an optional course of study to the traditional Ph.D. in Chemistry for students with backgrounds in engineering (civil, environmental and chemical engineering) and other sciences (physics, biology, etc.) as well as chemistry. Candidates will be exposed to advanced course work in chemistry and environmental engineering and will be able to choose an area of specialization that best suits their interests and previous experience. A combination of faculty from Chemistry, Work Environment and Civil Engineering with a variety of research expertise gives this program unique characteristics and affords the student the opportunity to perform practical interdisciplinary research. It is expected that most students will require at least four years beyond the Bachelor’s degree and two years past the Master’s degree.

Entrance Requirements

In addition to the requirements for admission listed in this catalog, applicant will have an earned bachelor’s degree in one of the following fields: chemistry, chemical or civil engineering, biology, environmental sciences, geology or physics. Students will be expected to have satisfactorily completed undergraduate courses in analytical, organic, and physical chemistry, physics and calculus. However, applicants who have not completed courses in these areas may remedy their deficiencies while in the program and, therefore, are encouraged to apply. Admissions will be determined by a committee consisting of faculty active in the program.

Program Outline

A total of 48 credits are required for the Ph.D. program. Of these, at least 30 credits must be in course work exclusive of seminar and the rest is usually in thesis research. Courses shown below are divided into three categories:

- core course requirements (9 credits),
- areas of specialization (12 credits), and
- elective courses (9 credits).

Additional elective courses from other departments may be substituted with the approval of the student’s Advisory Committee.

In addition, full-time students must register for CHEM.601/CHEM.602 or ENVE.502 Environmental/Analytical seminar every semester.

Each student will be required to give two seminars on current research topics during their graduate career. Students in the Environmental program must select a thesis advisor by the end of the second semester. At this time, an Advisory Committee is appointed and a plan of study is established. The Advisory Committee must consist of at least four members, including the thesis advisor. A minimum of two Chemistry Department faculty are required to be on the committee with two other members from any participating department. An additional member from another department may also be added if agreed upon by the student and thesis advisor. Students must maintain a 3.0 cumulative average in order to continue in the program.

Required Courses (21 credits):

I. Core Courses (9 credits)

- CHEM.5140 Advanced Analytical Chemistry
- CHEM.5320 Advanced Physical Chemistry
- CHEM.5230 Organic Reaction Mechanism or
- CHEM.5680 Structural Analysis

II. Areas of Specialization (12 credits)

a. Analytical /Environment

- CIVE.5670 Environmental Chemistry I (Aquatic Chemistry)
- CIVE.5680 Environmental Chemistry II (Fate and Transport)
- CHEM.5190 Environmental Chemistry III (Marine Chemistry)
- CHEM.5260 Chromatography
b. Water Environment

- CIVE.5670 Environmental Chemistry I (Aquatic Chemistry)
- CIVE.5680 Environmental Chemistry II (Fate and Transport)
- CHEM.5190 Environmental Chemistry III (Marine Chemistry)
- CIVE.5620 Groundwater Hydrology

III. Elective Courses (9 credits)

- CHEM.5320 Advanced Physical Chemistry
- CHEM.5230 Organic Reaction Mechanisms
- CHEM.5680 Structural Analysis
- CIVE.5670 Environmental Chemistry I (Aquatic Chemistry)
- CIVE.5680 Environmental Chemistry II (Fate and Transport)
- CHEM.5190 Environmental Chemistry III (Marine Chemistry)
- CHEM.6530 Chemical Oceanography
- CHEM.5260 Chromatography
- CHEM.5860 Spectrochemical Analysis
- CIVE.5620 Groundwater Hydrology
- CIVE.5610 Physical Chemical Treatment Processes
- ENVE.5680 Environmental Laboratory
- ENVE.5710 Air Pollution Phenomenology
- ENVE.5230 Air Resources Management & Control
- ENVE.5730 Air Pollution Laboratory (Monitoring and analysis)
- CIVE.5680 Environmental Chemistry II (Fate and Transport)
- CHEM.5320 Advanced Physical Chemistry
- CHEM.5230 Organic Reaction Mechanisms
- CHEM.5680 Structural Analysis
- CIVE.5670 Environmental Chemistry I (Aquatic Chemistry)
- CIVE.5680 Environmental Chemistry II (Fate and Transport)
- CHEM.5190 Environmental Chemistry III (Marine Chemistry)
- CHEM.6530 Chemical Oceanography
- CHEM.5260 Chromatography
- CHEM.5860 Spectrochemical Analysis
- CIVE.5620 Groundwater Hydrology
- CIVE.5610 Physical Chemical Treatment Processes
- ENVE.5680 Environmental Laboratory
- ENVE.5710 Air Pollution Phenomenology
- ENVE.5230 Air Resources Management & Control
- ENVE.5730 Air Pollution Laboratory (Monitoring and analysis)
- 93.4300 Atmospheric Diffusion
- ENVE.5720 Energy and the Environment
- MATH.5910 Statistical Modeling and Data Analysis
- CIVE.5650 Industrial Waste Water Treatment Processes
- ENVE.5100 Water Resources Management
- ENVE.5220 Solid Waste Management (Municipal, Industrial and Hazardous)
- ENVE.5250 Epidemiology for Environmental Studies
- ENVE.5270 Environmental Law
- PUBH.5010 Industrial Hygiene
- RADI.5010 Radiation Safety and Control
- RADI.5030 Radiation Biology
- RADI.5080 Environmental Toxicology

Written Area Examinations (Cumulative Examinations)

Beginning in the second year of study, the student must pass examinations in their major area of specialization. The faculty associated with the program administer examinations that are based on course work either completed or in progress as well as seminars, scientific literature and accepted theory in the field of study. Environmental studies students take six cumulative examinations each of which focuses on a different area of environmental science and analytical chemistry. Students must take the examinations consecutively in a given academic year. The topic, date, time and faculty member in charge of a particular exam in the cumulative examination series will be given to the student prior to the first cumulative exam. Students taking cumulative exams are urged to meet with the individual faculty member preparing an exam for more specific information. If a student misses a cumulative exam a grade of zero will be assigned. There are no makeup cumulative exams.

Research Proposal

A Ph.D. candidate must submit an original research proposal and successfully pass an oral defense of that proposal in their second or third year of study. After consulting with their Advisory Committee, the student selects a suitable subject for investigation, completes a literature survey, outlines the method of approach, and suggests possible results and conclusions. The oral defense of this proposal is conducted by the student’s Advisory Committee with other faculty in attendance. The proposal must be defended within three months following completion of the cumulative examinations.

Ph.D. Option in Polymer Science and Polymer/Plastics Engineering

The Department of Chemistry offers a Ph.D in Polymer Science and the Polymer Science/Plastics Engineering Option. The Polymer Science/Plastics Engineering Option doctoral program is organized jointly with the Department of Plastics.
Engineering. The program is designed to provide students with a background in advanced course work and laboratory techniques that will prepare them to carry out an original investigation leading to an acceptable contribution to the body of contemporary knowledge in the fields of macromolecules or plastics.

Plan of Program
The doctoral degree normally requires four years of full-time study beyond the bachelor’s degree or a minimum of two to three years of full-time study beyond the master’s degree. The plan of study pursued by each student is dependent on individual requirements and is developed through a conference with his/her Advisory Committee (or temporary advisor).

Requirements for Admission
Requirements for admission into the program are the same as those for students entering other Ph.D. programs in Chemistry. It is the student's responsibility to satisfy any admission requirements stipulated for the Ph.D. in Chemistry.

Undergraduate deficiencies in the student’s background must be remedied promptly, usually by the end of the student’s second semester. During this period, the student must also successfully complete graduate courses appropriate to his/her background. Students will not be formally admitted to the Ph.D. program if their grade point average is below B.

Advisory Committee
Upon admission the student will be assigned a temporary adviser by the Coordinator of the Graduate Polymer Program. The student’s major thesis adviser will become the chairperson of the permanent Advisory Committee.

The Advisory Committee will meet at least once each semester to monitor the progress of the student’s research.

Program Outline
The initial part of the program is devoted to formal course work. The first year usually is devoted to subjects in major branches of chemistry, polymers, and plastics in preparation for the student’s area (cumulative) examinations. The student must choose a research adviser before the end of the second semester and is normally expected to start research during the first summer.

Written Area Examinations
Upon formal admission to the Ph.D. program the student is required to pass a series of consecutive cumulative area examinations. Policy and grading underlying each examination will be announced at the beginning of each academic year.

Each student must also present an oral defense of an original research proposal within six months after the completion of the last area exam.

Course Requirements
Of the 45 minimum credit requirements a minimum of 27 credits in course work, exclusive of thesis and seminar, is required with at least 18 to be taken in chemistry and polymer science (CHEM and POLY prefixes). The remaining course credits (nine or more, with a student’s Advisory Committee having the authority to add six additional credits to the minimum in special situations) may be taken in chemistry or in a related field such as biology, physics, mathematics or engineering. Credit normally is not allowed for undergraduate subjects in chemistry except for those so designated in the catalog. Research credits would then make up the remainder of the 45 credit requirement. The program of courses is the responsibility of a student’s Advisory Committee and must include advanced subjects in the appropriate areas of chemistry, polymers, and plastics. When it is necessary to carry less then the normal credit load of 9 per semester, the student must consult the chair of his/her Advisory Committee to initiate the approval process.

Required Courses: The student must take the following core courses:

a. Polymer Science:
- CHEM.5230 Organic Reaction Mechanisms
- CHEM.5320 Advanced Physical Chemistry
- CHEM.5680 Structural Analysis
- POLY.5030 Polymer Science I
- POLY.5040 Polymer Science II
- POLY.5530 Organic Chemistry of Macromolecules
- POLY.5110 Biopolymers

The following course schedule is suggested to prepare the students for the cumulative examinations:

First Semester

<table>
<thead>
<tr>
<th>Course#</th>
<th>Course Name</th>
<th>Cr.</th>
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<tbody>
<tr>
<td>POLY.5030</td>
<td>Polymer Science I</td>
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<tr>
<td>CHEM.5680</td>
<td>Structural Analysis</td>
<td>3</td>
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<tr>
<td>PLAS.5030</td>
<td>Organic Reaction Mechanisms</td>
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Second Semester

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<th>Course Name</th>
<th>Cr.</th>
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<tr>
<td>POLY.5040</td>
<td>Polymer Science II</td>
<td>3</td>
</tr>
<tr>
<td>POLY.5530</td>
<td>Organic Chemistry of Macromolecules</td>
<td>3</td>
</tr>
<tr>
<td>CHEM.5320</td>
<td>Advanced Physical Chemistry</td>
<td>3</td>
</tr>
</tbody>
</table>

Third Semester

- POLY.5110 Biopolymers 3 cr

Cumulative Examinations
The remaining required courses may be taken in the following semesters. In addition, the student must register for Polymer Seminar POLY.6010/6020 and POLY.6030/6040 Polymer Science Colloquium each semester.

b. Polymer Science/Plastics Engineering Option:

- POLY.5030 Polymer Science I
- POLY.5040 Polymer Science II
- POLY.5110 Biopolymers
- POLY.5530 Organic Reaction Mechanisms
- CHEM.5230 Organic Chemistry of Macromolecules
- CHEM.5320 Advanced Physical Chemistry
- CHEM.5680 Structural Analysis
- PLAS.5030 Mechanical Behavior of Polymers
- PLAS.5060 Polymer Structure
- PLAS.5090 Plastics Processing I

The following course schedule is suggested to prepare the students electing the Polymer Science/Plastics Engineering option for the cumulative examinations:

<table>
<thead>
<tr>
<th>First Semester</th>
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<tbody>
<tr>
<td>Course#</td>
</tr>
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<td>PLAS.5090</td>
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<td>PLAS.5030</td>
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<table>
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<tr>
<th>Second Semester</th>
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<tbody>
<tr>
<td>Course#</td>
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<tr>
<td>POLY.5530</td>
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<td>PLAS.5060</td>
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<tr>
<th>Third Semester</th>
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<tbody>
<tr>
<td>POLY.5110 Biopolymers 3 cr</td>
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</tbody>
</table>

Candidacy for Ph.D. Polymer Science, and Polymer Science/Plastics Engineering Option

To be advanced to candidacy for the doctorate, a student must:

1. Satisfy the course credit requirement with a minimum grade point average of 3.0.
2. Pass the area examinations which includes completion of the research proposal.
3. Fulfill the language requirements.
4. Secure the approval of his/her Advisory Committee and the Graduate Coordinator of the Department of Chemistry.

Advancement to candidacy in no way guarantees the granting of the degree.

Master of Science in Chemistry - Professional Science Master's Options

The Chemistry Department offers two Professional Science Master's Options within the Master's of Science in Chemistry. Please read the admissions requirements and programs requirements carefully as they are not identical.

- Professional Science Master's in Chemistry and Polymer Science Option (PSMCPS) Admissions Requirements for the PSMCPS
- Course of Study for the PSMCPS
- Professional Science Master's in Pharmaceutical Biochemistry Option Admissions Requirements for the PSMPBCourse of Study for the PSMPB

Master's of Science - Professional Science Master's in Chemistry and Polymer Science Option (PSMCPS)

The goal of this program is to further educate ACS accredited chemists for a professional career in an industrial, government, or non-profit research setting.

This is a 32 credit program which requires the successful completion of 18 credits of chemistry/polymer science courses, 9 credits of management courses, 3 credits of management or chemistry electives, a one-credit ethics seminar; and a one-credit professional internship.

Applicants who have recently graduated, as well as, those who have worked in the chemistry/polymer field for multiple years, and foresee the potential of a managerial role in their future are urged to apply.

Chemistry Department Admissions Requirements for the PSMCPS:

Incoming students must possess an ACS undergraduate degree in chemistry (or its full equivalent) and have a minimum cumulative undergraduate GPA of 3.0 from an accredited college or university. Candidates with a closely related major may be admitted with the approval of the Graduate Program Coordinator.
Since advanced study is required in at least three disciplines of chemistry, a number of courses in Analytical/Environmental, Biochemistry, Inorganic, Organic, Physical and Polymer will be available every semester. All students must make up any deficiencies during the first year of their program.

Applications for the Professional Science Masters in Chemistry and Polymer Science are accepted year round, but it is recommended that completed applications be submitted one semester prior to expected matriculation.

Graduate Admissions Requirements:

General requirements for all applicants are a completed application packet supplied by the Graduate Admissions Office (https://www.uml.edu/Grad/default.aspx) which includes:

- Graduate Admissions Application form
- A Statement of Purpose
- Three letters of recommendation pertaining to academic ability and/or professional performance
- Official score report for the Graduate Record Exam, with a satisfactory level score
- Official transcript(s)
- Application fee

Applications may be downloaded or submitted electronically from the Graduate Admissions website (https://www.uml.edu/Grad/default.aspx).

PSMCPS Course of Study

Chemistry and Polymer Science Course Requirements (18-21 credits total)

Required Core Courses for Chemistry and Polymer Science
(Choose 4 courses from the following list. Each course is 3 credits):

- CHEM.5240 Modern Organic Synthesis
- CHEM.5430 Modern Inorganic Chemistry
- POLY.5030 Adv. Polymer Science I

Elective Courses for Chemistry and Polymer Science
(Choose 2-3 courses from the following list. Students may also use the fifth course from the list above. Each course is 3 credits.):

- CHEM.5230 Organic Reaction Mechanisms
- CHEM.5260 Chromatography
- CHEM.5500 Biochemistry I
- CHEM.5680 Structural Analysis
- CHEM.5800 Bioanalytical Chemistry
- CHEM.6720 Surface and Colloid Chemistry
- POLY.5040 Adv. Polymer Science II
- POLY.5530 Organic Chemistry of Macromolecules

Provision is made for a student to elect certain advanced subjects in related fields of chemistry, mathematics, physics, and engineering with permission of PSM Coordinator & Faculty advisor.

Management Course Requirements (9-12 credits total):
Students are required to take a minimum of six credits of advanced (6000 level) courses. Up to two 2-credit basic courses may count towards the degree if they are advanced course prerequisites.

Required Advanced Management Courses (2 courses; 3 credits each):

- MGMT.6350 Project Management
- MGMT.6880 Professional Communication

Advanced Elective Management Courses
(1-2 Courses; 3 credits each)

- FINA.6400 Financing Innovation & Technology Ventures
- MKTG.6300 Market Research for Entrepreneurs
- ENTR.650 Innovation & Emerging Technology
- MGMT.6300 New Product Development
- Other courses may be substituted with permission of the PSM Coordinator and the Faculty Advisor.

Required Science and Ethics Seminar (1 credit total)

Required Professional Internship: (1 credit total)

The duration of the internship component of the PSM degree is expected to be a minimum of 340 hours and be 3 to 6 months.
in duration. The student will work within a business, government agency or research institute directly related to their area of chemistry. The student is encouraged to participate in real world work situations involving not only technical problems, but also teamwork, communication skills and decision-making.

Before commencing the internship a student must be formally enrolled in the PSM program, have completed a minimum of 18 credit hours (including one management and one ethics course) towards the degree, and have permission of their faculty advisor.

Upon completion the intern will be required to submit a paper in thesis format and defend an oral presentation of their work.

Students who possess a full-time position in business, industry or government will be permitted to use work related to their current position as an internship.

Professional Science Masters in Pharmaceutical Biochemistry (PSMPB)

The goal of this program is to further educate scientists with strong backgrounds in chemistry/biochemistry for a professional career in an industrial, government, or non-profit research pharmaceutical setting. This is a 32 credit program which requires the successful completion of 18 credits of chemistry/biochemistry coursework, 9 credits of management coursework, an additional three credits of chemistry or management electives, a one-credit ethics seminar, and a one-credit professional internship.

Applicants who have recently graduated, as well as, those who have worked in the biochemistry/pharmaceutical field for multiple years, and foresee the potential of a managerial role in their future are urged to apply.

Chemistry Department Admissions Requirements for the PSMPB:

- The PSMPB program will consider applicants with BA/BS undergraduate degrees in chemistry, biochemistry, biology, health professions or related disciplines who possess a significant chemistry background and have a minimum cumulative undergraduate GPA of 3.0 from an accredited college or university.
- Since advanced study is required in at least three disciplines of chemistry, a number of courses in Analytical/Environmental, Biochemistry, Inorganic, Organic, and Physical Chemistry will be available every semester. All students must make up any deficiencies during the first year of their program.
- Applications for the Professional Science Masters in Chemistry and Polymer Science are accepted year round, but it is recommended that completed applications be submitted one semester prior to expected matriculation.

Graduate Admissions Requirements:

General requirements for all applicants are a completed application packet supplied by the Graduate Admissions Office (https://www.uml.edu/Grad/default.aspx) which includes:

- Graduate Admissions Application form
- A Statement of Purpose
- Three letters of recommendation pertaining to academic ability and/or professional performance
- Official score report for the Graduate Record Exam, with a satisfactory level score
- Official transcript(s)
- Application fee
- Applications may be downloaded or submitted electronically from the Graduate Admissions website (https://www.uml.edu/Grad/default.aspx).

PSMPB Course of Study

Pharmaceutical Biochemistry Course Requirements (18-21 credits total)

Required Core Courses for Pharmaceutical Biochemistry (All students must take CHEM.550 and CHEM.562 PLUS two courses from the following list. Each course is 3 credits):

- CHEM.5500 Biochemistry I
- CHEM.5620 Pharmaceutical Biochemistry

And two courses from the following list:

- CHEM.5600 Adv. Physical Biochemistry
- CHEM.5630 Chemistry of Natural Products
- CHEM.5700 Protein Chemistry
- CHEM.5800 Bioanalytical Chemistry

Elective Courses for Pharmaceutical Biochemistry (Choose 2-3 courses from the following list or an additional course from the above list. Each course is 3 credits.):
• CHEM.5260 Chromatography
• CHEM.5380 Biochemical Mechanisms
• CHEM.5430 Modern Inorganic Chemistry
• CHEM.5510 Biochemistry II
• CHEM.5670 Computational Biochemistry

Provision also is made for the student to elect certain advanced subjects in related fields of chemistry, health sciences, biology, and other related disciplines with permission of PSM Coordinator & Faculty advisor.

Management Course Requirements (9-12 credits total):

Required Courses (2 courses; 3 credits each):
• MGMT.6350 Project Management
• MGMT.6880 Professional Communication

Elective Courses (Students choose 1-2 courses from the following list. Each course is 3 credits.)
• PSM 5350 Project Management for Science Professionals
• PSM 5450 Professional and Scientific Communication
• PSM 5550 Leadership for Scientists
• PSM 5650 Technical Entrepreneurship
• FINA.6400 Financing Innovation & Technology Ventures
• MKTG.6300 Market Research for Entrepreneurs
• ENTR.6500 Innovation & Emerging Technology
• MGMT.6300 New Product Development

Other courses may be substituted with permission of the PSM Coordinator and the Faculty Advisor.

Science and Ethics Course (1 credit total)

Professional Internship: (1 credit total)

The duration of the internship component of the PSM degree is expected to be a minimum of 340 hours and be 3 to 6 months in duration. The student will work within a business, government agency or research institute directly related to their area of chemistry. The student is encouraged to participate in real-world work situations involving not only technical problems, but also teamwork, communication skills and decision-making. Before commencing the internship a student must be formally enrolled in the PSM program, have completed a minimum of 18 credit hours (including one management and one ethics course) towards the degree, and have permission of the PSM coordinator and their faculty advisor. Upon completion the intern will be required to submit a paper in thesis format and defend an oral presentation of their work.

Students who possess a full-time position in business, industry or government will be permitted to use work related to their current position as an internship.

Please address any inquiries to Chemistry PSM Coordinator: Jin Xu (mailto:jin_xu@uml.edu).

Graduate Certificates in Chemistry

• Chemistry
• Environmental Biotechnology

Chemistry

Department of Chemistry

David Ryan, Ph.D. (mailto:david_ryan@uml.edu), 978-934-3698

This certificate is aimed at the baccalaureate scientist who would like to expand his/her expertise in a pertinent area of modern chemistry. The certificate consists of two required courses from the concentration core, plus two approved electives. Course credits earned through the Certificate Program are directly applicable to the course credit requirements of the M.S. and Ph.D. degrees.

Core Concentrations (2 courses required for each concentration):

Analytical Chemistry Sequence:
• CHEM.5140 Advanced Analytical Chemistry
• CHEM.5260 Chromatography

Biochemistry Sequence:
• CHEM.5500 Biochemistry I
• CHEM.5510 Biochemistry II

Physical Chemistry Sequence:
• CHEM.5130 Spectroscopy
• CHEM.5320 Advanced Physical Chemistry

Organic Chemistry Sequence:
• CHEM.5230 Organic Reaction Mechanisms
• CHEM.5680 Structural Analysis

or
• CHEM.5630 Chemistry of Natural Products
Polymer Sequence:

- POLY.5030 Polymer Science I
- POLY.5040 Polymer Science II

Advanced Materials Sequence:

- CHEM.5100 Microscopy of Advanced Materials
- CHEM.5680 Structural Analysis

After concentration courses are completed, students take any two additional courses listed above or from the list of electives.

Electives:

- CHEM.6530 Chemical Oceanography
- CHEM.5380 Biochemical Mechanisms
- CHEM.5430 Modern Inorganic Chemistry
- CHEM.5600 Advanced Physical Biochemistry
- CHEM.5700 Protein Chemistry
- CHEM.5800 Bioanalytical Chemistry
- POLY.5120 Properties of Bulk Polymers
- POLY.5530 Macromolecules Organic Chemistry

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Chemistry-40.0501-Gedt.html).

Environmental Biotechnology

Biological Sciences, Chemistry, Civil & Environmental Engineering departments

Rich Hochberg, Ph.D. (mailto:rick_hochberg@uml.edu), 978-934-2885

Environmental biotechnology refers to the application of biological technologies to monitor, understand, and remediate environmental problems. This certificate combines courses that explore the ecological impact of anthropogenic environmental change with courses that provide training in current biological technologies that can be brought to bear on environmental problems. Recent advances in biotechnology are providing new avenues for investigating biologically mediated environmental processes, many of which were inaccessible using traditional approaches. New biological technologies are being developed to mitigate environmental problems. These include the biological remediation of pollutants, biological treatment of wastewater and drinking water, source tracking of microbial pathogens, and mitigation of toxic algal blooms. As environmental resources are increasingly strained and new biological technologies with the potential to improve our environment become available, the demand for professionals with training in environmental biotechnology will continue to increase.

Required Courses (choose two):

- BIOL.5230 Biology of Global Change
- CIVE.5780 Biological Wastewater Treatment

Elective Courses (choose six to eight credits):

- CHEM.5800 Advanced Analytical Biochemistry
- CHEM.5140 Advanced Analytical Chemistry
- CHEM.5260 Chromatography
- CIVE.5670 Environmental Aquatic Chemistry
- CIVE.5680 Environmental Fate and Transport
- CIVE.5950 Hazardous Waste Site Remediation
- BIOL.5670 Recombinant DNA Techniques
- BIOL.5690L Recombinant DNA Techniques Laboratory (2 credits)

Total: 12-14 credits

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information (https://www.uml.edu/gainful-employment/Environmental-Biotechnology-26.1305-Gedt.html).
CHEM.5020 Matter in Context (Formerly 84.502) - Credits: 3

This is the first course of a two-semester chemistry program that provides teachers with everyday experiences that are directly related to fundamental chemical concepts. As such, it emphasizes the need to make careful observations, collect data, formulate conclusions and make predictions based on those findings. Teachers gain knowledge and skills by observing local chemical phenomena that allow them to then examine more complex chemical systems like global warming, ozone depletion, and the greenhouse effect; air and water quality; ecosystems; environmental factors in evolution and biodiversity; the earth, and the food web. Inherent in this process is an exposure to modeling, both developing and using physical and mathematical models to describe observed chemical phenomena. Teachers will practice inquiry methods, enhance their critical thinking skills and learn to use a variety of technical and laboratory skills to design, perform and interpret experiments.

CHEM.5140 Advanced Analytical Chemistry (Formerly 84.514) - Credits: 3

Designed to provide graduate students and senior undergraduate students with an understanding of the principles and the theory of analytical measurements and instrumentation. The course is divided into three sections consisting of a) analytical measurements including potentiometry and voltammetry, b) spectrophotometric measurements (i.e. molecular spectrometry), and c) ionic equilibria and statistics. This course is required for graduate programs in Analytical Chemistry and Environmental Studies (Ph.D.) and is recommended for students in other graduate program such as Biology, Biochemistry and Environmental Studies (MS) and other areas of chemistry.

CHEM.5160 Advanced Techniques (Formerly 84.516) - Credits: 3

CHEM.5200 Chromatography (Formerly 84.520) - Credits: 3

CHEM.5230 Organic Reaction Mechanisms (Formerly 84.523) - Credits: 3

The course is designed to provide an advanced understanding of the principles controlling structure/reactivity and the experimental techniques used to elucidate the mechanisms of modern organic reactions. The material covered includes; advanced molecular orbital theory applied to bonding and reactivity, stereoelectronic and conformational effects, intermolecular interactions, potential energy surfaces, reaction kinetics, catalytic methods, pericyclic reactivity, and protochemistry. An introduction to the application of computational chemistry to these topics will also be covered.

CHEM.5240 Organic Synthesis (Formerly 84.524) - Credits: 3

Mechanism, scope and limitations of important selected types of reactions and design of synthetic sequences. Emphasis is placed on methodology of synthesis and current literature.

CHEM.5260 Chromatography (Formerly 84.526) - Credits: 3

Coverage includes the components, theory and performance of chromatographic separations including packed and capillary gas chromatography (GC) and high performance liquid chromatography (HPLC). Modern injectors, detectors, pumping systems, and other hardware used in chromatography are also discussed in detail.

CHEM.5320 Advanced Physical Chemistry (Formerly 84.532) - Credits: 3

Extension of introductory physical chemistry. Open to undergraduates and graduate students in chemistry and related fields. Emphasis is placed on classical and statistical thermodynamics; surface and colloid chemistry; and electronic and vibration-rotation spectra.

CHEM.5340 Quantum Chemistry - Credits: 3

This course will start with the basics of Quantum Mechanics and Quantum Chemistry followed by use of the molecular modeling software GAUSSIAN. Topics to be covered include: Schrodinger equation and wave functions; Particle in a box; Particle in a ring; Heisenberg uncertainty principle; QM operators, Eigenvalue problem; Eigenvectors & eigenvalues; Hermitian operators and commutators; Harmonic oscillator & IR spectroscopy; Rigid Rotator & Rotational Spectroscopy; H-atom, H2+ion; using Mathematics to solve QM problems (e.g. atomic/molecular orbitals visualization), He-atom and variational method; Electron spin and Pauli exclusion principle; EPR/NMR; Semiempirical methods; Many-electron systems; Slater Determinants, Hartree and Hartree-Fock methods; Diatomic molecules; Born-Oppenheimer approx.

CHEM.5380 Biochemical Mechanisms (Formerly 84.538) - Credits: 3

Discussion of various biochemical reactions from the point of view of organic reaction mechanisms. Kinetics, coenzymes and methods of the study of enzyme and catalysis and mechanisms are emphasized.

CHEM.5430 Modern Inorganic Chemistry (Formerly 84.543) - Credits: 3

Use of NMR, EPR, MCD, UV, IR, and Raman spectroscopy. There will be an introduction to the subject of coordination chemistry and the study of the electronic, magnetic, and structural properties of transition metal complexes. Reference to the natural sciences (biology, geology, chemistry, etc.) will be made where appropriate. Techniques used in the separation and purification of metal complexes will be demonstrated. The individual properties of a variety of compounds will be discussed, as will the general chemistry of the metal ions.
84.543) - Credits: 3

A theoretical treatment of atomic structure and chemical bonds, included are such topics as Russell Saunders’ coupling, molecular orbital theory, ligand field theory, and descriptive coordination chemistry.

CHEM.5500 Biochemistry I (Formerly 84.550) - Credits: 3

An advanced study of the structure and properties of proteins, nucleic acids, carbohydrates and lipids, including kinetics and mechanisms of enzyme action and detailed description of metabolic pathways of carbohydrates and lipids.

CHEM.5510 Biochemistry II (Formerly 84.551) - Credits: 3

A continuation of 84.550 with emphasis on metabolic pathways of amino acids and nucleic acid, biosynthesis of proteins and selected topics in molecular biology and various areas of biochemistry.

CHEM.5600 Advanced Physical Biochemistry (Formerly 84.560) - Credits: 3

Physical chemistry encompasses a group of principles and methods helpful in solving many different types of problems. This course will present selected principles of thermodynamics, kinetics, statistical thermodynamics and quantum mechanics as they are applied to biochemical systems. Various experimental techniques will be strongly emphasized in view of their importance in biochemical research.

CHEM.5620 Biopharmaceutical Development (Formerly 84.562) - Credits: 3

Pharmaceutical Biochemistry examines the biochemical and molecular mechanisms of drug interaction. Topics include basic aspects of molecular complementarity (molecular recognition), specificity and stability of ligand binding (energetic), as well as crystallographic and computational approaches.

CHEM.5630 Chemistry Of Natural Products (Formerly 84.563) - Credits: 3

Covers the proof of structure of various types of natural products, approaches to the total synthesis of these products and the biosynthetic pathways.

CHEM.5660 Nanomaterials and Nanostructures (Formerly 84.566) - Credits: 3

Nanoscience and nanotechnology focus on the understanding and control of matter at the dimension of 1-100 nanometers, i.e., the nanoscale. Nanoscale structures, materials and devices have unique properties and functions solely because of their sizes. Research and technology development in nanoscience and nanotechnology aim at understanding the fundamental nanoscale phenomena, synthesizing, fabricating and imaging nanomaterials and nanostructures, and constructing nanoscale systems that offer unprecedented properties and functions. In this course, we will discuss the fundamental nanoscale phenomena. We will learn variety of nanomaterial characterization techniques including scanning probe, electron probe, absorption and particle spectroscopies. Fabrication processes of top-down and bottom-up approaches will be discussed, including molecular and material self-assembly. We will study surface phenomena and surface energy that are of critical importance for nanomaterials and nanostructures. We will also learn various ways to control the structures and properties of nanomaterials and surfaces. A variety of nanomaterials and nanostructures will be discussed, including metal, semiconductor, organic and inorganic nanoparticles, carbon nanomaterials, and various natural and synthetic nanostructured surfaces. Applications of these nanomaterials in nanomedicine and theranostics will also be discussed.

CHEM.5670 Computational Biochemistry (Formerly 84.567) - Credits: 3

This course will provide an introductory survey of the basis of theory/simulations of biomolecules. It is accessible to anyone who has completed two semesters of undergraduate chemistry and who has some background in physical chemistry. Topics/examples will be borrowed from modern biological chemistry and biophysics of single biomolecules. The course will be useful for senior undergraduates and beginning graduate students. Chem/Bioinformatics 84.567 will attempt to cultivate computational skills, which on needs to tackle current scientific problems of biology and biophysics.

CHEM.5680 Structural Analysis (Formerly 84.568) - Credits: 3

Practical applications of instrumental data in the determination of the structure of organic compounds and polymers. Includes mass spectrometry, ultra-violet spectroscopy, infrared spectroscopy and nuclear magnetic resonance spectroscopy. Open to undergraduate students with permission.

CHEM.5700 Protein Chemistry (Formerly 84.570) - Credits: 3

This course outlines the assembly process, structural and functional attributes of protein. Special attention will be given to three-dimensional structures, folding, post translational modifications, misfolding and degradations, as well as
biochemical and biophysical techniques used to elucidate protein structure and function.

CHEM.5800 Bioanalytical Chemistry (Formerly 84.580) - Credits: 3
Analytical biochemistry involves the separation, detection, and analysis of biological molecules. This course addresses advanced theory and applications of contemporary biochemical techniques and instrumentation. Topics covered include chromatographic and electrophoretic separation techniques, detection of biomolecules by spectroscopy and radiochemical methods, biological preparations, and structural analysis of proteins, nucleic acids, polysaccharides and lipids.

CHEM.5850 Modern Organic Chemistry - Credits: 3
This course aims to provide deepened and widened knowledge of concepts, reactivity, and synthesis in modern organic chemistry. It encompasses: main group chemistry, carbonyl/enol/enolate chemistry, heterocyclic compounds, fragmentations, rearrangements, frontier molecular orbital theory, pericyclic reactions, reactive intermediates, organometallic chemistry, selective synthesis, stereochemistry, catalysis, asymmetric synthesis, and multi-step synthesis.

CHEM.5950 Supramolecular Chemistry - Credits: 3
Supramolecular chemistry can be described as 'chemistry beyond the molecule' and involves the study of complex structures held together by weaker interactions. In general, non-covalent bond types, such as electrostatic interactions, van der Waals forces, hydrogen bonds, and metal coordination, are used, but reversible covalent bonds can also be included. This course will provide detailed understanding of the general principles and concepts of the field, including host-guest chemistry, molecular recognition, and self-assembly, as well as highlight a wide variety of examples and applications of supramolecular systems in chemistry, biology, nanotechnology, and materials science.

CHEM.6010 Chemistry Seminar (Formerly 84.601) - Credits: 2
Required of all graduate students. Presentation of current topics by graduate students.

CHEM.6020 Chemistry Seminar (Formerly 84.602) - Credits: 2
Required of all graduate students. Presentation of current topics by graduate students.

CHEM.6030 Chemistry Colloquium (Formerly 84.603) - Credits: 1
Required of all graduate students. Presentation of current topics by visiting scientists and staff.

CHEM.6040 Chemistry Colloquium (Formerly 84.604) - Credits: 1
Required of all graduate students. Presentation of current topics by visiting scientists and staff.

CHEM.6310 Principles of Medicinal Chemistry I (Formerly 84.631) - Credits: 3
This course teaches fundamental principles of drug development, including small organic compounds and biologics. Key aspects of their synthesis, physical characteristics, and pharmaceutical properties are discussed. Topics covered include discovery strategies, statistic-based modeling (e.g., QSAR), structure-based and mechanism-based design methods, and combinatorial techniques.

CHEM.6320 Principles of Medicinal Chemistry II (Formerly 84.632) - Credits: 3
The mechanisms of prototypical drug classes are discussed, including structure-property relationships. Computational methods and means of visualizing drug-substrate interactions at the molecular level are emphasized. Drug design and function are integrated with relevant topics in related disciplines, including biochemistry, biology and physiology.

CHEM.6410 Co-Op Internship (Formerly 84.641) - Credits: 0-1
Practical training for International Students in a Co-operative agreement with Industry or a Government Laboratory for 1 semester.

CHEM.6510 Selected Topics: Chemistry (Formerly 84.651) - Credits: 3
Advanced topics in various fields of chemistry. Content may vary from year to year so that students may, by repeated enrollment, acquire a broad knowledge of contemporary chemistry.

CHEM.6520 Selected Topics: Chemistry (Formerly 84.652) - Credits: 3
CHEM.6530 Chemical Oceanography (Formerly 84.653) - Credits: 3
CHEM.6720 Surface and Colloid Chemistry (Formerly 84.672) - Credits: 3

Surface and colloid chemistry describes the nanoscopic and mesoscopic regimes that connect molecular and macroscopic length scales. The course focuses on how phenomena at macroscopic surfaces and interfaces arise from molecular interactions. Intermolecular and surface forces discussed in detail include van der Waals and electrostatic forces, and how these together with steric interactions give rise to different molecular aggregates (self-assembled structures of surface active molecules and polymers) in bulk solution and in the vicinity of solid surfaces. Examples of modern experimental techniques for measurements of surface forces and for characterization of surfaces and aggregates are discussed and demonstrated.

CHEM.7050 Supervised Teaching Ch & Ps (Formerly 84.705) - Credits: 0
CHEM.7310 Graduate Project in Chemistry (Formerly 84.731) - Credits: 1

Continued research project supplementing the research credits for a doctoral student. This course will require special permission from the Graduate Coordinator.

CHEM.733OL Graduate Project - Chemistry (Formerly 84.733) - Credits: 3
CHEM.7410 Master’s Thesis - Chemistry (Formerly 84.741) - Credits: 1

Master's Thesis - Chemistry

CHEM.7430 Master's Thesis - Chemistry (Formerly 84.743) - Credits: 3
CHEM.7460 Master’s Thesis - Chemistry (Formerly 84.746) - Credits: 6
CHEM.7490 Master’s Thesis - Chemistry (Formerly 84.749) - Credits: 9

CHEM.7510 Graduate Doctoral Research Credit (Formerly 84.751) - Credits: 1
CHEM.7530 Doctoral Dissertation/Chemistry (Formerly 84.753) - Credits: 3
CHEM.7560 Doctoral Dissertation/Chemistry (Formerly 84.756) - Credits: 6
CHEM.7590 Doctoral Dissertation /Chemistry (Formerly 84.759) - Credits: 9

CHEM.7630 Continued Graduate Research (Formerly 84.763) - Credits: 3
CHEM.7690 Continued Graduate Research (Formerly 84.769) - Credits: 9

POLY.5030 Polymer Science I (Formerly 97.503) - Credits: 3

A study of the principles of condensation, free radical, ionic, coordination and ring opening polymerization. The topics include the effect of polymerization techniques on reaction kinetics and molecular weight, and the evaluation of reactivity ratios in copolymerization reactions.

POLY.5040 Polymer Science II (Formerly 97.504) - Credits: 3

Introduction to chain statistics and thermodynamics of macromolecular solutions, methods of study of molecular weight and chain conformation, and the properties of polymers in bulk including viscoelasticity and crystallinitiy.

POLY.5110 Biopolymers (Formerly 97.511) - Credits: 3

Topics include conformation and configuration of vinyl polymers and polypeptides, energetics of chain folding and examination of the forces dictating ordered structures, helix to coil transitions in biopolymers with emphasis on polypeptide structures, instrumental analysis of biopolymer conformation, synthesis of biopolymers including polypeptides, polysaccharides and polynucleotides, and examination of relationships between synthetic polymers and naturally occurring polymers.

POLY.5530 Macromolecules Organic Chemistry (Formerly 97.553) - Credits: 3

An advanced study in polymer science concerned with the synthesis of macromolecules and their mechanisms of formation.

POLY.6010 Polymer Science Seminar (Formerly 97.601) - Credits: 2

Required of all Polymer Science graduate students. Presentation of current topics in polymer science by graduate students.

POLY.6020 Seminar in Polymer Science (Formerly 97.602) - Credits: 2

Required of all Polymer Science graduate students. Presentation of current topics in polymer science by graduate students.
POLY.6030 Polymer Science Colloquium (Formerly 97.603) - Credits: 1

Required of all Polymer Science graduate students. Presentation of current topics in polymer science by visiting scientists and staff.

POLY.6040 Polymer Science Colloquium (Formerly 97.604) - Credits: 1

Required of all Polymer Science graduate students. Presentation of current topics in polymer science by visiting scientists and staff.

POLY.6490 Introduction to Conjugated Polymers (Formerly 97.649) - Credits: 3

This course is an introduction to the fundamental science and potential applications of conjugated polymers in optical and electronic technologies. The topics covered include history, synthesis and molecular structure, including solid state polymerization; crystallinity and morphology, including assembly methods; electronic structure including energy bands, conjugation defects and photoelectron spectroscopy; properties of the insulating forms including light absorption and emission, thermochromism, carrier transport, electroluminescence and nonlinear optical properties; properties of the conducting forms, including "doping"; some specific devices.

POLY.7050 Supervised Teaching in Polymer Science (Formerly 97.705) - Credits: 0

POLY.7430 Master’s Thesis in Polymer Science (Formerly 97.743) - Credits: 3

POLY.7460 Master’s Thesis in Polymer Science (Formerly 97.746) - Credits: 6

POLY.7490 Master’s Thesis in Polymer Science (Formerly 97.749) - Credits: 9

POLY.7510 Thesis Review (Formerly 97.751) - Credits: 1

This is a one credit thesis review course.

POLY.7530 Doctoral Dissertation in Polymer Science (Formerly 97.753) - Credits: 3

POLY.7560 Doctoral Dissertation in Polymer Science (Formerly 97.756) - Credits: 6

POLY.7590 Doctoral Dissertation in Polymer Science (Formerly 97.759) - Credits: 1-9

POLY.7690 Continued Graduate Research (Formerly 97.769) - Credits: 9
Department of Computer Science

The UMass Lowell Computer Science graduate program provides computer scientists with an education of sufficient breadth and depth to prepare them for leadership positions in both industrial and academic environments. It is distinguished by a balanced mixing of the practical, engineering aspects of computer science, with substantial exposure to the theoretical foundations of the field. This mission is supported by departmental and university research labs and Centers. Our graduate program is intended primarily for students with undergraduate degrees in computer science, or for those who have completed a degree in a related area (Engineering, Mathematics, Physics, etc.) and who possess a substantial background in computer science.

- Resources
- Master of Science
- Master of Science, Professional Science Master’s Entrepreneurship Option
- Master of Science, Bioinformatics Option
- Master of Science, Information Technology MSIT (Online Program)
- Doctor of Philosophy and Admission Requirements

Resources

The Computer Science Department has strong industrial ties through its faculty members, its participation in the research activity in various University Centers, its internal laboratories and institutes, its continuing relationships with many local computer and software manufacturers, and its industrial advisory committee. These relationships provide sources of short and long range research projects, hardware donations and student funding, while also providing insight to and understanding of the short and long term directions of local industry. To support instructional and research activities, the Department of Computer Science maintains a large heterogeneous network, including PCs, workstations, and a collection of more specialized equipment. All systems and servers are connected to accessible via the Universitys network.

Department Research Groups / Laboratories:

- Compilers and Parallel Systems
- Computational Mathematics Research Group
- Computing Theory and Algorithms Group
- Database and Software System Research Group
- Discovery and Knowledge Representation Research Group
- Engaging Computing Group
- Institute for Visualization and Perception Research
- Laboratory for Artificial Intelligence and Robotics
- Network and Systems Security Laboratory
- Robotics Lab
- Text Machine Lab for Natural Language Processing

The Master of Science Degree Program

The Master of Science degree program in Computer Science serves several audiences, from the professional with extensive industrial experience to the recent graduate aiming ultimately for an advanced research degree. In all cases, a major objective is to prepare the student for a professional work environment in which continued growth is the norm.

The Computer Science Department offers to outstanding undergraduates a Bachelor’s-Master’s (BS/MS) program. The major advantage of this program is that it allows students to integrate their undergraduate and graduate education, possibly reducing the amount of time required for completion and reducing the administrative overhead for the student.

To be accepted into the BS/MS program, students are expected to have at least a B (3.0) grade point average, both overall and in Computer Science, and to apply during their junior year. The rules governing eligibility for the program appear in the current UMass Lowell online Graduate Catalog.

The Master of Science, Professional Science Master’s Entrepreneurship Option

Course Requirements:

- 34 Course Credits (11 courses)
- Eight Graduate level courses in Computer Science and three graduate level courses in Management, plus 1-credit Professional Internship and two zero-credit Seminars, under the direction of the Graduate Coordinator, from approved list of courses.

The Master of Science, Bioinformatics Option

Course Requirements:

- 30 Courses Credits (10 courses)
- Eight Graduate level courses in Computer Science and two graduate level courses in Biology, under the direction of the Graduate Coordinator, from an approved list of courses.
The Master of Science, Information Technology (Online Program)

The program is offered fully online, providing a pathway for students who have completed a Bachelor’s in Information Technology degree and for working professionals who want to pursue advanced graduate studies in information technology. The online delivery framework provides an accessible format for students juggling work and family responsibilities.

Students may also count course from two graduate IT certificate programs in Systems Models and Management and Network Security towards the Master’s Degree in Information Technology.

The 10-course master’s degree program is designed to provide both a principled and applied exposure toward designing, managing and deploying networked systems of computers. The program places emphasis on practical skills based on Linus/Unix, Windows and Apple platforms, but also teaches general principles along with their technical and ethical foundations.

Admissions Requirements:

1. Completion of an undergraduate BS or BA degree from an accredited institution.
2. Mathematical Maturity: Students should have completed a minimum of one semester of precalculus mathematics, one semester of discrete mathematics and one semester of statics as part of their undergraduate studies, or possess the equivalent experience.
3. C Programming proficiency, to include a minimum of one semester of C Programming an one semester of Data Structures, or the equivalent experience.

Note: Students who do not meet the above requirements, may need to take additional undergraduate courses in order to meet the requirements.

Program Outline:

30 Course Credits (10 Courses)

System Infrastructures Courses: (Choose 2 of the following)

- MSIT.5110 Network and Systems Administration (3 credits)
- MSIT.5170 Operating Systems Foundations (3 credits)
- MSIT.5190 Virtual Systems (3 credits)
- MSIT.5140 Systems Security and Auditing (3 credits)

Network Infrastructure Courses: (Choose 2 of the following)

- MSIT.5600 Network Infrastructures (3 credits)
- MSIT.5610 Computer Network Security (3 credits)
- MSIT.5620 Digital Forensics (3 credits)
- MSIT.5630 Secure Mobile Networks (3 credits)
- MSIT.5650 Cloud Computing (3 credits)

Software Management Courses: (Choose 2 of the following)

- MSIT.5180 Large Scale Application Deployment (3 credits)
- MSIT.5310 Project Management (3 credits)
- MSIT.5320 Managing Large Data (3 credits)

Program Electives: (Choose 4 additional MSIT.xxxx courses from this Program Electives or from any of the first three categories above, as long as you have not already taken the course to fulfill the above category requirements).

- MSIT.5350 Agile and Iterative Project Management (3 credits)
- MSIT.5360 Data Mining (3 credits)
- MSIT.5410 Information Security, Privacy and Regulatory Compliance (3 credits)
- MSIT.5430 Intrusion Detection Systems (3 credits)
- MSIT.5450 Designing and Building a Cybersecurity Program (3 credits)
- MSIT.5660 Advanced Cloud Computing (3 credits)

The Doctor of Philosophy Degree Program

The Doctor of Philosophy degree program aims to provide a student, whether planning on an industrial or academic career, with a challenging research environment and the opportunity to tackle theoretical or applied projects of major scope, depth, and originality.

Admission Standards and Criteria

General Requirements

In addition to the general requirements for admission, applicants for admission to the graduate program at both the Master of Science and Doctor of Philosophy level are expected to have an undergraduate degree in Computer Science or a related discipline such as Mathematics, Physics, or Engineering. They should submit an official application (obtainable from the Graduate Admissions Office). In addition to undergraduate transcripts and letters of recommendation, applicants are expected to submit an official score from the Graduate Record
Examination (GRE). Any student may be required, at the discretion of the department, to complete transitional or remedial courses without graduate credit.

**MS Admission Requirements**

In order to be fully matriculated into the MS program, students must demonstrate competency in the following six knowledge areas:

- Data Structures and Programming in C, C++, or Java
- Operating Systems
- Analysis of Algorithms
- Calculus
- Discrete Mathematics
- Probability and Statistics

Competency is typically demonstrated by producing a transcript of previous academic experience which contains passing grades in courses related to these six areas, or by earning a B or better in the courses below. Knowledge in areas that have not been satisfied at the time of entrance into the M.S. program become conditions on full matriculation. It is the student's responsibility to fulfill his/her conditions at the earliest possible time. The following is the list of courses which satisfy each of the six knowledge areas.

**Data Structures and Programming in C, C++ or Java:**
- COMP.1020 Computing II

**Operating Systems:**
- COMP.3080 Introduction to Operating Systems

**Algorithms:**
- COMP.4040 Analysis of Algorithms

**Calculus:**
- MATH.1310 Calculus I and MATH.1320 Calculus II

**Discrete Math:**
- MATH.3210 Discrete Math I and MATH.3220 Discrete Math II

**Probability and Statistics:**
- MATH.3860 Probability and Statistics I

**Ph.D. Admission Requirements**

In addition to the requirements for admission into the Master of Science in Computer Science program, admission into the Doctor of Philosophy degree program requires a Masters degree in Computer Science. If the student does not already have an MS in CS, they may be admitted into the MS/Ph.D. program; in this program, students must complete the required coursework for the MS in CS as well as degree requirements for the Ph.D. in CS.

**Financial Support**

The Department has a limited number of teaching assistantships available to qualified graduate students. These assistantships can be renewed for up to four semesters. Other support is available through funded research programs in the departmental laboratories and, possibly, through support from other university departments.

**Master of Science Degree in Computer Science**

- Bioinformatics Option
- Entrepreneurship Option

**Admissions requirements**

Admissions requirements for the MS in CS are designed to ensure that MS candidates enter the program on roughly the same level as our own BS in CS graduates. See CS Graduate Admissions Requirements for details.

[MS degree requirements for students matriculated Spring 2012 and later](https://www.uml.edu/docs/MS_Degree_Course_Requirements_2013_tcm18-142414.pdf)

[MS degree requirements for students matriculated Spring 2010 and later](https://www.uml.edu/docs/CSMS%20Degree%20Course%20R_tcm18-53253.pdf)

[MS degree requirements for students matriculated September 2008 and later](https://www.uml.edu/docs/MS-degree-req_tcm18-53252.pdf)

**Master’s Thesis**

An optional master’s thesis can be substituted for at most six credits, and can be used to substitute for one pair of Project- or General-area courses. Students who wish to do a thesis must file a Proposed Thesis Committee form with the Graduate Coordinator prior to beginning work on the thesis.

**Doctor of Philosophy Degree Coursework**
Requirements

- Admission Requirements
- Candidacy Requirements
- Course Requirements
- Additional Requirements
- Computational Mathematics Option

Admission Requirements

In addition to the requirements for admission into the Master of Science in Computer Science program, admission into the Doctor of Philosophy degree program requires a Masters degree in Computer Science. If the student does not already have an MS in CS, they may be admitted into the MS/Ph.D. program; in this program, students must complete the required coursework for the MS in CS as well as degree requirements for the Ph.D. in CS.

Candidacy Requirements

Despite acceptance into the program, in order to be admitted to candidacy, student must:

- Complete the degree requirements for the MS in CS (unless he or she possesses an MS in CS or a closely related engineering, scientific, or mathematical discipline)
- Pass the departmental qualifying examinations.

Course Requirements:

- 6 courses (18 credits) from the Masters course group list (http://www.cs.uml.edu/%7Egcoord/MS_Degree_Course_Requirements.pdf) (pdf), with at most 4 courses from a single Masters course group (http://www.uml.edu/docs/MS-degree-req_tcm18-53252.pdf) (pdf). No course applied towards an MS degree can be used to satisfy course distribution requirements for the Doctoral degree.
- Thesis Credits: 24 Credits
- Total: 42 credits

Course Requirements for Students Matriculated Prior to January 2009

Major Area

- 6 credits (course pairs list)

Minor Area I

- 6 credits (two courses from the course pairs list)

Minor Area II

- 6 credits (two courses from the course pairs list)

Ph.D. Thesis

- 24 credits
- Total: 42 credits

The major and minor area course requirements for the Ph.D. degree are above and beyond the corresponding requirements for the MS degree, but may continue and deepen specializations begun at that level. The primary purpose of the major and minor courses is to provide breadth of knowledge. Therefore, students are encouraged to select courses from a variety of areas. Among all course pairs for the MS and Ph.D. combined, at most one pair may contain a course "piggybacked" onto a core course.

Additional Requirements

- passing qualifying exams (rules (https://www.uml.edu/docs/QualRules_tcm18-148146.pdf) pdf)
- submission and defense at an oral examination of a thesis proposal
- completion of the thesis
- final defense of the thesis during another oral examination
- acceptance of two papers for publication in a peer-reviewed (refereed) journal or conference approved by the thesis advisor. At least one of these publications must be in the thesis area. This rule applies to students whose thesis proposals were defended on or after July, 2007.
- Students are required to report completion of each of these milestones according to the Procedures for Student Progress Through the Ph.D. Program (https://www.uml.edu/Sciences/computer-science/Programs/Grad/Doctorate/Checklist.aspx).

Computational Mathematics Option

Requirements: (beyond a master’s degree)
18 Course Credits (6 courses)
- Four Graduate level courses in Computer Science and two graduate level courses in Mathematics, under the direction of an advisor, from an approved list of courses
- 24 Dissertation Credits
- Supervised by faculty from the Mathematics and Computer Science Departments
- Any student interested in this program should contact the Chair of the CS Department and/or the Chair of the Mathematics Department.

Graduate Certificate Programs
The department of Computer Science offers the following graduate level certificate Programs:

- Human-Computer Interactions
- Cyber Security
- System Models and Management
- Telecommunications

To fulfill requirements and earn a certificate, the required courses for the certificate must be completed within a five year period with a minimum 3.0 grade point average, and with no more than 3 credits below B. Courses completed for one certificate may not be used for another certificate.

Human-Computer Interaction Certificate
Coordinator: Jill Drury, Jill_Drury@uml.edu

Admission Requirements: Prerequisites as specified in the Catalog for admission to the MS program in Computer Science. Candidates with a Bachelors degree in some other suitable area and extensive programming experience should contact the CS Graduate Program Coordinator.

All courses for the Human-Computer Interaction certificate may be used toward a graduate degree in Computer Science, subject to the approval of the Graduate Coordinator and meeting the requirements for admission to the MS program.

Core Courses:
- COMP.5270 Introduction to HCI (3 credits)
- COMP.5280 Evaluation of HCI (3 credits)
- COMP.5680 Seminar in HCI (3 credits)

Elective:
One three-credit course taken from the following list:
- COMP.5130 Internet and Web Systems I
- COMP.5140 Internet and Web Systems II
- COMP.5230, Software Engineering I
- COMP.5411 Data Visualization
- COMP.5460 Computer Graphics I
- COMP.5470 Computer Graphics II
- COMP.5480 Robot Design
- COMP.5490 Mobile Robots
- COMP.5500 selected Topics courses, such as Human-Robot Interaction or Multi-Touch Interaction, with permission of the Certificate Coordinator.

Gainful Employment Disclosure Information

Cyber Security
Coordinator: William Moloney, 978-934-3640, bill@cs.uml.edu

This certificate program is available to students who have an undergraduate degree in Information Technology, Computer Science, Information Systems and related majors. Students should be familiar with the C programming language and have a math background that includes at least pre-calculus math, statistics and a first course in discrete structures. The certificate courses do not have pre-requisite requirements among themselves, and may be taken in any order.

NOTE: Courses taken for this certificate may not be used towards the MS in Computer Science degree.

Admission Requirements:
- Transcript showing proof of completion of an undergraduate BS or BA degree from an accredited institution
- Mathematical experience to include a minimum of one semester of pre-calculus, one semester of discrete mathematics and one semester of statistics, or the equivalent experience
C programming proficiency, to include a minimum of one class of C programming and one class of data structures, or the equivalent experience

Approval of the Graduate Coordinator

Choose four courses (12 credits total):

- MSIT.5610 Computer Network Security
- MSIT.5620 Digital Forensics
- MSIT.5600 Network Infrastructures
- MSIT.5640 Secure Mobile Networks
- MSIT.5650 Cloud Computing

**Systems Models and Management**

**Coordinator:** William Moloney, 978-934-3640, bill@cs.uml.edu

This certificate program is immediately available to students who have completed an undergraduate degree in Information Technology, Computer Science, Information Systems and related majors. Students should be familiar with the C programming language and have a math background that includes at least pre-calculus math, statistics and a first course in discrete structures. The certificate courses do not have pre-requisite requirements among themselves, and may be taken in any order.

NOTE: Courses taken for this certificate may not be used towards the MS in Computer Science degree.

**Admission Requirements:**

- Transcript showing proof of completion of an undergraduate BS or BA degree from an accredited institution
- Mathematical experience to include a minimum of one semester of pre-calculus, one semester of discrete mathematics and one semester of statistics, or the equivalent experience
- C programming proficiency, to include a minimum of one class of C programming and one class of data structures, or the equivalent experience
- Approval of the Graduate Coordinator

Required Courses: The certificate is comprised of the following courses:

Choose four courses, 12 credits

- MIST.5170 Operating Systems Foundations
- MSIT.5180 Large Scale Application Deployment
- MSIT.5110 Network and Systems Administration
- MSIT.5190 Managing Virtual Systems
- MSIT.5430 Intrusion Detection Systems
- MSIT.5650 Cloud Computing

**Gainful Employment Disclosure Information**


**Telecommunications**

**Coordinator:** Benyuan Liu, Ph.D. (bliu@cs.uml.edu) 978-934-2425

This graduate certificate consists of courses from both the Computer Science and Electrical Engineering Departments. It is intended for students who hold a baccalaureate degree in science or engineering and who wish to concentrate on hardware/software issues pertaining to telecommunications.

Admissions requirement:

- BS in Computer Science/Engineering/Mathematics

Course requirements:

- COMP.5630 Data Communications I
- COMP.5640 Data Communications II
- EECE.5430 Introduction to Communication Theory
- or another three credit course with the permission of the Certificate Coordinator

All courses for the Telecommunications certificate may be used toward a graduate degree in either the Electrical Engineering or the Computer Science Department subject to the approval of the appropriate graduate coordinator and meeting the requirements for admission to the MS program.

**MS and Ph.D. Course Pairs**

The following is the list of approved course pairs for both the MS and the Ph.D.

NOTE: Among all course pairs for the MS and Ph.D. combined, at most one pair may contain a course “piggybacked” onto a core course.
• COMP.5630 Data Communications I
• COMP.5640 Data Communications II

• COMP.5630 Data Communications I
• COMP.5550 Computer Networks

• COMP.5150 Operating Systems I
• COMP.5160 Operating Systems II

• COMP.5460 Graphics I
• COMP.5470 Graphics II

• COMP.5460 Graphics I
• COMP.5411 Scientific Data Visualization

• COMP.527 Human-Computer Interaction
• COMP.568 Human-Computer Interaction Seminar

• COMP.5270 Human-Computer Interaction
• 57.521 SWD in Context (formerly 65.790)

• COMP.527 Human-Computer Interaction
• COMP.5650 Evaluation of Human-Computer Interaction

• COMP.5220 Object-Oriented Analysis and Design
• COMP.5230 Software Engineering I

• COMP.5230 Software Engineering I
• COMP.5240 Software Engineering II

• COMP.5230 Software Engineering I
• COMP.5210 A Discipline for Software Engineering

• COMP.5230 Software Engineering I
• COMP.5260 Project Management

• COMP.5730 Database I
• COMP.5740 Database II

• COMP.5510 Computer Architecture
• COMP.5530 Parallel Processing

• COMP.5510 Computer Architecture
• COMP.5150 Operating Systems I

• COMP.5530 Parallel Processing
• COMP.5200 Storage Architecture

• COMP.5150 Operating Systems I
• COMP.5530 Parallel Processing

• COMP.5040 Algorithms II
• COMP.5030 Algorithms I

• COMP.5040 Algorithms II
• COMP.5030 Algorithms I

• COMP.5310 Programming Language Design
• COMP.5380 Semantics of Programming Languages

• COMP.5310 Programming Language Design
• COMP.5390 Computational Logic

• COMP.5380 Semantics of Programming Languages
• COMP.5390 Computational Logic

• COMP.5430 Artificial Intelligence
• COMP.5380 Semantics of Programming Languages

• COMP.5430 Artificial Intelligence
• COMP.5390 Computational Logic

• COMP.5130 Internet and Web Systems I
• COMP.5140 Internet and Web Systems II

• COMP.5340 Compiler Writing I
• COMP.5350 Compiler Writing II
M.S. in Computer Science Bio/Cheminformatics Option

Admissions Criteria and Requirements

Applicants for admission to the Master of Science Program with a Bio/Cheminformatics option typically have an undergraduate degree in computer science or a related discipline such as mathematics, physics, biochemistry or engineering. Students wishing to enroll in the Master's program in Computer Science with Bio/Cheminformatics option must demonstrate competency in the knowledge areas listed below. Competency in these areas is usually demonstrated by producing a transcript of previous academic experience which contains related courses passed with a B or better, or by earning a B or better in the courses listed below. Competency in the biology and chemistry area may be demonstrated by successfully passing a CLEP exam. Additional information regarding these exams may be obtained at the CollegeBoard website. The following are the knowledge areas in which competency must be demonstrated:

- Biology BIOL.1110 Principles of Biology I
- Chemistry CHEM.1210 Chemistry I and CHEM.1220 Chemistry II

Course Pairs:

The following course pairs are selected from the approved list of Computer Science pairs, these courses have been chosen because they complement the goals of the bio/cheminformatics option.

Total 12 Credits (Two pairs of courses from the approved list of CS pairs.)

- COMP.5030 Algorithms I
- COMP.5460 Graphics I
- COMP.5040 Algorithms II
- COMP.5470 Graphics II
- COMP.5730 Database I
- COMP.5730 or COMP.5740 Database I or II

Core courses: Total 9 credits

- COMP.5020 Foundations of CS
- COMP.5030 Algorithms
- COMP.5310 Design of Programming Languages

- Discrete Mathematics MATH.3210 Discrete Structures I and MATH.3220 Discrete Structures II
- C or C++ through Data Structures
- COMP.2500 Accelerated C with Data Structures or COMP.1010 Computing I and COMP.1020 Computing II
- Programming Languages
- COMP.3010 Organization of Programming Languages
- Computer Architecture
- COMP.3050 Computer Architecture
- Operating Systems
- COMP.3080 Introduction to Operating Systems
- Analysis of Algorithms
- COMP.4040 Analysis of Algorithms
- Calculus MATH.1250 Calculus A and MATH.1260 Calculus B or MATH.1310 Calculus I and MATH.1320 Calculus II
• COMP.5740 Database II
• COMP.5500 Data Mining

• COMP.5730 or COMP.5740 Database I or II
• COMP.5460 or COMP.5470 Graphics I or II

• COMP.5220 Analysis and Design
• COMP.5411 Scientific Data Visualization

• COMP.5230 or COMP.5250 Software Engineering I or II
• COMP.5500 Data Mining
• COMP.5230 or COMP.5250 Software Engineering I or II

• COMP.5210 SWD in Context
• COMP.5260 Project Management

• COMP.5030 or COMP.5040 Algorithms I or II
• COMP.5430 Artificial Intelligence

• COMP.5530 Parallel Processing
• COMP.5500 Advanced Data Mining

• COMP.5030 or COMP.5040 Algorithms I or II
• COMP.5130 Internet and Web Systems I

Topics Course Data Mining

• COMP.5140 Internet and Web Systems II

• COMP.5030 or COMP.5040 Algorithms I or II
• COMP.5030 or COMP.5040 Algorithms I or II

• COMP.5100 Computational Methods in Molecular Biology
• COMP.5430 Artificial Intelligence

• BIOL.5050* (3 credits) Bioinformatics
• BIOL.5070* (1 credit) Bioinformatics Laboratory (coreq. BIOL.4050)

• BIOL.5190 (3 credits) Biochemistry I
• BIOL.5200 (3 credits) Biochemistry II
• BIOL.5010 (3 credits) Selected Topics I
• BIOL.5020 (3 credits) Selected Topics II
• BIOL.5670 Recombinant DNA Techniques
• CHEM.6510 Selected Topics in Chemistry: Protein and Chemical Informatics

• CHEM.5500 (3 credits) Biochemistry I
• CHEM.5510 (3 credits) Biochemistry II
• CHEM.5670 (3 credits) Biocheininformatics
• CHEM.5680 (3 credits) Computational Chemistry
• CHEM.5700 (3 credits) Advanced Protein Chemistry
• CHEM.5800 Advanced Analytical Biochemistry

MATH.5930 (3 credits) Experimental Design (Mathematics Department)

Although Organic Chemistry is not required as a prerequisite, some of the courses offered as part of this degree rely on knowledge of this subject.

Students should be aware that the above courses may only be used toward the Bio/Cheminformatics option. If the entire requirements of the option are not completed then these courses cannot be applied in isolation toward the M.S. in Computer Science.

Program Total: 30 credits (assuming prerequisites have been filled)

An optional master’s thesis can be substituted for at most 6 credits, and may be used to substitute for one pair of related courses.

**MS in Computer Science - Entrepreneurship Option**

**Entrepreneurship Option**

This is a Masters Degree Option within the Computer Science Graduate Program. It is directed to people with a strong undergraduate background in Computer Science who are interested in both deepening their technical knowledge and in understanding the tools required for developing a company directed towards software services and products.
Admission Requirements: as specified in the Catalog for admission to the MS program in Computer Science.

MS Requirements

Non-thesis option:

- 7 courses from Computer Science, satisfying the MS core and distribution requirements. (total of 21 credits)
- 3 College of Management courses (total of 9 credits) chosen from: ENTR.6500: Innovation and Emerging Technologies (3 credit) MKTG.6300: Market Research for Entrepreneurs (3 credit) FINA.6400: Financing Innovation and Technology Ventures (3 credit) MGMT.6300: New Product Development (3 credit)

and taken within the first two semesters of full-time study (first six graduate courses).

1 course from either Computer Science or Management, as deemed appropriate in consultation with the faculty adviser(s). (3 credits)

Total Credits: 33

Thesis option:

- 6 courses (18 credits) from Computer Science, satisfying the MS core and distribution requirements.
- 3 College of Management courses (9 credits) chosen from: ENTR.6500: Innovation and Emerging Technologies (3 credit) MKTG.6300: Market Research for Entrepreneurs (3 credit) FINA.6400: Financing Innovation and Technology Ventures (3 credit) MGMT.6300: New Product Development (3 credit)

and taken within the first two semesters of full-time study (first six graduate courses).

- 6 credits of Masters Thesis. The primary adviser shall be from CS, with a member of the thesis committee from the College of Management. The thesis will articulate the results of appropriate market research, a detailed business plan, and will deliver a prototype of a product. A course taken from either CS or Management could substitute for 3 thesis credits, if approved by both advisers as being critical for the thesis.

Total Credits: 33
COMP.5000 Fundamental of Computer Science
(Formerly 91.500) - Credits: 3
Mathematical topics necessary for graduate study in computer science in the areas of discrete mathematics, probability, linear algebra and proof techniques. Material may include topics such as: summations, sets, relations, functions, recurrences, graphs, trees, elementary combinatorics, basic axioms and laws of probability, discrete random variables, probability distributions, matrices, Boolean algebra, logarithms.

COMP.5020 Foundations of Computer Science
(Formerly 91.502) - Credits: 3
An advanced introduction to theoretical computer science. This course will cover the fundamentals of automata, formal languages, and computability theory.

COMP.5030 Algorithms (Formerly 91.503) - Credits: 3
Advanced algorithms and complexity analysis. Dynamic programming; greedy algorithms; amortized analysis; shortest path and network flow graph algorithms; NP-completeness; approximation algorithms; number-theoretic algorithms; string matching; computational geometry. Additional topics may include linear programming, parallel algorithms, fast Fourier transforms, polynomial, integer, and matrix algorithms. Readings may include conference and journal papers from the algorithms literature. Abstract types, lists, trees, graphs, sets; relevant algorithms and their worst and average case analyses; fast transforms; polynomial, integer, and matrix algorithms; NP-completeness.

COMP.5040 Advanced Algorithms: Computational Geometry (Formerly 91.504) - Credits: 3
Advanced algorithms topics, such as design and analysis of geometric and combinatorial algorithms, computability and complexity.

COMP.5080 Analysis Of Algorithms (Formerly 91.508) - Credits: 3
Topics in algorithm design and analysis; mapping and modeling; issues in complexity; lower bounds; models of parallel computation.

COMP.5100 Computational Complexity Theory
(Formerly 91.510) - Credits: 3
This course covers polynomial-time hierarchy and polynomial space, circuit complexity, structure of NP, probabilistic machines and complexity classes, complexity of counting, interactive proof systems, probabilistically checkable proofs, complexity of approximation problems, and average-case NP-completeness.

COMP.5130 Internet And Web Systems I (Formerly 91.513) - Credits: 3
This course is a survey of Web programming technologies. It begins with a discussion of what Web servers and clients are, how they interact, and how one sets them up. We then explore a wide variety of Web technologies including HTML, JavaScript, JavaServer Pages, Java Servlets, and XML and its many related technologies. Our goal in this course is to provide the basic understanding and knowledge of how the Internet and World Wide Web operate and the technical knowledge required to establish and maintain an Internet/Web site and to develop and introduce new capabilities and features on such sites.

COMP.5140 Internet & Web Systems II (Formerly 91.514) - Credits: 3
A continuation of 91.513 with a focus on current topics and topics of special interest. Examples of recent topics include: The semantic Web and ontologies, Web services, Peer-to-peer networks, Information Search and Retrieval, Autonomous intelligent agents and Multi-modal presentations.

COMP.5150 Operating Systems I (Formerly 91.515) - Credits: 3
This course provides insight into multiprocessing operating systems including processor memory, peripheral, and file systems management in batch, timesharing, real time, and distributed systems targeted for various hardware. Particular emphasis will be placed on techniques of virtual memory as well as the problems of concurrency in both centralized and distributed systems. An OS simulation is a required programming project. Some topics to be covered are process synchronization; high-Level mechanisms for concurrency; processor scheduling and system analysis; deadlock; virtual memory; distributed systems; computer security.

COMP.5160 Operating Systems II (Formerly 91.516) - Credits: 3
The design and implementation of an interactive multiprocessing operating system to run on a bare hardware system. Separate teams manage the major subsystems with in-class design reviews to coordinate system integration. A functioning system is a class requirement.

COMP.5200 Digital Storage Architectures (Formerly
This course will focus on existing and proposed technologies for storing digital information. Both hardware and software issues will be examined, beginning with device and controller organization and proceeding through aggregation techniques, interconnect architectures and host consideration. At each level, specific components will be evaluated with respect to critical storage criteria, such as bandwidth and latency, fault tolerance, infrastructure requirements and cost.

COMP.5220 Object Oriented Analysis (Formerly 91.522) - Credits: 3
Object-oriented techniques for analysis, specification, and design. Static information models and state-based dynamic behavior models applied to rapid prototyping projects that both use and implement object-oriented CASE tools.

COMP.5230 Computer Vision I (Formerly 91.423 & 91.523) - Credits: 3
Computer vision has seen remarkable progress in the last decade, fueled by the ready availability of large online image collections, rapid growth of computational power, and advances in representations and algorithms. Applications range from 3-D scene reconstruction, to visual Simultaneous Localization and Mapping (SLAM) for robotics, to real-time human body pose estimation. This introductory computer vision course explores various fundamental topics in the area, including the principles of image formation, local feature analysis, segmentation, multi-view geometry, image warping and stitching, structure from motion, and object recognition.

COMP.5270 Human Computer Interaction (Formerly 91.527) - Credits: 3
The purpose of this class is to ground students in the basics of how humans interact with technology, and make students aware of the breadth of topic areas related to human-computer interaction (HCI). This course emphasizes theoretical constructs such as the Model-Human Processor, and includes seminal readings by the original researchers. Further, the course emphasizes techniques for understanding users’ tasks, formulating users’ requirements, and assessing proposed designs using heuristic evaluation. As part of understanding users’ needs, students will consider social, organizational, and ethical perspectives on information technology. Students are also exposed to specialty topics in human-computer interaction such as multi-user computing, universal access to computer applications, and internationalizing interfaces. This course includes a project to design, develop, document, and orally present a prototype interface. At the end of the course students will be able to cite basic principles of human interaction and devise and carry out a usability engineering plan to aid in developing new human interfaces.

COMP.5280 Evaluation of Human-Computer Interaction (Formerly 91.528) - Credits: 3
This course is an introduction to methods used to evaluate the design of human-computer interaction (HCI). Students will apply examples of all three of the major types of HCI evaluation techniques: inspection, analytical, and empirical techniques. The course also covers HCI experiment design and data analysis, including threats to experimental validity. The course project consists of a formal usability test. This project requires students to learn principles of ethical treatment of human subjects, complete the University’s Institutional Review Board applications and training for human-subject testing, conduct testing sessions, analyze data, recommend design changes, and document results in a professional manner. At course completion, students will have demonstrated skills for assessing the effectiveness of interface designs and will understand how evaluation fits into computer products’ lifecycles.

COMP.5300 Special Topics - Credits: 3
Topics of mutual interest to the instructor and student(s) (Formerly 91.530).

COMP.5310 Design of Program Languages (Formerly 91.531) - Credits: 3
A one-semester course designed to provide students with hands-on understanding of the underlying concepts of programming languages, the principles of their design, and the fundamental methods for their implementation. An executable metalanguage such as Scheme or SML is used throughout the course, facilitating the design of high-level, concise interpreters that are easy to comprehend. The approach is analytical because the salient features of the imperative, functional, object-oriented, and logic programming paradigms are described in the executable meta-language.

COMP.5340 Compiler Construction I (Formerly 91.534) - Credits: 3
This course implements a compiler for a complete language. Topics include grammars, syntax, elements of parsing and recursive descent, semantics, basic code generation, fast compilation runtime support. Programming project required.

COMP.5400 Visual Analytics (Formerly 91.540) - Credits: 3
This course covers the basic topics for the interdisciplinary field of visual analytics. This course is not just for computer science
students but also for analysts and scientists in different disciplines. The topics include visual analytics science and technology, perception, cognitive processes and human tasks and reasoning, data and knowledge representation, visualization and interaction, statistical and analytic methods, data mining and knowledge discovery, and evaluation and usability. Numerous examples of systems, tools and applications will be presented.

COMP.5411 Data Visualization (Formerly 91.541) - Credits: 3

This course looks at classical and novel methodologies for the visualization of large and complex data sets. The course covers both scientific and information visualization starting with data modeling, human perception and cognition, basic and advanced techniques, interaction, formal models, real time systems, and frameworks for integrated analysis and visualization. Examples used come from numerous areas including the biomedical literature and security.

COMP.5420 Natural Language Processing (Formerly 91.442 & 91.542) - Credits: 3

This course introduces principles and techniques behind natural language processing (NLP), and covers a large selection of important automatic text processing tasks. Selected topics include n-gram language models, part-of-speech tagging, statistical parsing, word sense disambiguation, discourse segmentation, information extraction, sentiment analysis, machine translation. Quantitative techniques are emphasized, with a focus on applying statistical models to large collections of text. The course provides students with a hands-on experience in building a substantial NLP application of their choice.

COMP.5430 Artificial Intelligence (Formerly 91.543) - Credits: 3

Search and games, knowledge representation paradigms, natural language understanding, planning, perception. Use of the LISP language for one or more programming projects.

COMP.5440 Data Mining (Formerly 91.544) - Credits: 3

This introductory data mining course will give an overview of the models and algorithms used in data mining, including association rules, classification, clustering, etc. The course will teach the theory of these algorithms and students will learn how and why the algorithms work through computer labs.

COMP.5450 Machine Learning (91.545) - Credits: 3

This introductory course gives an overview of machine learning techniques used in data mining and pattern recognition applications. Topics include: foundations of machine learning, including statistical and structural methods; feature discovery and selection; parametric and non-parametric classification; supervised and unsupervised learning; use of contextual evidence; clustering, recognition with strings; small sample-size problems and applications to large datasets.

COMP.5460 Computer Graphics I (Formerly 91.546) - Credits: 3

Introduction to the hardware, software and mathematics of 2- and 3-dimensional interactive computer graphics systems, including standards, modeling, transformations, hidden-surface removal, shading, and realism.

COMP.5470 Computer Graphics II (Formerly 91.547) - Credits: 3

Lighting models, photo-realism, animation, constructive solid geometry, and distributed graphics.

COMP.5480 Robot Design (Formerly 91.548) - Credits: 3

A broad interpretation of robotics to mean systems that interact with people, each other, and the world around them, using sensors, actuators, communications, and a control program. Project- and lab-based course that involves electronics, embedded coding, mechanical design, and research.

COMP.5490 Mobile Robots (Formerly 91.549) - Credits: 3

This course will focus on the artificial intelligence side of robotics in a project- and lab-based course. Topics to be covered include robot architectures, mapping and localization, learning, vision, multi-agent systems and current research areas.

COMP.5500 Topics (Formerly 91.550) - Credits: 3

Topics of mutual interest to the instructor and student(s).

COMP.5510 Bioinformatics for CS - Credits: 3

Complete genomic sequences of human, other mammals, and numerous other organisms are known for some time. From early on, comparisons or analyses of genomic sequences require aids on computer programming. After brief introductions to molecular biology for Computer Science students, the course will examine computer algorithms used in bioinformatics problems including sequence alignment, phylogeny, DNA
sequencing, and data analyses.

COMP.5530 Parallel Processing (Formerly 91.553) - Credits: 3
A survey of parallel computer architectures, parallel programming languages, and parallel algorithms, with emphasis on solving practical problems with parallel computers. A final project, typically a substantial parallel program, is required. Usually offered during the Spring semester.

COMP.5610 Computer & Network Security I (Formerly 91.561) - Credits: 3
Basic concepts and techniques of computer network security; data encryption algorithms; public-key cryptography and key management; data authentication; network security protocols in practice; wireless network security; network perimeter security; the art of anti-malicious software; the art of intrusion detection. Students will implement encryption and authentication algorithms as network applications.

COMP.5620 Computer Security II (Formerly 91.562) - Credits: 3
Applied computer security topics such as a computer and network forensics, virtual private networks, denial of service, viruses and worms, intrusion detection systems, smart cards, biometrics, programming language security, web security and privacy, e-commerce; case studies of deployed systems; policy and legal considerations.

COMP.5630 Data Communications I (Formerly 91.563) - Credits: 3
Resource sharing; computer traffic characterizations; multiplexing; network structure; packet switching and other switching techniques; design and optimization; protocols; routing and flow control; simulation and measurement; communications processors.

COMP.5640 Data Communications II (Formerly 91.564) - Credits: 3
Continuation of 91.563

COMP.5680 Seminar in Human-Computer Interaction (Formerly 91.568) - Credits: 3
The two main purposes of this seminar course are to involve students in current human-computer interaction (HCI) research and to learn to critique others’ HCI research. Each offering of the seminar will center on a theme of applying HCI techniques to a particular type of interaction such as human interfaces for robots, pervasive computing, or social media. Students will be expected to read and critique a number of papers from the current literature in the designated topic area. Further, class members will form a research team (led by the course instructor) to perform original research in the topic area. Class members will co-author a paper based on their research results with the goal of submitting it to a conference. By the end of the course, students will be able to describe the state-of-the-art in the course topic, recognize examples of good and poor research techniques, document research to high academic standards, and become productive members of HCI research teams.

COMP.5700 Topics (Formerly 91.570) - Credits: 3
Topics of mutual interest to the instructor and student(s).

COMP.5730 Data Base I (Formerly 91.573) - Credits: 3
Study of various database models including hierarchical, network, relational, entity-relationship, and object-oriented models. This course also covers data design, integrity, security, concurrency, recovery, query processing, and distribution.

COMP.5740 Data Base II (Formerly 91.574) - Credits: 3
Continuation of Data Base I. Various issues in the implementation of database systems will be covered.

COMP.5800 Topics in Computer Science (Formerly 91.580) - Credits: 3
Topics of mutual interest to the instructor and student(s).

COMP.5870 Computer Science Education in Secondary School (Formerly 91.587) - Credits: 3
COMP.5920 Special Topics: Computer Science (Formerly 91.592) - Credits: 3
COMP.5930 Cooperative Education (Formerly 91.593) - Credits: 0-1
COMP.6040 Network Optimization (Formerly 91.604) - Credits: 3
This course covers advanced topics in network optimization on continuous and discrete models, including the max-flow problem, the min-cost flow problem, simplex methods for min-cost flow, dual ascent methods for min-cost flow, auction algorithms for min-cost flow, nonlinear network optimization,
convex separable network problems, and network problems with integer constraints.

COMP.6130 Advanced Topics in Information Retrieval and Mining (Formerly 91.613) - Credits: 3

This is a proposed new 600-level course. The topics are advanced topics in Information Retrieval and Mining, including (but not limited to) Search and Information Retrieval, Visual Text Mining, Document Retrieval and Analysis, Non-textual Retrieval (including Image-, Sound, Video-Retrieval). The course's format is a seminar: (advanced, doctoral) students will be reading and presenting the current state-of-the-art literature. Course requirements include weekly bibliography reports (at least 2 new entries each week) class presentations, two term papers, and a term project.

COMP.6400 Advanced Research Topics in Data Visualization (Formerly 91.640) - Credits: 3

This course will cover modern information visualization research. Student will read and summarize current research and published papers. If a student already has a thesis topic or is already doing research, the student will participate in the development of a proposal for external funding related to their thesis topic or research. If a student does not have a thesis topic, the student will develop their thesis proposal.

COMP.6410 Advanced Topics in Visualization (Formerly 91.641) - Credits: 3

This course covers advanced topics in data visualization. Coverage will be topical and may include advanced graph visualization, modern coordinated visualizations, collaborative visualization knowledge visualizations, security visualization, web-based visualization, and high-performance visualization. Theory will also be covered.

COMP.6440 Topics in Data Mining (Formerly 91.644) - Credits: 3

This course continues with 91.421/91.544 Data Mining and explores the state of the art research advances in mining large amount of data especially algorithms in association classification, clustering, and applications such as web mining and spatio-temporal data mining.

COMP.6500 Advanced Research Topics in Wireless Networks (Formerly 91.650) - Credits: 3

This course will cover state-of-art wireless networking research topics, including communications, management, security, sensors, and mobile applications. Students will read and summarize current research and published papers, and do experimental projects. This course allows subtitle (topics), and students can take this course multiple times with different subtitle (topics). The subtitle (topic) of this course is to be determined when the course is offered.

COMP.6610 Advanced Topics in Network Security (Formerly 91.661) - Credits: 3

This is a topic course, with a subtitle to be determined by the instructor. It covers advanced topics in network security of mutual interests to the faculty and students.

COMP.6730 Advanced Database Systems (Formerly 91.673) - Credits: 3

This course covers advanced topics in database management systems, including query processing and optimization, indexing, transaction management, data warehousing, data mining, etc. It also covers spatio-temporal databases, search engines, stream and sensor databases, and open problems for research.

COMP.6910 International Finance (Formerly 91.691) - Credits: 3

COMP.7010 Computer Science Research (Formerly 91.701) - Credits: 1

COMP.7020 Computer Science Research (Formerly 91.702) - Credits: 6

COMP.7030 Computer Science Research (Formerly 91.703) - Credits: 3

COMP.7060 Directed Research (Formerly 91.706) - Credits: 6

COMP.7100 Approximation Algorithms (Formerly 91.710) - Credits: 3

This course covers advanced topics in approximation algorithms for NP-hard problems, including combinatorial algorithms and LP-based algorithms for set cover, k-cut, k-center, feedback vertex set, shortest superstring, knapsack, bin packing, maximum satisfiability, scheduling, Steiner tree, Steiner Forest, Steiner network, facility location, k-median, semidefinite programming. It also covers counting problems, shortest vector, hardness of approximation, and open problems for research.

COMP.7110 Combinatorial Optimization (Formerly 91.711) - Credits: 3

This covers advanced topics in computational combinatorial
optimization. Topics will be drawn from practical applications in various areas, including wireless sensor networks, different types of complex networks, online social networks, bioinformatics, and computational medicine.

COMP.7410 Thesis Review (Formerly 91.741) - Credits: 1
COMP.7430 Master’s Thesis - Computer Science (Formerly 91.743) - Credits: 3
COMP.7460 Master’s Thesis - Computer Science (Formerly 91.746) - Credits: 6
COMP.7490 Master’s Thesis - Computer Science (Formerly 91.749) - Credits: 9
COMP.7510 Doctoral Thesis Research (Formerly 91.751) - Credits: 1-3
COMP.7530 Doctoral Dissertation/Computer Science (Formerly 91.753) - Credits: 3
COMP.7560 Doctoral Dissertation/Computer Science (Formerly 91.756) - Credits: 6
COMP.7570 Doctoral Thesis Research (Formerly 91.757) - Credits: 12
COMP.7590 Doctoral Dissertation/Computer Science (Formerly 91.759) - Credits: 9

This course introduces the concepts and techniques of systems and network administration. The course covers topics in a wide range from host management, network management, host and network security to automating system administration. In this course learners will be installing and configuring various popular network based services in a Linux environment.

MSIT.5140 Systems Security and Auditing (Formerly 94.514) - Credits: 3

This course examines the strategies for deploying and auditing secure systems. IT auditors primarily study computer systems and networks form the point of view of examining the effectiveness of their technical and procedural controls to minimize risks. Risk analysis and the implementation of corresponding best practice control objectives will be studied. The material will include methodologies that help auditors to:

Discover what’s really going on at a point in time., Find out about potential problems, before it’s too late to fix them., Evaluate business situations objectively., Make informed, if difficult decisions., Implement corrective actions, changes and improvements where needed.

MSIT.5170 Operating Systems Foundations (Formerly 94.517) - Credits: 3

This course investigates the organization and deployment of contemporary operating systems. The process model is examined both generically and in the context of the current Linux/Unix and Windows implementations. Process attributes such as address spaces, threads, channels and handles, access rights, scheduling behavior and states and state transitions will be studied. Memory management, deadlock management and the file system development are also evaluated. A subsystem of system configuration options will be considered during the course in order to highlight the functional deployment of the core OS issues discussed. Pre-req: BS in IT or equivalent. Cannot be used toward MS or PhD in Computer Science.

MSIT.5180 Large Scale Application Deployment (Formerly 94.518) - Credits: 3

This course will develop a systematic framework for the life cycle management of large scale applications. Beginning with requirements assessments, and impact analysis, and continuing through regulatory compliance, lifetime maintenance, scalability concerns, and end-of-life evolution, the material in this course will characterize the stages and transitions of large scale applications. Deployment and management tools will be examined in the context of live applications, with an emphasis on convergent analysis and configuration. Several case studies will be considered, including operating systems, database applications, mailing systems and collaboration systems.

MSIT.5190 Virtual Systems (Formerly 94.519) - Credits: 3

This course will investigate the current state of virtualization in computing systems. Virtualization at both the hardware and software levels will be examined, with emphasis on the hypervisor configurations of systems such as Vmware, Zen and Hyper-V. The features and limitations of virtual environments will be considered, along with several case studies used to demonstrate the configuration and management of such systems. Para-virtualized software components will be analyzed and their pros and cons discussed. Processor and peripheral support for virtualization will also be examined, with a focus on emerging hardware features and the future of virtualization.

MSIT.5310 Project Management (Formerly 94.531) - Credits: 3
This course explores the application of knowledge, skills, tools, and techniques that project managers use when managing information technology projects as well as the current IT factors that affect IT project management decision making. Special emphasis will be placed on learning the best practices currently used by organizations and practitioners to ensure the best chance for project success by learning and applying the concepts of managing scope, risk, budget, time, expectations, quality, people, communications, procurement, and externally provided services. Students will be expected to perform research in the above areas as well as using tools such as Microsoft Project to solve project management related problems. Special attention will also be placed on the issues affecting project managers today such as PMOs, virtualization, green IT, and outsourcing. Practical examples will be used to demonstrate the concepts and techniques, plus you will receive hands on experience by working on a case study.

**MSIT.5320 Managing Large Data Sets (Formerly 94.532) - Credits: 3**

The amount of data generated by businesses, science, Web, and social networks is growing at a very fast rate. This course will cover the algorithms and database techniques required to extract useful information from this flood of data. Data mining, which is the automatic discovery of interesting patterns and relationships in data, is a central focus of the course. Topics covered in data mining include association discovery, clustering, classification, and anomaly detection. Special emphasis will be given to techniques for data warehousing where extremely large datasets (e.g., many terabytes) are processed. The course also covers Web mining. Topics covered include analysis of Web pages and links (like Google) and analysis of large social networks (like Facebook).

**MSIT.5350 Agile and Iterative Project Management (Formerly 94.535) - Credits: 3**

This course explores the differences between the Traditional Project management and the Agile management approaches, introduces the principles of Agile Development through applications within each major Project Management process: Project Initiation, Project Planning, Project Execution, and Project Closing. The project will be developed in a timely manner, using Agile techniques that encourage frequent adaptation, self-organization, accountability and with a focus towards rapid delivery. Upon completion, students will understand how to apply Agile principles and practices, recognize ways to increase team performance through better communication and close involvement of stake holders, and recognize the key success criteria for implementing Agile Projects.

**MSIT.5360 Data Mining (Formerly 94.536) - Credits: 3**

Today, we are surrounded by big data applications. Smartphone and sensor data, medical and scientific data, financial data, web and text data, and social network data are just a few examples. As a result, mining useful information and discovering knowledge from the big data are increasingly important. It is fair to say that, without data mining, we would not be able to make good use of this large amount of data. In this course, we learn the state-of-the-art techniques in data mining and analysis. Topics include types and properties of data, exploring data, classification, association analysis, clustering, and anomaly detection.

**MSIT.5410 Information Security, Privacy and Regulatory Compliance (Formerly 94.541) - Credits: 3**

This course focuses on enterprise-level information security, privacy and regulatory compliance through study of the rapidly emerging Information Governance (IG) discipline which is applied to electronic documents, records management and output of information organization-wide. The key principles of IG will be examined including the security, privacy and compliance of corporate e-documents/records as well as email, social media, instant messaging, cloud computing, and mobile computing. The student will learn how IG leverages existing information technologies to enforce policies, procedures and controls to manage information risk in compliance with legal and litigation demands, external regulatory requirements, and internal governance objectives.

**MSIT.5430 Intrusion Detection Systems (Formerly 94.543) - Credits: 3**

Intrusion Detection Systems is a survey of the hardware and software techniques that are applied to the detection, identification, classification and remediation of compromised information systems. From this introduction to intrusion detection systems, students will develop a solid foundation for understanding IDS and how they function. This course will give students a background in the technology of detection network attacks. It will introduce all the concepts and procedures used for IDS (intrusion Detection Systems) and IPS (Intrusion Prevention Systems). Students will have hands-on experience with implementing and configuring software and hardware based IDS in a network infrastructure. This course is designed with a network administrator in mind.

**MSIT.5450 Designing and Building a Cybersecurity Program (Formerly 94.545) - Credits: 3**

This course focuses on best practices for designing and building a comprehensive Cybersecurity Program based on the NIST Framework for Improving Critical Infrastructure Cybersecurity (“The Framework”). The Framework was issued on February 12, 2014, as directed by President Obama in Executive Order 13636. This framework provides guidance for reducing
cybersecurity risk for organizations, and this course will examine its basic tenets of: “Cybersecurity Fundamentals”, techniques applied to “Building a Controls Factory”, “Cybersecurity Programs” “Establishing Cybersecurity Centers of Expertise” and “The Cybersecurity Program Implementation Roadmap”.

**MSIT.5600 Network Infrastructures (Formerly 94.560) - Credits: 3**

This course provides an introduction to the fundamental concepts in the design and implementation of computer communication networks, their protocols, and applications. Topics to be covered include: an overview of network architectures, applications, network programming interfaces (e.g. sockets), transport, congestion, routing, and data link protocols, addressing, local area networks, network management, and emerging network technologies. Cannot be used toward MS or D.Sc. in Computer Science.

**MSIT.5610 Computer Network Security (Formerly 94.561) - Credits: 3**

This course is aimed to provide students with a solid understanding of key concepts of computer network security and practical solutions to network security threats. Topics to be covered include common network security attacks, basic security models, data encryption algorithms, public-key cryptography and key management, data authentication, network security protocols in practice, wireless network security, network perimeter security and firewall technology, the art of anti-malicious software, and the art of intrusion detection. Pre-Req: BS in IT or Equivalent. Cannot be used toward MS or D.Sc. in Computer Science.

**MSIT.5620 Digital Forensics (Formerly 94.562) - Credits: 3**

Identifying, preserving and extracting electronic evidence. Students learn how to examine and recover data from operating systems, core forensic procedures for any operating or file system, understanding technical issues in acquiring computer evidence and how to conduct forensically sound examinations to preserve evidence for admission and use in legal proceedings.

**MSIT.5630 Secure Mobile Networks (Formerly 94.563) - Credits: 3**

This course covers principles and practices of wireless networks, including cellular networks, wireless LANs, ad hoc mesh networks, and sensor networks. The potential attacks against these wireless networks and the security mechanisms to defend these networks will be discussed. Topics to be covered include cellular network architecture, wide-area mobile services, wireless LANs and MACs, introduction to emerging wireless networks, survey of malicious behaviors in wireless networks, securing wireless WANs and LANs, securing wireless routing, securing mobile applications, wireless intrusion detection and prevention, challenges in securing next-generation wireless networks, and privacy issues in wireless networks.

**MSIT.5650 Cloud Computing (Formerly 94.565) - Credits: 3**

This course starts with an overview of modern distributed models, exposing the design principles, systems architecture, and innovative applications of parallel, distributed, and cloud computing systems. The course will focus on the creation and maintenance of high-performance, scalable, reliable systems, providing comprehensive coverage of distributed and cloud computing, including: Facilitating management, debugging, migration, and disaster recovery through virtualization. Clustered systems for research or ecommerce applications. Designing systems as web services. Principles of cloud computing using examples from open-source and commercial applications.

**MSIT.5660 Advanced Cloud Computing (Formerly 94.566) - Credits: 3**

This course is a continuation of the 94.565 Cloud Computing course and will cover in further detail such topics as Cloud Based Storage, Virtualization, Service Oriented Architecture (SOA), High Availability, Scaling, and Mobile Devices. The course will also study the role of Open Source cloud software such as Hadoop, OpenStack and others. Similar to the first course where hands-on projects included the use of Cloud Services such as Amazon Web Services (AWS), Google Apps and App Engine, and Windows Azure, this course will continue with those services and add others such as Rackspace and VMware. Current articles and publications in this fast moving field of Cloud Computing will also be followed.
Department of Environmental, Earth & Atmospheric Sciences

Masters of Science in Environmental Studies

- Atmospheric Science Option (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Environmental Geoscience Option (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Professional Science Masters Environmental Geoscience Option (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Professional Science Master’s Atmospheric Science Option (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)

Graduate Certificate Programs

- Certificate in Environmental Geoscience
- Certificate in Environmental Atmospheric Science

Professional Internship and Seminar

This professional internship is required for students in this program and is expected to represent a minimum of 350 hours and will have a 3-6 month duration. The internship is designed to provide students with an opportunity to obtain real-world experience in business, government agencies, non-profit organizations or research institutes. To be eligible for the internship students will be expected to have completed half of their STEM courses, two business/communication courses, attained a minimum GPA of 3.0 and received departmental permission. Through this experience the student engages in real-world work situations involving technical problems, teamwork, communication skills and decision-making. Students who are employed full-time in a pertinent field may fulfill the internship requirement by completing an approved project, which adds to the students current set of skills. All students will be required to submit a final written report and give an oral presentation on their work at a seminar. All Professional Internships require supervision by program faculty.

Master of Science in Environmental Studies

- Atmospheric Science Option (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Environmental Geoscience Option (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Professional Science Master’s Environmental Geoscience Option (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)
- Professional Science Master’s Atmospheric Science Option (https://www.uml.edu/catalog-AY18/pdf/Graduate.pdf)

For information on the Master’s Program in Environmental Studies/Environmental Engineering, visit the Civil and Environmental Engineering Department.

Graduate Certificate in Environmental Geoscience

- Admission Requirements
- Certificate Pathway
- Curriculum

This certificate is designed for students who have an interest in the environmental aspects of the geosciences. Students who would benefit from this certificate are:

1. individuals who hold an undergraduate degree in geo/environmental science who want to increase their technical skills with additional geoscience courses,
2. individuals with an undergraduate degree in Civil/Environmental Engineering who want to broaden their expertise and
3. individuals who hold other science and engineering degrees and work in the environmental field.

Students who successfully complete the Graduate Certificate in Environmental Geoscience at UMass Lowell with a GPA of 3.5 or higher may waive the GRE requirement if applying to the MS Environmental Studies - Environmental Geoscience option program. Upon acceptance into the Environmental Geoscience program, the 12 credits from the Graduate Certificate in Environmental Geoscience with a course grade of 3.0 or higher may be transferred into the MS Environmental Studies - Environmental Geoscience (option) program.

Admission Requirements:

- Baccalaureate degree in science, engineering, or similar area from an accredited institution with a Minimum GPA
Certificate Pathway

Four courses (minimum of 12 credits) are required for an Environmental Geoscience Certificate. Select one course from Area I and one course from Area II. Select two additional courses from any of the three areas.

Curriculum

**Area I. Surface Processes (Elect 1) (3 cr)**
- GEOL.5020 Quantitative Geomorphology (3 cr)
- GEOL.5100 Glacial and Pleistocene Geology (3 cr)
- GEOL.5240 Regional Hydrogeology (3 cr)

**Area II. Geochemistry and Geophysics (Elect 1)**
- GEOL.5150 Topics in Environmental Geochemistry (3 cr)
- GEOL.5310 Isotopes in Environmental & Geosciences (3 cr)
- GEOL.5560 Applied Geophysics (3 cr)

**Area III. Electives**
- GEOL.5200 Structural Geology (3 cr)
- GEOL.5220 Structural Geology Laboratory (1 cr)
- GEOL.5410 Environmental and Engineering Geology (3 cr)

**Two Additional courses from any of the above three areas (6 cr)**

**Total Credits (12 cr)**

Graduate Certificate in Environmental Geoscience

- Admission Requirement

This certificate is designed for students who have an interest in the environmental aspects of the geosciences. Students who would benefit from this certificate are:

1. individuals who hold an undergraduate degree in geology/environmental science who want to increase their technical skills with additional geoscience courses,
2. individuals with an undergraduate degree in Civil/Environmental Engineering who want to broaden their expertise and,
3. individuals who hold other science and engineering degrees and work in the environmental field.

Students who successfully complete the Graduate Certificate Geoscience at UMass Lowell with a GPA of 3.5 or higher may waive the GRE requirement if applying to the MS Environmental Studies - Environmental Geoscience (option) program. Upon acceptance into the Environmental Geoscience program, the 12 credits from the Graduate certificate in Environmental Geoscience with a course grade of 3.0 or higher may be transferred into the MS Environmental Studies-Environmental Geoscience (option) program.

Admission Requirements:

- Baccalaureate degree in science, engineering, or similar area from an accredited institution with a minimum GPA of 3.0. This requirement may be waived if the applicant has significant professional experience or submits other evidence supporting the likelihood of academic success.
- Graduate Certificate Application Form.
- Application Fee.
- Official transcripts from the baccalaureate institution.
- Citizens of non-English speaking countries who have never earned an academic degree in the United States must submit TOEFL scores.
Curriculum

- **Area I. Surface Processes (Elective 1) (3 credits)** 89.502 Quantitative Geomorphology (3 credits) 89.510 Glacial and Pleistocene Geology (3 credits) 89.524 Regional Hydrogeology (3 credits)

- **Area II. Geochemistry and Geophysics (Elective 1) (3 credits)** 89.515 Topics in Environmental Geochemistry (3 credits) 89.531 Isotopes in Environmental Geosciences (3 credits) 89.556 Applied Geophysics (3 credits)

- **Area III. Electives (3 credits)** 89.520 Structural Geology (3 credits) 89.541 Environmental and Engineering Geology (3 credits)

Two Additional courses from of of the above three areas (6 credits)

**Total credits (12 credits)**

Graduate Certificate in Environmental Atmospheric Science

- Admission Requirements
- Certificate Pathway
- Curriculum

This certificate is designed for students who have an interest in the environmental aspects of the Atmospheric Sciences. The intended audience is practitioners in the environmental field who want to broaden their expertise. The target audience would encompass individuals with engineering or science degrees. There are two suggested concentrations (see below) one addressing the needs of individuals interested in air quality and the other energy.

Students who successfully complete the Graduate Certificate in Environmental Atmospheric Science at UMass Lowell with a GPA of 3.5 or higher may waive the GRE requirement if applying to the MS Environmental Studies-Atmospheric Science (option) program.

Admission Requirements:

- Baccalaureate degree in science, engineering or similar area from an accredited institution with a minimum GPA of 3.0. This requirement may be waived if the applicant has significant professional experience or submits other evidence supporting the likelihood of academic success.
- Graduate Certificate Application Form.
- Application Fee.
- Official transcript from the baccalaureate institution.
- Citizens of non-English speaking countries who have never earned an academic degree in the United States must submit TOEFL scores.

Certificate Pathway:

Four courses (minimum of 12 credits) are required for an Environmental Atmospheric Science Certificate. Required course from Area I and three courses from Area II.

**Area I. Foundation Course (3 cr)**

- ATMO.5010 Boundary Layer Meteorology (3 cr)

**Area II. Environmental and Energy Courses (Elect 3) (9 cr)**

- ATMO.5080 The Climate System (3 cr)
- ATMO.5100 Regional Climate and Weather Modeling (3 cr)
- ATMO.5230 Air Pollution Control (3 cr)
- ATMO.5710 Air Pollution
- ATMO.6740 Air Quality Modeling (3 cr)
- PUBH.6190 Measurement of Chemical Exposures (3 cr)
- MECH.5210 Solar Fundamentals (3 cr)
- MECH.5810 Advanced Fluid Mechanics (3 cr)

**Total Credits (12 credits)**

Air Quality suggested courses:

- ATMO.5010 (required) and three of the following:
  - ATMO.5100
  - ATMO.5230
  - ATMO.5710
  - ATMO.6740
  - PUBH.6190

Energy suggested courses:
ATMO.5010 (required) and three of the following:

- ATMO.5080
- ATMO.5100
- ENVI.5720
- MECH.5210
- MECH.5810

Gainful Employment Disclosure Information

Completion rates, median loan debts and programs costs are outlined in the Graduate Certificate Gainful Employment Disclosure Information.
ATMO.5010 Boundary Layer Meteorology (Formerly 85.501) - Credits: 3

This course draws upon the equations of motion in the atmosphere to develop a theoretical understanding of the atmospheric boundary layer. This understanding is compared with real observations taken with the Department’s rawinsonde equipment, as well as published data. The emphasis is on blending theory and practice to enhance the student’s understanding of the behavior of the atmosphere.

ATMO.5020 Advanced Synoptic Meteorology (Formerly 85.502) - Credits: 3

This course is designed for graduate students who have a strong background in mathematics and physics, but whose meteorology preparation is weak. The basic concepts of weather forecasting and analysis on synoptic scales are covered theoretically as well as in application to case studies and current weather. The coursework encourages the development of three-dimensional visualization techniques and an appreciation of the physics which controls weather systems.

ATMO.5030 Remote Sensing (Formerly 85.503) - Credits: 3

This course is a survey of ground based, balloon, rocket probe, radar and satellite remote sensing techniques. Optical and radio frequency remote sensing techniques are surveyed. The focus is on the determination of physical, chemical and dynamical quantities by remote sensing measurements. The theory is presented used to interpret data obtained by remote sensing techniques. Various inversion methods are discussed used to obtain spatial discrete quantities from line-of-sight observations. Modeling and simulation techniques are described and practiced.

ATMO.5080 The Climate System (Formerly 85.508) - Credits: 3

The main elements of the Climate System are the atmosphere, ocean, biosphere, land surface, and the cryosphere; the primary input of energy is from the Sun. This course examines these elements, the ways in which they interact and how they can be modeled. The Global Energy Budget is examined and both natural and human-caused climate change are considered.

ATMO.5100 Regional Weather and Climate Modeling (Formerly 85.510) - Credits: 3

Mesoscale atmospheric dynamics and regional climate dynamics. Application of regional weather and climate model to regional weather, climate modeling and forecast problems. Multi-scale physical processes, such as mesoscale and convective-scale phenomena, low-level jets, mountain waves and orographic precipitation, land/sea breezes, cyclones etc., will be discussed in order to understand the linkage between regional weather and climate.

ATMO.5130 Physical Meteorology (Formerly 85.513) - Credits: 3

This course explores the essentials of cloud physics, beginning with the basic laws of thermodynamics of both dry and moist atmospheres. Condensation, nucleation, and drop growth are studied in detail at an advanced level.

ATMO.5150 Atmospheric Structure and Dynamics (Formerly 85.515) - Credits: 3

The temperature, pressure and density structure of the atmosphere are reviewed, as well as the chemical composition. Topics include atmospheric and solar radiation, atmospheric heat budget and the hypsometric equation. Dynamics of the atmosphere explores the behavior of fluids on a rotating earth, global circulation, synoptic scale motions, perturbation theory of wave motions. Elements of climatic change and the effects of anthropogenic emissions on climate and weather will also be discussed.

ATMO.5160 Mesoscale Atmospheric Dynamics (Formerly 85.516) - Credits: 3

This course is designed for students to apply atmospheric dynamics and physical analysis techniques to mesoscale and convective-scale phenomena, including mesoscale convective systems, severe thunderstorms, tornadoes, dry lines, low-level jets, mountain waves and orographic precipitation, land/sea breezes, boundary layer rolls, and hurricanes. Emphasis will be given to the physical understanding of these processes instead of forecasting.

ATMO.5180 Forecasting and Synoptic Techniques I (Formerly 85.518) - Credits: 3

This is the first of a two-course sequence that provides graduate students a combined theoretical and applied understanding of synoptic-scale meteorology, with an emphasis on forecasting applications. The first course introduces the concepts of vorticity advection and the quasi-geostrophic approximation, and applies them synoptic-scale cyclones, including nor’easters. The graduate students will learn to use Gempak graphics and will be introduced to the National Weather Service Weather Event Simulator, a combined hardware and software package that simulates the NWS forecast environment.

ATMO.5190 Forecasting and Synoptic Techniques II
ATMO.5230 Air Pollution Control (Formerly 85.523) - Credits: 3
This course describes air pollutants, their characterization, ambient concentrations, effects on human health and the ecology, and the environmental laws and regulations that set standards on emission rates and ambient concentrations. The basics of air pollutant dispersion and transport are also covered. The main focus of the course is on emission control technologies for particulate matter, carbon monoxide, sulfur oxides, nitrogen oxides, organic and inorganic toxic pollutants. The following technologies are discussed: cyclones, scrubbers, electrostatic precipitators, baghouses, adsorption, absorption and incineration. The automobile and its emission control are reviewed. Alternative methods are also discussed, such as fuel substitution, conservation and efficiency improvement.

ATMO.5240 Simple Atmospheric Models (Formerly 85.524) - Credits: 3
The basic wave types and fundamental dynamics of atmospheric motion are considered through analytical and numerical modeling of the main simplifications (models) of the full equations of motion for the atmosphere. These models are derived by making assumptions that greatly simplify the full equations and which isolate individual wave types and specific physical mechanisms. Together, these models describe the basic aspects of atmospheric motion: the maintenance and structure of the jet stream, the genesis and propagation of synoptic storms, and the forced and internal contributions to seasonal patterns of midlatitude climate variability.

ATMO.5290 Advanced Forecasting (Formerly 85.529) - Credits: 3
This course builds on the student's basic understanding of storm systems and extends their theoretical knowledge to particular weather patterns. Topics include nowcasting, long-range forecasting, snow squalls, sea breeze, and especially deep convection. Particular attention is paid to the structure and development of supercells. Students will also be required to write a special report on a topic assigned by the professor, and present this in class as a special lecture.

ATMO.5400 Tropical Meteorology (Formerly 85.540) - Credits: 3
An introduction to the tropical atmosphere, including tropical climatology, structure and dynamics of easterly waves, tropical cyclones and monsoon circulation.

ATMO.5500 Satellite and Rad Meteorology (Formerly 85.550) - Credits: 3

ATMO.5710 Air Pollution Phenomenology (Formerly 85.571) - Credits: 3
The course centers on transport, dispersion and transformation of air pollutants in the atmosphere. Atmospheric structure and dynamics are reviewed. The atmospheric dispersion equation is developed for instantaneous and steady-state releases of pollutants, including the Gaussian Plume Equation for point, line and area sources. The sources and transport of particulate matter are discussed, including haze and visibility impairment. Other topics are photooxidants (ozone), acid deposition, stratospheric ozone depletion and the greenhouse effect.

ATMO.5810 Meteorology for Teachers (Formerly 85.581) - Credits: 3
The purpose of this course is to provide the middle school teacher with: a thorough understanding of several key concepts and processes of meteorology; the ability to effectively present meteorology topics that are appropriate for the middle school science classroom; the tools necessary to develop inquiry based lessons for the classroom.

ATMO.5910 Directed Study (Formerly 85.591) - Credits: 3

ATMO.5950 Professional Experience Atmospheric Science (Formerly 85.595) - Credits: 1-3
Professional experience with a private or public employer. Written report and supervisor evaluation required.

ATMO.6410 Special Topics in Meteorology (Formerly 85.641) - Credits: 3

ATMO.6420 Special Topics in Meteorology (Formerly 85.642) - Credits: 3

ATMO.7010 Graduate Research Seminar (Formerly 85.701) - Credits: 3
85.701) - Credits: 1
ATMO.7310 Master’s Research (Formerly 85.731) - Credits: 1-6
ATMO.7320 Graduate Research (Formerly 85.732) - Credits: 2
ATMO.7330 Master’s Research in Atmospheric Sciences (Formerly 85.733) - Credits: 1-6
ATMO.7430 Master’s Thesis in Atmospheric Sciences (Formerly 85.743) - Credits: 1-6
ATMO.7530 Doctoral Dissertation in Atmospheric Sciences (Formerly 85.753) - Credits: 3-8
ATMO.7600 Continuing Graduate Research (PhD) (Formerly 85.760) - Credits: 1-9

Continuing Graduate Research at the PhD level. May be taken for variable credit.

ATMO.7610 Continuing Graduate Research (PhD) (Formerly 85.761) - Credits: 1
Research on dissertation or other research areas as required by the program and the student’s advisor.

ATMO.7630 PhD Research in Atmospheric Sciences (Formerly 85.763) - Credits: 2
ATMO.7650 Doctoral Dissertation (Formerly 85.765) - Credits: 1-9
ATMO.7680 Doctoral Dissertation (Formerly 85.768) - Credits: 9

ENVI.5000 Graduate Seminar in Environmental Sciences - Credits: 1
The Graduate Seminar in Environmental Sciences includes speaker presentations by invited external and internal faculty, as well as student presentations. Graduate seminar students will also be expected to evaluate professional papers and complete several writing assignments specific to presentations and/or research papers. The class includes interdisciplinary topics in Atmospheric Sciences, Geosciences, and Environmental Sciences. The goals are to improve oral and written communication skills and expand knowledge of state-of-the-art research approaches and research themes.

ENVI.5040 Geographic Information Systems (Formerly 87.504) - Credits: 3
This course will cover most of the elements of a geographic information system commonly found in basic and mid-level GIS applications. Topics will include file organization, data entry including digitizing and image registration, geocoding, thematic mapping, Structured Query Language (SQL) applications, map algebra, raster operations, interpolative methods, distance mapping, density mapping, cost surfaces, and an introduction to modeling. This course will use the Arcview GIS platform.

ENVI.5100 Environmental Pollution - Credits: 3
This class is designed for graduate students in Environmental, Earth and Atmospheric Sciences, Environmental Engineering, Environmental Chemistry and Biology. The class describes the origin, transport, and transformation of pollutants in the environmental behavior and biological impacts of contaminants. Students also will learn about national and international regulations regards pollutant emissions and technology for control and remediation.

ENVI.5160 Climate Change: Science, Communication, and Solutions (Formerly 81.516/BIOL.5160) - Credits: 3
Like many of the 'grand challenges' currently facing society, climate change is a complex problem that cuts across academic disciplines, including the physical sciences, biology, engineering, economics, political sciences, and behavioral psychology. In this course, we integrate recent research from many of these disciplines to explore the scientific basis of climate change, its impacts on the natural world and human society, and societal responses to it. Through interactive simulations, class discussions, lectures, current scientific literature, and student-led projects, the goal of this course is to empower students to come to their own decisions about how society can address the climate change challenge. Students taking this course at the graduate level will lead group projects.

ENVI.5170L Climate Change: Science, Communication, Solutions Recitation Lab - Credits: 1
This course is designed to integrate closely with the lecture course, Climate Change: Science, Communication, and Solutions. Students will use interactive simulations, build models, and create media projects that explore climate change and sustainability. Topics include the physical climate system and carbon cycle, human energy systems, and climate policy and economics. Students take this course at the graduate level will lead group projects.

ENVI.5200 Methods in Environmental Impact Assessment and Analysis (Formerly 87.520) - Credits: 3
This course describes, and illustrates with case studies, environmental evaluation required to implement projects and policies potentially affecting the environment. Methods available to integrate technical impact predictions, prepare Environmental Statements, and make informed decisions regarding environmental effects will be covered. Incorporation of sustainability and permitting with environmental analyses will also be examined.

ENVI.5720 Energy and Environment (Formerly 87.572) - Credits: 3

This course discusses the world and U.S. primary energy resources and consumption, including fossil, nuclear and renewable energy sources. Principles of thermodynamics are reviewed, especially in regard to energy usage efficiency improvement. A significant part of the course is devoted to electricity production, including site visits to fossil and nuclear power plants. The environmental effects are discussed of energy extraction and consumption, such as SOx, NOx and particulate matter emissions, acid deposition, the greenhouse effect, radioactive waste disposal. Also the risks of accidents are discussed in fossil and nuclear fuel usage.

ENVI.5850 Climate Change in the Classroom (Formerly 87.585) - Credits: 3

The course is designed to help teachers from all levels improve their ability to foster student learning about the earth’s changing climate. The course addresses the scientific, sociological, and pedagogical dimensions associated with climate change science. How to incorporate climate change into existing curriculum across disciplines is considered.

GEOL.5010 Paleoclimatology (Formerly 89.501) - Credits: 3

This course provides students with an overview of paleoclimatology by examining the use of proxy records, such as marine and lake sediment sequences, ice cores, tree rings, corals and historical data to reconstruct past climatic conditions. Dating methods will be introduced. Throughout, we will critically analyze our understanding of past climates and environments and identify directions for future research. Topics include: abrupt climate change, human evolution and climate, biosphere-climate interactions and paleoclimate modeling.

GEOL.5020 Quantitative Gemorphology (Formerly 89.502) - Credits: 3

This course follows the path of material as it is weathered from bedrock, moved down hillslopes and transported via glaciers and rivers. Emphasis is on 1) quantifying erosion and sediment transport, 2) applying computer-based models and conservation of mass equations to earth surface processes and 3) understanding long-term landform evolution.

GEOL.5040 Igneous and Metamorphic Petrology (Formerly 89.504) - Credits: 3

The origin and evolution of igneous and metamorphic rocks. Emphasis will be on physical and chemical processes, magma transport and crystallization, phase equilibria, development of metamorphic facies, open and closed system behavior, and the development of metamorphic fabric.

GEOL.5060L Igneous and Metamorphic Petrology Laboratory (Formerly 89.506) - Credits: 1

Identification and classification of igneous and metamorphic rocks. Emphasis is on thin section identification and use of rock textures and compositions as guides to petrogenesis.

GEOL.5100 Glacial and Pleistocene Geology (Formerly 89.510) - Credits: 3

A survey and interpretation of the erosional and depositional effects of glaciation with emphasis on the New England area. Topics include glaciology, glacial geology, and Pleistocene stratigraphy.

GEOL.5150 Topics in Environmental Geochemistry (Formerly 89.515) - Credits: 3

Case-based course dealing with the application of thermodynamics and kinetics, acid-base equilibria, oxidation-reduction reactions, radioactive and stable isotopes, and mineral chemistry to the understanding and solution of environmental problems. Other topics will be considered based on student interest.

GEOL.5200 Structural Geology (Formerly 89.520) - Credits: 3

An analysis of crustal deformation through detailed study of geologic structures with emphasis upon the response of geologic materials to stress and strain. Field techniques, tectonic principles, and geometrical analysis are employed.

GEOL.5240 Regional Hydrogeology (Formerly 89.524) - Credits: 3

Concentrating on the storage and steady state flow of ground water at a basin-wide scale, the course studies flow nets, fluid potential, and numerical modeling of flow controlled by basin geometry and geology; water movement in the zone of
aeration, the interaction of groundwater with surface water, the transport and dispersion of contaminants, and the use of modeling for groundwater management.

GEOL.5310 Isotopes in Environmental and Geosciences (Formerly 89.531) - Credits: 3

The course will show how radioactive and stable isotopes can be used to understand environmental and geological systems. Topics to be covered include radiometric dating using short and long half-life isotopes, radiogenic isotopic tracers, and stable isotopes.

GEOL.5400 Mass Transit Modeling (Formerly 89.540) - Credits: 3

GEOL.5410 Environmental and Engineering Geology (Formerly 89.341/541) - Credits: 3

Fundamentals of geology applied to environmental and engineering problems. Topics include minerals and rocks, soil properties, rock mechanics, active tectonics and earthquake hazards, slope stability and landslides, groundwater, rivers and flood hazards, coastal processes, and site assessment. Student project.

GEOL.5520 Sedimentation & Stratigraphy (Formerly 89.552) - Credits: 3

Principles and processes of sedimentation: erosion, mechanics of transport, diagenesis and lithification, models for sedimentary environments. Development of the stratigraphic record, relative and absolute time, and seismic stratigraphy.

GEOL.5540L Sedimentation and Stratigraphy Laboratory (Formerly 89.554) - Credits: 1

Determination of mass properties of sediments with emphasis on mechanical and statistical analysis, identification and description of sedimentary rocks, facies models and stratigraphic cross-sections.

GEOL.5560 Applied Geophysics (Formerly 89.556) - Credits: 3

Application of geophysics to problems in geology and environmental science. Principles and techniques of gravity, magnetic, electrical, and seismic methods. Field projects and surveys.

GEOL.5580 Advanced Geochemistry (Formerly 89.558) - Credits: 3

Application of chemical principles to geological and environmental problems. Topics include abundance and distribution of elements in the earth, Crystal chemistry, stable and radiogenic isotopes, radiogenic dating, isotopic and elemental tracers, water-rock interactions.

GEOL.5850 Oceanography for Teachers (Formerly 89.585) - Credits: 3

This course will introduce students to basic oceanographic principles and processes. Content will be linked to National and State Science Standards. Students will create a number of oceanography-based lessons linked to the standards. Pedagogy will be modeled in relation to teacher instruction and student learning.

GEOL.5930 Special Topics: Environmental Geoscience (Formerly 89.593) - Credits: 3

Student/Instructor selected in-depth study of a specific topic(s) within the Environmental Geosciences of a closely related field.

GEOL.5950 Professional Experience: Environmental Geoscience (Formerly 89.595) - Credits: 1-3

Professional experience with a private or public employer. Written report and supervisor evaluation required.

GEOL.5990 Advanced Rocks (Formerly 89.599) - Credits: 3

GEOL.7020 Graduate Seminar Biology (Formerly 89.702) - Credits: 3

GEOL.7310 Master's Research in Environmental Geoscience (Formerly 89.731) - Credits: 1-6

GEOL.7410 Master's Thesis in Environmental Geoscience (Formerly 89.741) - Credits: 1-6
ENVS.5010 Wetlands Ecology (Formerly 18.501) - Credits: 3
Types, characteristics and definitions, functions and values, regulation and management of wetlands; with due regard given to geology, soils and hydrology, and biological/ecosystem interactions.

ENVS.5020 Freshwater Ecology - Credits: 3
Freshwater Ecology is a 3-credit lecture course that covers the basic concepts regarding the physical structure, water quality, and ecological communities of freshwater lake and pond as influenced by the environment. Physical and chemical concepts (e.g., lake circulation patterns, thermal stratification, nutrient budgets, etc.) are incorporated with the lake biota (e.g., phytoplankton, zooplankton, and fish) and synthesized to provide perspective on ecosystem function. Within this scientific framework, we will also study the application of practical lake management using current lake and watershed-based management tools and options.

ENVS.5810 Understanding Massachusetts Contingency Plan (Formerly 18.581) - Credits: 3
The Massachusetts Contingency Plan (MCP) is a body of regulations designed to streamline and accelerate the assessment and cleanup of releases of oil and hazardous materials to the environment. This course serves as an introduction to the MCP and will explore the intent and use of key aspects of this working document. Though primarily a regulatory course, some topics to be covered are technical by nature. Prerequisites: None. Though not required, some familiarity with relevant environmental science and/or engineering principles is desirable.
Marine Science

The University of Massachusetts School of Marine Sciences (SMS) offers both Master's (M.S.) and Doctoral (Ph.D.) programs in marine science. Students graduating with a MS or Ph.D. degree from SMS receive a joint degree from the University of Massachusetts Amherst, Boston, Dartmouth and Lowell. The degree programs are fundamentally grounded in a broad, integrated, interdisciplinary approach to the study of marine science. Students located at the four participating campuses are required to complete core courses in the areas of biological, physical, and chemical oceanography, as well as a course in policy-management to equip them for interdisciplinary studies and research before focusing upon an area of concentration.

The programs prepare students for employment opportunities in the private and governmental sectors and academia. Emphasis is placed on the education of researchers and scholars who will contribute not only to basic research but also to the application of that research in a coherent approach to resource management and economic development issues.

Combining facilities and resources on four campuses into a single, coherent graduate program greatly expands the opportunities for SMS students. Students have access to a much greater range of education and research opportunities, expertise, and facilities than exists on one campus alone. Each campus has a number of departments and interdepartmental programs with areas of strength in marine-sciences related teaching, research, and outreach that either complement or constitute critical units of SMS.

SMS is also closely affiliated with a number of on-campus research centers and institutes and off-campus marine research facilities, expanding its realm of research opportunities and resources.

Core Courses

To achieve interdisciplinary breadth and depth, each SMS student will be required to take courses in four areas:

- Biological Oceanography (BO)
- Chemical Oceanography (CO)
- Physical Oceanography (PO)
- Socio-Economics of Coastal/Marine Systems (S/E)
- Marine-related Technologies (MT)

Courses in BO, CO, and PO are generally taken in the first 4 to 6 semesters (preferably in the first 2). For each area, course content is fairly uniform, though there may be multiple offerings between campuses.

Courses in S/E and MT are taken after selection of an area of concentration. Course content is not uniform and selection of course should be consistent with a students concentration area. Depending on the student’s concentration, the socio-economic requirement might be met best by courses in policy, economics, law or international/intergovernmental relations. Courses satisfying the technology requirement could be drawn from such areas as marine measurement technology, wastewater and environmental mitigation technology, Geographic Information Systems (GIS), Data/Information Management Systems, graphic display technologies or marine modeling approaches.

To build on the core courses, each SMS student selects an area of concentration and chooses electives appropriate to this concentration, as approved by their faculty advisor and/or thesis committee. Reflecting the interdisciplinary character of SMS, both natural and social science courses support certain concentrations, and many courses support more than one concentration.

Students typically take most of their courses on the campus where they and their major faculty advisor are in residence. Some courses, however, including at least two core courses each semester, will also be taught using the University's substantial distance learning facilities. Students may also choose to be in residence at different campuses for a period of time during their course of study, in order to take certain courses or to take advantage of research opportunities.

Admissions Standards

Successful applicants will generally have completed an undergraduate or graduate degree with a GPA of 3.00 or better and have an undergraduate major in one of the basic scientific disciplines or engineering, or will have strong multidisciplinary training with completion of at least six semesters of coursework in the natural sciences, generally to include biology, chemistry, and/or physics. Preparation in mathematics at least through integral calculus is strongly encouraged. Students who do not meet these criteria need to identify a faculty advocate who must bring a request for exception before the Admissions Committee. At the discretion of the Admissions Committee applicants may make up deficiencies in prior coursework either before or after admission is granted to the SMS. Consideration will be on a case-by-case basis, and the recommendation of the committee will be forwarded to the Dean for approval.

Candidates may apply for admission at either the Masters or Doctoral level. Students admitted directly into the Doctoral Program are expected to have exceptional academic credentials and/or work experience. Students entering with a Bachelors degree may be required to complete the requirements of a Masters degree before admission to the Doctoral Program. Students entering with a Masters can be admitted at the Doctoral level provided the degree, coursework and research experience warrant such a decision by the Admissions Committee.
Application Criteria

The Admissions Committee will evaluate a number of additional criteria in its consideration of applications. The following five items must be submitted for consideration by the UMass School of Marine Sciences (SMS):

A single application form has been prepared for the use of applicants for admission to the UMass School of Marine Sciences. It is available in the graduate admissions offices of each participating campus.

Three letters of recommendation from those familiar with the applicants academic and/or work experience are required.

Official transcripts of all undergraduate and graduate coursework.

Graduate Record Examination (GREs) scores and The Test of English as a Foreign Language (TOEFL, if the applicant is not a native English speaker). Typically, for the GREs students should have a combined score 1200 or greater. For TOEFL, a minimum of 550 (or 213 on the computer based exam) is highly recommended.

Statements of interest and intent are also requested. The statement of interest should provide reviewers an indication of the motivation of the student for pursuing graduate work. The statement of intent should describe how graduate training would address the students career goals.

**It is imperative that prospective students take an active role in contacting faculty member(s) who could potentially advise them, as well as making an effort to seek funding before applying to SMS. Students must also understand that we have a limited number of TA positions, so to be considered they must get their applications in before the deadline.**

Admissions Procedures

Applications for admission to the graduate programs of the UMass School of Marine Sciences are currently being processed by the Office of Graduate Studies at the University of Massachusetts Dartmouth. You will send your application and its associated materials and should address any inquiries about your application to that campus.

Students considering entry into the fall semester must be aware of the following dates:

December 15th:
Students who are interested in obtaining a TA must have a completed application and all other appropriate forms sent to the Graduate Office. Prospective students who are not interested in receiving a teaching assistantship are highly encouraged to apply at this time as well.

January 15th:
Admissions Committee will have evaluated all applicants and will send a revised list of all prospective students to the SMS faculty. Any revisions and reconsiderations to the list will be made within a week

February 1st:
The Dean will send final acceptance letters to students who are being awarded a TA, as well as those students who have sufficient funding and an SMS advisor.
The Dean will send conditional letters of acceptance to students who have found an advisor, but have a lack of funding.
The Dean will send letters of deferral to qualified students who have been waitlisted, due to having no apparent advisor and inadequate funding.
The Dean will send letters of rejection to students who do not meet the standards of the school.

March 1st:
Students should be receiving their acceptance, deferral, and rejection letters between February 1st and March 1st. Students who have been accepted with funding and an advisor are expected to reply within one month of receiving the letter.

April 15th:
All students accepted with funding and an advisor must reply by this date, in order to be able to enter into the SMS program.

May 1st:
The admissions committee will evaluate all acceptances and deferments from students who had to send in their applications by April 15th. Depending on the number of students admitted, the Admissions Committee will consider the following, in order:

1. Students who have an advisor, but no funding.
2. Students who have no advisor or funding.

May 15th:
The Dean will send final letters of acceptance and rejection to the two groups of students listed above.

June 15th:
Students who are accepted by or after May 15th have until this date to reply, in order to enter into the SMS program. All admission decisions are closed by this date.

Students considering entering in the spring semester must be aware of the following dates:

September 1st:
Students must have a completed application and all other appropriate forms sent to the Graduate Office.

September 30th:
Admissions Committee will have evaluated all applicants and will send a revised list of all prospective students to the SMS faculty. Any revisions and reconsiderations to the list will be made within a week.
October 15th:
The Dean will send out acceptance and rejections letters by October 15th.
Accepted students are encouraged to reply promptly.

November 15th:
All students who are accepted must reply no later than this date, in order to enter into the SMS program. All admission decisions are closed by this date.

Admission decisions will be made as expeditiously as possible once the application file is complete. The SMS application deadlines will go into effect once the semester begins.
Prospective candidates must observe these deadlines throughout the entire application process. Those who apply out of sequence will automatically be placed in the next cycle of admissions.

Marine Sciences and Technology Master's Program

The Marine Sciences and Technology Master’s Program, offered by the School of Marine Sciences (SMS), requires a minimum of 30 credit hours with the thesis option and 33 credit hours with the non-thesis option. Students are required to take three core courses (9 credits) and choose additional courses (15 credit minimum for thesis option, 22 credit minimum for non-thesis option) appropriate to a selected area of concentration. Attendance at a weekly seminar series is required (1 credit each for two semesters), and each student must present at least one seminar in their third or fourth semester. Fulltime MS students normally complete their degree requirements in four semesters. Part-time MS students are encouraged to take two courses per semester.

Core Course Requirements

Each SMS student must complete three core courses (9 credits), which includes 2 out of 3 of the core courses in the biological, chemical, and physical oceanography and a third core course in marine policy and/or management areas (including law and economics). The Core column in the SMS course list identifies the core courses and their respective areas. The core courses are intended to provide a common grounding in the biological, chemical, and physical oceanographic areas of marine sciences and technology, and in related marine policy and management disciplines. Courses covering technology and quantitative skills are generally subject to student choice and guidance committee approval, though there may be requirements specific to each option area. At least two core courses are offered each semester using the University’s substantial distance learning facilities and technology. Students normally complete the core courses in the first two semesters.

SMS has developed core courses, that are taught via distance learning, one in each of the core areas (biological, chemical, and physical oceanography), which will satisfy the requirements of SMS students. These courses will ensure that all SMS students master key concepts and skills central to an interdisciplinary marine sciences and technology graduate program. The core courses may be team taught in some cases.

Concentrations and Electives

To build on the core courses, each SMS student selects an area of concentration and chooses a marine policy or management core course and electives appropriate to this concentration, as approved by their faculty advisor and/or thesis committee. Concentrations and Courses describes the concentrations and lists the electives associated with each concentration.

Students typically take most of their elective courses on the campus where they and their major faculty advisor are in residence. Some elective courses, however, will also be taught via distance learning. In addition, students may choose to be in residence at different campuses for a period of time during their course of study, in order to take certain courses or to take advantage of research opportunities.

Weekly Seminars

Weekly seminars presented by students and by visiting speakers are intended to broaden the scope of each student's experience and to provide experience in verbal communication. Each MS student must present at least one seminar in the third or fourth semester. Attendance at the weekly seminars is required during all four semesters, for which students receive 1 credit for each of the first two semesters but no credit for the second two semesters.

Thesis and Non-Thesis Options

MS students may choose either a thesis or non-thesis option. Each student electing the thesis option will be assigned a Thesis Committee, chaired by the students major advisor, which will be responsible for insuring that the student fulfills all requirements of the SMS as well as other campus requirements, including presentation of a thesis defense consisting of a public lecture on the thesis, and a subsequent oral examination by the Thesis Committee. Each student electing the non-thesis option, in addition to an additional 3 credits, must complete a substantial research paper that must be read and approved by the major advisor and at least one other faculty member.

Sequence of Courses by Semester

In the first two semesters, fulltime MS students normally complete the core courses (9 credits), register for the seminar series (one credit each semester), and take electives (9 credits). Additional coursework and the thesis or the non-thesis research paper are typically completed in the third and fourth semesters. A minimum total of 30 credits (thesis) or 33 credits (non-thesis) is required for the degree. The following tables summarize the
sequence of courses for each of the four semesters.

**Semester 1**

<table>
<thead>
<tr>
<th>Courses</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Core courses</td>
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<tr>
<td>One elective</td>
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<tr>
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Total: 10 Credits

**Semester 2**

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</tr>
<tr>
<td>One elective</td>
<td>6</td>
</tr>
<tr>
<td>Seminar series</td>
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Total: 10 Credits

**Semester 3**

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<tr>
<td>Thesis/non-thesis</td>
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<tr>
<td>Seminar series(required)</td>
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</table>

Total: 10+ Credits

**Semester 4**

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<th>Courses</th>
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<tbody>
<tr>
<td>One elective(minimum)</td>
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</tr>
<tr>
<td>Thesis/non-thesis</td>
<td>1 - 6</td>
</tr>
<tr>
<td>Seminar series(required)</td>
<td>no credit</td>
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</tbody>
</table>

Total: 10+ Credits

**Marine Sciences & Technology Doctoral Program**

The Marine Sciences and Technology Ph.D. program, offered by School of Marine Sciences (SMS), includes four core courses taken by all students (12 credits), courses in a concentration area beyond the core, seminars, and dissertation research. Work in the concentration area usually includes a minimum of 24 credit hours of courses and helps the student prepare for the written and oral candidacy examinations. Ph.D. students are not normally accepted as part-time students. Courses may be taken at any SMS-affiliated program on the four campuses, in other departments, or at other area institutions, and may be included in a students program of studies as determined by the students major advisor and/or dissertation committee.

**Core Course Requirements**

Each SMS student must complete four core courses (12 credits), one in each of four core areas: biological oceanography, chemical oceanography, physical oceanography, and Marine Policy and/or Management areas (including law and economics). The Core column in the SMS course list identifies the core courses and their respective areas. The core courses are intended to provide a common grounding in the biological, chemical, and physical oceanographic areas of marine sciences and technology, and in related marine policy and management disciplines. At least two core courses are offered each semester using the University’s substantial distance learning facilities and technology. Students normally complete the core courses in the first two semesters.

SMS has developed core courses that are taught via distance learning, one in each of the core areas (biological, chemical and physical oceanography), which will satisfy the requirements of SMS students. These courses will ensure that all SMS students master key concepts and skills central to an interdisciplinary marine sciences and technology graduate program. The core courses may be team taught in some cases.

**Concentrations and Electives**

To build on the core courses, each SMS student selects an area of concentration and chooses a marine policy or management core course and electives appropriate to this concentration, as approved by their faculty advisor and/or thesis committee. Concentrations and Courses describes the concentrations and lists the electives associated with each concentration.

Students typically take most of their elective courses on the campus where they and their major faculty advisor are in residence. Some elective courses, however, will also be taught via distance learning. In addition, students may choose to be in residence at different campuses for a period of time during their course of study, in order to take certain courses or to take advantage of research opportunities.

**Weekly Seminars**

Weekly seminars presented by students and by visiting speakers are intended to broaden the scope of each students experience and to provide experience in verbal communication. Each M.S. student must present at least one seminar in the third or fourth semester. Attendance at the weekly seminars is required during all four semesters, for which students receive 1 credit for each of the first two semesters but no credit for the second two
Candidacy Examinations and Dissertation

Generally, at the end of the fourth semester but no later than the end of the sixth semester, after passing the comprehensive written and oral examinations, the student and major faculty advisor select additional faculty who constitute the students graduate committee, and the student presents a written dissertation proposal to the committee. The students major advisor and committee may determine a later date for the presentation of the dissertation proposal. A students committee is chaired by the students major advisor and guides the students research. Committee members may be selected from SMS faculty, other departments, and other institutions. All committees must include at least one SMS faculty member from a campus other than the campus where the student resides.

Successful performance in the core courses is required for advancement to degree status. A grade of B or better in each core course and an overall average of 3.0 in the core courses are required. There is a retake option on a course for which the student receives a grade of B- or less.

No later than the sixth semester, the students committee administers the written and oral candidacy examinations. The candidacy examinations are comprehensive and cover the core areas and the students area of concentration. They are designed to test the intellectual competence and maturity of the student in the broad area of marine sciences and technology and in the selected area of concentration. Upon successful completion of the Ph.D. candidacy examinations, the student is awarded an M.S. degree.

A scholarly dissertation based on original research is required of all Ph.D. candidates. Dissertation research may be done in the laboratory or the field, or may be carried out in part during residence with an appropriate private business or government agency. Presentation and defense of a satisfactory dissertation, normally to be completed within five years from the date of advancement to candidacy, fulfill the degree requirements. The dissertation defense consists of a public lecture on the dissertation and a subsequent oral examination by the candidates dissertation committee.

Sequence of Courses by Semester

In the first two semesters, Ph.D. students normally complete the core courses (12 credits), register for the seminar series (one credit each semester), and take two electives (6 credits). Additional coursework (24 credits minimum) is normally completed by the end of the fifth semester, in order to complete the written and oral candidacy examinations no later than the sixth semester. Upon advancement to candidacy, Ph.D. students register each semester for dissertation research and other courses as appropriate until graduation.
IM.769 Continuing Graduate Research (Formerly IM.769) - Credits: 9
Graduate Research.

MARI.6300 Biological Oceanography (Formerly IM.630) - Credits: 3

MARI.6500 Physical Oceanography (Formerly IM.650) - Credits: 3

MARI.7430 Master's Thesis (Formerly IM.743) - Credits: 3
MARI.7460 Master's Thesis (Formerly IM.746) - Credits: 6
MARI.7490 Master's Thesis (Formerly IM.749) - Credits: 9
MARI.7510 Doctoral Dissertation (Formerly IM.751) - Credits: 1-9
Doctoral Dissertation Research

MARI.7520 Doctoral Dissertation (Formerly IM.752) - Credits: 2
Doctoral Dissertation Research

MARI.7530 Doctoral Dissertation (Formerly IM.753) - Credits: 3
Doctoral Dissertation Research

MARI.7540 Doctoral Dissertation (Formerly IM.754) - Credits: 4
Doctoral Dissertation Research

MARI.7550 Doctoral Dissertation (Formerly IM.755) - Credits: 5
Doctoral Dissertation Research

MARI.7560 Doctoral Dissertation (Formerly IM.756) - Credits: 6
Doctoral Dissertation Research

MARI.7570 Doctoral Dissertation (Formerly IM.757) - Credits: 7
Doctoral Dissertation Research

MARI.7580 Doctoral Dissertation (Formerly IM.758) - Credits: 8
Doctoral Dissertation Research

MARI.7590 Doctoral Dissertation (Formerly IM.759) - Credits: 9
Doctoral Dissertation Research

MARI.7690 Continuing Graduate Research (Formerly IM.769) - Credits: 9
Graduate Research.
Department of Mathematical Sciences

Graduate Programs offered:

- **Master's of Science in Mathematics**
  - Applied and Computational Option
  (http://www.uml.edu/Catalog/Graduate/Sciences/Mathematical-Sciences/Masters-Program.aspx#Applied)
- Mathematics for Teachers Option
  (http://www.uml.edu/Catalog/Graduate/Sciences/Mathematical-Sciences/Masters-Program.aspx#Teachers)
- Probability and Statistics Option
  (http://www.uml.edu/Catalog/Graduate/Sciences/Mathematical-Sciences/Masters-Program.aspx#Probability)
- Industrial Mathematics Professional Science Master's (PSM) Option
  (http://www.uml.edu/Catalog/Graduate/Sciences/Mathematical-Sciences/Masters-Program.aspx#Industrial-Mathematics)

- **Doctor of Science Program in Computational Mathematics**
  (offered through the Computer Science Department)

- **Graduate Certificates**
  - Applied Statistics

Applicants to the master's and doctoral programs must have an undergraduate degree from an accredited four-year college or university with a major in mathematics or a related discipline and a satisfactory grade point average. Minimal course prerequisites for each of the options are listed in the descriptions below, and additional information can be obtained from the coordinator for that option, whose name is listed at the end of this brochure. Each option coordinator provides individualized advising during the course of graduate study. Applicants must submit the Graduate School application form, an official score for the aptitude portion of the Graduate Record Examination, three letters of reference, and an official undergraduate transcript indicating receipt of the bachelor's degree.

Students holding the bachelor's degree may take courses as a non-degree student while applying for matriculation and may transfer up to four courses (12 credits) taken before matriculation with grades of B or better. Up to 12 credits taken at another accredited U.S. or Canadian university may be transferred into a program, but no more than a total of 12 credits taken either at another institution or at the University of Massachusetts Lowell before matriculation, or any combination of the two, may be transferred.

Most courses are offered in the late afternoon or evening, and part-time study is possible. A limited number of teaching assistants are available each year. Students should be fully accepted into the graduate program by March to be eligible for a TA position for the following September.

Formal admissions procedures must be initiated through Graduate Admissions (https://www.uml.edu/Grad/default.aspx). Students may take a limited number of graduate courses before formal acceptance into a program. Check with the graduate coordinator for details.

- **Combined Bachelor's-Master's Program**

**Master of Science in Mathematics**

There are four options available in this program:

- Applied and Computational Mathematics
- Probability and Statistics
- Mathematics for Teachers
- Industrial Mathematics Professional Science Master’s

All options require a four-year undergraduate degree from an accredited college or university with a satisfactory grade point average, and the official score report of the Aptitude Test of the Graduate Record Examination. For the Applied and Computational Mathematics and the Probability and Statistics options, the undergraduate degree must be in mathematics or a related discipline. For the Mathematics for Teachers option, three semesters of calculus (12 credits) are required. Applicants lacking some prerequisites may be accepted as matriculated with conditions. The Applied and Computational Mathematics, Probability and Statistics, and Mathematics for Teachers programs consist of thirty credit hours approved by the Graduate Curriculum Committee. The Industrial Mathematics Professional Science master’s option requires 37 credit hours, including a paid internship. These credit requirements include both required courses and electives (which may be offered in other departments). Up to six credits at the 400 level may be considered for inclusion in the program of study. In addition, in all options except the Industrial Mathematics Professional Science Master’s Option, three or six credits may, with the permission of the student advisor and Graduate Committee, be obtained by thesis. Most courses are offered on a regular basis in the late afternoon and early evening so that all programs can be completed on a part-time basis.

**Applied and Computational Mathematics**
The M.S. Option in Applied and Computational Mathematics focuses on techniques of mathematical modeling and the basic tools needed to investigate problems from both a theoretical and computational viewpoint. Courses range from classical applied mathematics and state of the art courses in signal processing to modern applications of software in problem solution.

Required courses:

- MATH.5010 Real Analysis I
- MATH.5300 Applied Mathematics I
- MATH.5630 Computational Mathematics I

Probability and Statistics

This option is a professionally oriented program that provides the necessary mathematical skills to solve many of the data analysis problems of government, industry, science, engineering, and management. Courses range from theory based courses in probability through to applied hands-on course in statistical programming, including a course in the use of SAS statistical software.

Required courses:

- MATH.5010 Real Analysis I
- MATH.5090 Introduction to Probability & Statistics
together with one of:
  - MATH.5840 Stochastic Processes
  - MATH.5870 Probability Theory
  - MATH.5880 Mathematical Statistics
and one of:
  - MATH.5190 Introduction to Probability & Statistics II
  - MATH.5910 Linear Statistical Modeling & Regression
  - MATH.5930 Experimental Design

Mathematics for Teachers

The Master of Science in Mathematics for Teachers Program aims to give students a balanced combination of theory and practice, to enhance their appreciation and understanding of Mathematics as a science, and to provide them with the tools necessary to instill in their own students an interest in the subject. Courses in Mathematical Analysis, Discrete Mathematics, Linear Algebra, Number Theory, Geometry, and Probability and Statistics are designed to introduce the student to several important areas of Mathematics. Courses in Problem Solving, History of Mathematical Science, Mathematical Modeling, and Computers in the Classroom are intended to provide a deeper awareness of the contexts in which mathematical activity takes place and of the mental processes and technological aids employed by people in solving practical problems. Note that this is not a teaching certification program - contact the Graduate School of Education for information about certification.

Required courses:

- MATH.5000 Discrete Structures
- MATH.5200 Problem Solving

Industrial Mathematics Professional Science Master’s

Admission Requirements

Incoming students will be expected to have completed the equivalent of an undergraduate degree in mathematics. Applicants with degrees in other sciences or engineering may be admitted if they demonstrate significant background in mathematics.

Degree Requirements - Total Number of Credits: 34

Mathematics Courses (12 credits)

Required:

- MATH.5010 Real Analysis I
- MATH.5090 Introduction to Probability & Statistics
- MATH.5300 Applied Mathematics I
- MATH.5630 Computational Mathematics I

Science Cluster - One cluster of 12 credits from the following.

(Variations on these clusters or different ones can be proposed with the guidance of the student's advisor.)

Algorithms Cluster

- MATH.5800 Discrete Math for Science and Engineering
- COMP.503 Algorithms
- COMP.504 Advanced Algorithms: Computational Geometry
- COMP.544 Machine Learning and Data Mining

Random Processes Cluster
Internship (or PSM Project for students employed in their career field) the student is required to take PSMA.5010 Reflective Seminar (1 credit).

- PSMA.5000 Professional Development Seminar (0 credits)
- PSMA.5100 Internship (0 credits)
- PSMA.5010 Reflective Seminar (1 credit)

Professional Courses (9 credits)

- MKTG.5450 Professional and Scientific Communication

Plus two additional courses from the following list:

- PSMA.5350 Project Management for Scientists
- PSMA.5550 Leadership for Scientists
- PSMA.5650 (ENTR.5650 Technical Entrepreneurship
- MGMT.5750 Business Fundamentals for Scientists and Engineers

Doctoral Program

The Mathematical Sciences Department, through the Computer Science Department, offers a doctoral program in Computational Mathematics.

Comprehensive examination include areas of both mathematical sciences and computer science in order to assure that the student has a well-rounded background. Students can pursue a research program with faculty from Mathematical Sciences.

For further details, contact the Computer Science Department Chair at 978-934-3620, Olsen 313, or Professor Lee Jones, Coordinator of the Doctoral Program in Computational Mathematics

Graduate Certificates in Mathematics

The Mathematical Sciences Department offers two Graduate Certificates:

- Applied Statistics
- Mathematics for Teachers

Download Graduate Certificate Application Form (pdf) (https://www.uml.edu/docs/Graduate%20Certificate%20ApplicationForm.pdf)
Applied Statistics

Department of Mathematical Sciences

Coordinator: Ravi Montenegro, Ph.D (Mathematics), 978-934-2442, ravi_montenegro@uml.edu

This certificate provides professionals in biology, business, computer science, engineering, insurance, medicine, pharmaceutical and other sciences with statistical tools for survival in a highly competitive world marketplace. Experimental design provides methodology for gaining information in an efficient manner. Use of designed experiments in product development is known as off-line quality control. Clinical trials are examples of designed experiments in the medical field. Statistical modeling (linear regression analysis) includes systematic procedures for collecting and analyzing data in order to predict a response variable based on one or more predictor variables. The techniques covered in design of experiments are special cases of the general approach to statistical modeling. Certificate holders will be equipped with quantitative tools that form the heart of a quality approach to development and improvement of products and services. Most courses are offered in the evening.

This is a 12-credit certificate.

Required of Students without Probability/Statistics Background: (3 credits)

- MATH.5090 Introduction to Probability and Mathematical Statistics

Required of All Students: (6 credits)

- MATH.5910 Statistical Modeling and Linear Regression Analysis
- MATH.5930 Experimental Design

Electives: (6 credits)

- Electives may be selected from among the courses listed in the graduate school catalog subject to approval by the graduate coordinator.

Gainful Employment Disclosure Information

MATH.5000 Discrete Structures (Formerly 92.500) - Credits: 3
An introduction to discrete mathematics, including combinatorics and graph theory. The necessary background tools in set theory, logic, recursion, relations, and functions are also included. Masters degree credit for Teacher Option Only.

MATH.5010 Real Analysis (Formerly 92.501) - Credits: 3
The class is aimed to give rigorous foundations to the basic concepts of Calculus such as limits of sequences and functions, continuity, Riemann integration. The main focus is given to rigorous proofs rather than computations. Tentative topics are: Real numbers (algebraic, order and distance structures); Archimedean property; Sequences and their limits. Bolzano-Weierstrass theorem; Cauchy sequences and completeness; Limit of a function; Continuity of a function at a point and on a set; Uniform continuity; Open and closed sets, idea of compactness, compactness of a closed interval; Sequences of functions, uniform convergence; Riemann integration. Prerequisites: Calculus I-III or equivalent, Discrete Structures or equivalent.

MATH.5030 Mathematical Analysis (Formerly 92.503) - Credits: 3
Development of number systems, including axiomatic and constructive treatment of the integers and the reals; sequences and series; functions of a real variable and their properties, including continuity, derivatives and integrals; functions of several real variables, including partial derivatives and multiple integration; differential equations and applications; metric spaces. Masters degree credit for the Teacher Option only.

MATH.5070 Applied Functional Analysis I (Formerly 92.507) - Credits: 3

MATH.5090 Probability and Mathematical Statistics (Formerly 92.509) - Credits: 3
This course provides a solid basis for further study in statistics and data analysis or in pattern recognition and operations research. It is especially appropriate for students with an undergraduate science or engineering major who have not had a rigorous calculus-based probability and statistics course. The course covers the topics in probability models, random variables, expected values, important discrete and continuous distributions, limit theorems, and basic problems of statistical inference: estimation and testing.

MATH.5100 Computers and Calculators in Classroom (Formerly 92.510) - Credits: 3
Explores the roles of computers and calculators in instruction, examines some of the available software, and considers their use in a variety of areas of school mathematics, such as algebra, geometry (Euclidean and analytic) probability and statistics, and introductory calculus. Mathematics Masters degree credit for Teacher Option Only.

MATH.5130 Number Theory (Formerly 92.513) - Credits: 3
Study of primes, congruences, number-theoretic functions, Diophantine approximation, quadratic forms and quadratic number fields. Additional topics as time permits.

MATH.5190 Introduction to Probability and Statistics II (Formerly 92.519) - Credits: 3
The course combines theory with applications and covers both fundamental topics in statistical inference and their applications in data analysis. Discussions of the theoretical topics of statistical estimation and hypotheses testing will be complemented by analyzing simulated and real data sets. The course is taught at the computer lab equipped with MINITAB, SAS and other packages. Students will learn how statistical theory helps using statistical software, how to choose the right tool for the problem at hand and how to interpret the output. Topics to be covered include point and interval estimation, hypotheses testing, maximum likelihood estimation, likelihood ratio and related tests, applications of statistical inference to commonly used statistical models, such as one-sample, two-sample and many-sample (ANOVA) models, linear regression models, goodness-of-fit tests and contingency tables, and elements of statistical quality control and experimental design. Time permitting, topics in nonparametric and robust statistics will also be covered. Pre-requisite: 92.386, 92.509 or equivalent.

MATH.5230 Linear Algebra (Formerly 92.523) - Credits: 3
Sets and maps; vector spaces and linear maps, matrix of linear maps, solving systems of equations, scalar products and orthogonality, eigenvalues and applications. Masters degree credit for Teachers Option Only.

MATH.5290 Differential Geometry (Formerly
92.529) - Credits: 3
Differential geometry involving curves and surfaces in 3-space. Curvature, torsion, Frenet equations, intrinsic equations, involutes and evolutes.

MATH.5300 Applied Mathematics I (Formerly 92.530) - Credits: 3
Ordinary and partial differential equations; Fourier series and Fourier integrals; Laplace transform; matrix theory.

MATH.5310 Applied Mathematics II (Formerly 92.531) - Credits: 3
Vector analysis and vector calculus; Gauss, Green, and Stokes theorems; complex analysis; calculus of variations; special functions; orthogonal functions.

MATH.5320 Advanced Geometry (Formerly 92.532) - Credits: 3
Historical perspectives: Euclid's synthetic geometry, Descartes' analytic geometry, attempts to prove parallel postulate, emergence of non-Euclidean geometry's, axiomatic development of geometry, Klein's Erlanger Program; projective, affine, and metric geometries; non-Euclidean geometry's; foundations of geometry; algebraic geometry; finite geometry. Requires knowledge of linear algebra, abstract algebra for groups and fields including Galois fields, some familiarity with propositions and set-theoretic topology as covered in a course on Discrete Mathematics.

MATH.5430 Ordinary Differential Equations (Formerly 92.543) - Credits: 3

MATH.5450 Partial Diff Equations (Formerly 92.545) - Credits: 3

MATH.5480 Mathematics Of Signal Processing (Formerly 92.548) - Credits: 3
Representation of signals: Fourier analysis, fast Fourier transforms, orthogonal expansions. Transformation of signals: linear filters, modulation; band-limited signals; sampling; uncertainty principle; Windows and extrapolation.

MATH.5500 Mathematical Modeling (Formerly 92.550) - Credits: 3
Applications of mathematics to real life problems. Topics include dimensional analysis, population dynamics wave and heat propagation, traffic flow. Pre-requisite: 92.132 Calculus II.

MATH.5510 Calculus of Variations (Formerly 92.551) - Credits: 3

MATH.5520 Wavelet Analysis (Formerly 92.552) - Credits: 3
Introduction to time-frequency localization of signals; frames; windowed Fourier transforms; continuous and discrete wavelet transforms; time frequency sampling theorems; orthonormal bases of wavelets; algebraic wavelet theory; applications to electrodynamics and optics.

MATH.5550 Applied Math for Life Scientists (Formerly 92.555) - Credits: 3
The objective of this course is to give students an opportunity to learn how to use a computer algebra system in the context of reviewing some of the key mathematical topics that are used in the life sciences. The first half of the course includes a review of mathematical topics ranging from trigonometry through differential equations. A parallel introduction to a computer algebra system is also included in the first half. In the second half, students will study a mathematical topic such as pattern recognition or models for growth and complete a project using the computer algebra system. (UMassOnline).

MATH.5630 Computational Mathematics (Formerly 92.563) - Credits: 3
Introduction and review of Taylor series. Finding roots of F(x)=0. Numerical interpolation and extrapolation. Curve fitting and nonlinear best fits. Numerical differentiation and

MATH.5640 Applied Linear Algebra (Formerly 92.564) - Credits: 3
Use of iterative algorithms to find exact or approximate constrained solutions to large, and often sparse, systems of linear equations, and on applications, such as medical imaging, in which such problems arise. Maximization of likelihood and entropy. Emphasis on exploiting sparseness, accelerating convergence, and stabilizing calculations in the presence of noise. Block-iterative methods and bounds for singular values will be included. Basic results in matrix theory presented as needed.

MATH.5650 Special Functions (Formerly 92.565) - Credits: 3
Introduction to functions beyond those studied in calculus and which arise in applied mathematics, including gamma, beta, elliptic, Bessel, orthogonal polynomials ... Asymptotic approximation will be introduced.

MATH.5680 Approximation Theory (Formerly 92.568) - Credits: 3
Overview of descriptive statistics, data analysis, probability of events, discrete random variables, continuous random variables, normal, binomial and other probability distributions, central limit theorem, survey sampling, estimation, hypothesis testing, regression, experimental design, analysis of categorical data, nonparametric statistics. Masters degree credit for Teachers Option Only.

MATH.5700 Probability and Statistics (Formerly 92.570) - Credits: 3
This is a methods course focusing on the applications of statistics using R programming language. Topics include: Study designs, review of inference and regression, categorical data, logistic regression, rates and proportions, and nonparametric methods. Additional topics may be considered if time permits. Only one of 92.575(R) and 92.576(SAS) may be applied toward a Masters degree in Mathematics.

MATH.5720 Optimization (Formerly 92.572) - Credits: 3
Optimization without calculus; geometric programming; convex sets and convex functions; review of linear algebra; linear programming and the simplex method; convex programming; iterative barrier-function methods; iterative penalty-function methods; iterative least-squares algorithms; iterative methods with positivity constraints; calculus of variations; applications to signal processing, medical imaging, game theory.

MATH.5750 Applied Statistics with R (Formerly 92.575) - Credits: 3
An introduction to creation and manipulation of databases and statistical analysis using SAS software. SAS is widely used in the pharmaceutical industry, medical research and other areas. Cannot be used as a Math Elective.

MATH.5760 Statistical Programming using SAS (Formerly 92.576) - Credits: 3
Topics in nonasymptotic direct computational methods for statistical inference in data mining. Background in probability and statistics required.

MATH.5780 Statistical Inference and Data Mining (Formerly 92.578) - Credits: 3
Building models for discrete time series and dynamic systems and their use in forecasting and control. Stationary and non-stationary time series models. Box-Jenkins (ARMA) and other techniques.
Random variables, densities, joint and conditional distributions, expectations, variance, estimation, sufficiency and completeness, hypothesis testing, limiting distributions.

MATH.5900 Statistical Quality Control (Formerly 92.590) - Credits: 3

Overview of quality and managing quality, Define Measure Analyze Improve Control (DMAIC), the six sigma approach to quality, visual representation of data, Pareto charts, histograms, process capability vs specification (process) limits, t-tests, ANOVA, and other statistical hypothesis testing in quality, normal probability plots, control charts, measurement system analysis, application of regression analysis to manufacturing and/or design, Minitab.

MATH.5910 Linear Statistics Modeling and Regression (Formerly 92.591) - Credits: 3


MATH.5920 Multivariate Statistics (Formerly 92.592) - Credits: 3

Nonlinear model building via the method of least squares. Discriminant and factor analysis, principal components, profile analysis, canonical correlation, cluster analysis. Experience on real data sets.

MATH.5930 Experimental Design (Formerly 92.593) - Credits: 3

How to design, carry out, and analyze experiments. Randomized block designs, randomization, blocking, matching, analysis of variance and covariance, control of extraneous variables.

MATH.6510 Selected Topics in Mathematics (Formerly 92.651) - Credits: 3

Intended to satisfy individual student needs. Topics include various fields of mathematics.

MATH.6530 Selected Topics (Formerly 92.653) - Credits: 3

Advanced topics in various fields of mathematics and related fields. Since topical coverage varies from term to term, a student may be allowed to receive credit more than once for this course.

MATH.7420 Thesis Review (Formerly 92.472) - Credits: 1
MATH.7430 Graduate Research/Math (Formerly 92.743) - Credits: 3
MATH.9650 Introduction To Pascal (Formerly 92.965) - Credits: 3
Department of Physics and Applied Physics

The Department of Physics and Applied Physics offers programs leading to the degrees of Master of Science and Doctor of Philosophy.

The M.S. degree may be taken in physics or radiological science and protection (health physics) or in the applied physics option in optical sciences. Course requirements for the M.S. program consist of a total of 30 credits, including work on a thesis or project. The M.S. may serve as a basis for further study toward a Ph.D. degree. Students are expected to complete the M.S. program in two years.

The Ph.D. program requires 60 credits, including thesis research. Candidates for the degree must pass a written and oral comprehensive examination and a doctoral research admission examination (taken after successfully completing two semesters of an advanced research project) and demonstrate a proficiency in computer programming. Areas of research include experimental and theoretical nuclear physics, experimental and theoretical solid-state physics and material science, optics, laser physics and far infrared spectroscopy, scattering theory, quantum optics, relativity, particle physics, atmospheric and environmental physics, energy applications, applied mechanics, and radiological sciences.

Research Programs

Members of the Department are engaged in research programs in the following areas in which opportunities for advanced degree research are offered:

- Nuclear Physics,
- Solid State Physics,
- Laser Physics,
- Optics,
- Submillimeter-Wave Science and Technology,
- Theory of Elementary Particles,
- Quantum Field Theory,
- Atomic Physics,
- Relativity,
- Atmospheric Physics,
- Nuclear and Solar Energy,
- Applied Mechanics,
- Computational Physics,
- Radiological Sciences and Medical Physics.

Areas of study in nuclear physics include high-resolution neutron scattering, fission-product properties, and high-spin nuclear states (work conducted at national heavy-ion accelerators via in-beam gamma-ray spectroscopy).

Research equipment includes

- a 5.5-MeV Van de Graaff accelerator,
- neutron time-of-flight spectrometer,
- helium-jet fission-product transfer system,
- fast neutron irradiation facility,
- MW nuclear research reactor,
- 400-kilocurie Co-60 source for gamma-ray irradiation.

Principal areas of optics research include Raman, fluorescence, UV-visible-near-IR spectroscopy, and characterization of nonlinear optical properties of polymeric and semiconductor materials.

Solid state physics and materials science studies include photonic and opto-electronic devices, polymers and biological materials.

Research equipment includes

- an advanced materials characterization laboratory,
- transmission and scanning electron microscopy,
- x-ray analysis and surface science facilities,
- photonics and optoelectronics device development laboratory,
- molecular beam epitaxy,
- lithography of thin films, and
- epilayer characterization facilities.

The Submillimeter-Wave Science and Technology Laboratory develops coherent sources, receivers and novel imaging systems for application at terahertz frequencies. Research equipment includes microwave through infrared spectrometers for design and characterization of material dielectric properties, a CO2 and far-infrared laser magnetospectroscopy facility, and submillimeter-wave compact ranges for electromagnetic scattering studies.

Entering Graduate Students

Every entering graduate student is assigned a departmental adviser who will counsel the student on programs of study and other academic requirements. The adviser will serve as registration officer, help the student to become acquainted with research opportunities in the Department, and assist in selecting a research supervisor. In addition to the requirements for admission, applicants must submit the official test score report for the GRE general test; the Physics subject test is recommended, but not required. Applicants for the M.S. and Ph.D. degrees in Physics are expected to have a sound background in intermediate level
mechanics, electricity and magnetism, quantum mechanics, and modern physics. Any student found deficient in any of these areas may be required to take appropriate courses to remove the deficiency. Students in the Radiological Sciences and Protection M.S. program should have adequate preparation in mathematics, chemistry, physics, biology and nuclear and radiological sciences similar to the undergraduate curriculum in Radiological Health Physics at the University of Massachusetts Lowell.

Medical Physics

Overview and Program Goals

The University of Massachusetts Lowell's Department of Physics and Applied Physics offers a M.S. and Ph.D degrees in Medical Physics, both accredited by the Commission on Accreditation of Medical Physics Educational Program (CAMPEP [http://www.campep.org/]) in collaboration with local and regional hospitals and cancer centers in the Boston area, the program is designed for individuals who wish to be educated in therapeutic and imaging medical physics.

Students gain education and training in fundamental radiation sciences, medical physics and dosimetry, which includes laboratory work and clinical internship. The MS program duration is designed to be two years plus one summer semester, although the typical academic plan may be different due to elective courses and the length of thesis research. The duration of the Ph.D. program depends on the students' academic progress, and it is usually between four and six years. Both the MS thesis and Ph.D. dissertation must be based on hypothesis- or development-driven research, and the student is expected to submit the results to a peer-reviewed journal.

Program Objectives

The MS Degree in Medical Physics qualifies students for all medical physics specialties and prepares them for residency programs, junior medical physics positions, and future ABR (http://www.theabr.org/) exams. The clinical component provides the students with training dominantly in radiation therapy, but diagnostic imaging traineeships are also available.

The Ph.D. degree program provides the students with fundamental knowledge of physics with a specialization in medical physics. Students receive advanced research training in particular areas of medical physics, which will prepare them for entry-level research positions in academia or industry, or for a medical physics resident position under the supervision of a board-certified medical physicist.

Historically, most students have concentrated on therapy physics but because sometimes faculty and the cooperating hospitals have imaging or nuclear medicine research projects, over the last decade a number of students have focused on other medical physics specialties as well.

Upon graduation, medical physics students are prepared to receive advanced clinical training through working under the direction of a board-certified medical physicist or entering a medical physics residency program. The students will be prepared for a career as:

- A professional clinical medical physicist.
- A medical physicist in a research laboratory.
- A medical physicist in industry.
- For Ph.D. students, career as a medical physicist in an academic environment.
- For MS students, further research training in a Ph.D. medical physics program.

Qualification for Admission

Applicants are expected to have a strong foundation in physics, documented by either a degree in physics or in a related engineering or physical science with the following undergraduate coursework at the minimum:

- Physics: Core physics courses, including two semesters of general physics plus Classical Mechanics, Electricity and Magnetism, and Modern Physics or Quantum Mechanics;
- Mathematics: Three semesters of calculus and one semester of differential equations;
- Computer Science: Proficiency in a scientific/engineering programming language and knowledge of fundamental numerical methods;
- Chemistry (preferred): Two semesters of general chemistry;
- Biology (preferred): One semester of general biology;
- Anatomy (preferred): One semester of human anatomy.

Although Anatomy is not a requirement for admission, completion of an appropriate anatomy course is a requirement before graduation.

Successful applicants typically have an undergraduate major in physics, engineering, or a similar technical field. Students with other undergraduate degrees may be accepted if the prerequisite coursework is satisfied. Applicants with minor deficiencies, such as the undergraduate anatomy course, may be admitted with the provision of satisfying the prerequisite during the first year of graduate study.
The application deadline is normally the last day of February. Further information on the graduate admission process, including online and downloadable application forms, may be accessed at the UMass Lowell Graduate Admission website (https://www.uml.edu/admissions/default.aspx).

Programs of Study

**Master of Science Degree**

The MS Degree in Medical Physics requires 31 hours of didactic courses, 2 hours of clinical training (counting as laboratory courses), and a thesis of publishable quality that includes a minimum of 6 hours of thesis research. Elective courses may be taken to meet particular educational needs, especially for the students research.

- Sample curriculum leading to the MS Degree in Medical Physics (https://www.uml.edu/docs/Typical%20MS_tcm18-64823.pdf)
- Core Medical Physics Curriculum (https://www.uml.edu/docs/Core%20MedPhys%20courses%2010242014_tcm18-155471.pdf)

**Doctor of Philosophy Degree**

There are two paths towards earning a Ph.D. degree in Medical Physics at UMass Lowell: Via the Department of Physics and Applied Physics Ph.D. Program with Medical Physics option and via the University's interdisciplinary doctoral program in Biomedical Engineering Biotechnology (BMEBT) with Medical Physics specialization. The Ph.D. in Physics path invariably appeals to traditional physics students. Students with engineering background often choose the BMEBT path. While retaining their respective Physics and Biomedical Engineering ancestry, these programs offer a common Medical Physics curriculum, which is based on the required courses in the MS curriculum.

Both Ph.D. programs, via Physics or BMEBT, offer an en-route MS degree option: Students who entered the program with a BS or non-Medical Physics MS degree and pass the Comprehensive Examination may be eligible for the MS degree in Medical Physics if they have satisfied the relevant MS degree requirements as detailed above.

Sample curricula

- Leading to the Ph.D. Degree in Physics - Medical Physics Option, entering with MS in Medical Physics (https://www.uml.edu/docs/Medical%20Physics%20BS-typ lical%20PhD-MS%2010242014_tcm17-155469.pdf)(pdf)

For the latest course information please visit the UMass Lowell Online Academic Catalog.

Detailed description of the programs of study is published each year by the Department of Physics and Applied Physics, which includes the Medical Physics Programs, and it is available from the Physics Graduate Coordinator. For further information, the Medical Physics Program can be reached at: MED_PHYS@uml.edu

**Statistics on Medical Physics Program Students and Graduates**

- Link to Medical Physics Statistics, Academics and Professional Development and Placement (http://www.uml.edu/Sciences/physics/Programs-of-Study/Medical-Physics/Program-Statistics.aspx)

**Medical Physics Faculty, Research and Resources**

- Faculty (http://www.uml.edu/Sciences/physics/Programs-of-Study/Medical-Physics/Medical-Physics-Faculty.aspx)
- Resources (http://www.uml.edu/centers/radlab/default.html)

**Masters of Science Degree Program**

The Department of Physics and Applied Physics offers Master of Science degrees in Physics and in Radiological Sciences and Protection. The masters program in Physics provides an
opportunity for advanced study and research in most of the areas mentioned above, including a M.S. option in Optical Sciences. The masters program in Radiological Sciences and Protection is described elsewhere in this catalog.

**Graduate Credits and Course Requirements**

At least 30 graduate credit hours are required. For the Thesis Option, at least 6 and at most 12 credits are to be M.S. research. For the Project Option, a maximum of 3 credits of M.S. Project will be allowed. Alternatively, the student may substitute satisfactory performance on the Ph.D. Comprehensive Examination for completion of an M.S. Thesis or Project. For this option, a maximum of 6 research credits, and no more than 12 transfer credits, can be applied toward the M.S. degree. At most, 3 credits of Physics Colloquium and Seminar courses may be applied to the 30 credit requirements. Candidates for the Master of Science degree in Physics, except those in the Optical Sciences Concentration, are required to complete the following courses:

- PHYS.6050 Mathematical Methods of Physics I (3-0)3
- PHYS.5100/7020 Physics Colloquium (1-0)1
- Thesis 6-12 Credits or, Project 3 Credits, 4 Electives

Electives may be chosen in consultation with the academic advisor and research supervisor from the list of Physics courses acceptable for graduate credit. Some graduate courses offered by other departments may also be acceptable for graduate credit in Physics, with the approval of the Physics Department. All students are expected to have completed as part of their undergraduate studies a two-semester course in electromagnetic theory (PHYS.5530/5540 or equivalent) and a two-semester course in introductory quantum mechanics (PHYS.535/536 or equivalent). These courses cannot be counted as one of the 4 Physics electives needed for the M.S. requirement.

**Optical Sciences Option**

This program is designed to provide the necessary preparation for students wishing to specialize in such rapidly expanding fields as electro-optical phenomena, lasers, applications of optics to telecommunications and information processing, fiber optics and other new optical materials and devices. This option is intended for students who have completed a bachelor's degree program in Physics, Engineering, or other sciences. It is offered in cooperation with the Department of Electrical Engineering which offers an allied option in Opto-electronics. The Optical Sciences option emphasizes laboratory research providing the student valuable hands-on experience with optical systems and devices. Two course sequences are available (1) for students with a B.S. in Physics and (2) for students with a B.S. in Engineering or another scientific discipline.

Course requirements for the Optical Sciences Concentration:

For Students with a Physics B.S.

- PHYS.6050 Math. Meth. Phys. I (3-0)3
- PHYS.5390 Electro-Optics (3-0)3
- PHYS.5770 SS Electronic & Optoelectronic Devices (3-0)3
- Seminars and Colloquium 3 Credits
- Thesis 6-12 Credits or,
  - Project 3 Credits
- 2 Electives

For Students with B.S. in other Sciences or Engineering*

- PHYS.6050 Math. Meth. Phys. I (3-0)3
- PHYS.5470 Laser Physics and App. (3-0)3
- PHYS.5390 Electro-Optics with Lab (3,3)4
- PHYS.5100 Quantum Physics (3-0)3
- Seminars and Colloquium 3 Credits
- Thesis 6-12 Credits or, Project 3 Credits
- 2 Electives

Electives must be chosen from the following list of courses:

- PHYS.5400 Image Processing & Lab (2-3)4
- PHYS.5470 Laser Physics and Applications (3-0)3
- PHYS.5510 Fiber Optics & Lab (2-3)4
- PHYS.5720 Solid State Physics (3-0)3
- PHYS.5780 Integrated Optics: Wave Guides and Lasers (3-0)3
- PHYS.6150 Quant.Mech I (3-0)3
- PHYS.6310 Non-Linear Optics (3-0)3
- PHYS.5470 Experimental Laser Optics (12)2
- EECE.5680 Electro-Optics System Design (3-0)3
- EECE.6100 Optics for Information Processing (3-0)3

*Assuming adequate preparation in mathematics and electromagnetism.

**Colloquia**

All full-time masters candidates are required to attend Physics Colloquium, PHYS.7010/7020, each semester.

**Seminars**

All full-time masters candidates are required to take PHYS.7110/7120 Graduate Seminar in Physics, in addition to the Colloquium each semester. After a student has presented a
seminar in PHYS.7110/7120 (s)he may substitute one of the other seminars offered by the Department.

Thesis or Project

The thesis or project is to be based on research performed under the supervision of a member or adjunct member of the Physics Faculty. A student may do a thesis or project under the supervision of a faculty member in another department provided he has a member of the Physics Faculty as a co-supervisor. The student must submit to the Department, for its approval, nine copies of a typewritten proposal briefly describing the project or the problem to be solved for the thesis. This proposal must bear the written approval of the research supervisor. A thesis student must submit the proposal prior to or during the first semester of registration in M.S. Thesis Research in Physics. Students registered for Thesis must submit a brief progress report on the research to the Graduate Coordinator each semester unless a thesis is submitted.

Students registered for M.S. Project Research in Physics must submit a final report and complete an oral defense of the Project before the end of the semester. An M.S. Project may not be carried over into a second semester. After completing the work, thesis students must submit three copies of a typewritten thesis to the Department. The student must then pass an oral examination, administered by a Thesis Committee of the Department appointed by the Graduate Coordinator. The examination will be based upon, but not necessarily restricted to, the subject of the thesis. A student who completes a project rather than a thesis must submit three copies of the final project report to the department and pass an oral examination based upon, but not necessarily restricted to, the subject of the project.

Bachelor’s-Master’s Program

Medical Physics Master of Science Degree

The MS Degree in Medical Physics requires 31 hours of didactic courses, 2 hours of clinical training (counting as laboratory courses), and a thesis of publishable quality that includes a minimum of 6 hours of thesis research. Elective courses may be taken to meet particular educational needs, especially for the students research.

- Sample curriculum leading to the MS Degree in Medical Physics  
  (https://www.uml.edu/docs/Typical%20MS_tcm18-64823.pdf) (pdf)

Doctor of Philosophy Degree Program

The UMass Lowell Doctor of Philosophy program in Physics and Applied Physics is designed to develop advanced competence in physics. The Physics course of study prepares the student to carry out original and independent research in physics, while the Applied

- Graduate Credits
- Colloquia
- Seminars
- Computer Skills
- Comprehensive Examination
- Graduate Research Admission Examination
- Dissertation
- Doctorate in Physics
- Applied Physics Options
- Physics/Energy Engineering Option
- Applied Mechanics Option
- Atmospheric Sciences Option
- Radiological Sciences Option

Graduate Credits

At least 60 graduate credit hours are required, of which at least 15 and at most 24 are to be Ph.D. Dissertation Research. At most 3 credits of Physics Colloquium and seminar courses may be applied to the 60 credit requirement.

Colloquia

All full-time doctoral candidates are required to attend Physics Colloquium, PHYS.7010/7020, each semester.

Seminars

All full-time doctoral candidates are required to take at least one physics seminar, in addition to Colloquium, each semester. After a student has presented a seminar in PHYS.7110/7120 (s)he may substitute one of the other seminars offered by the Department.

Computer Skills

All candidates are required to demonstrate proficiency in computer programming, which may be accomplished by passing the Departmental computer language exam or by achieving a grade of at least B in courses such as FORTRAN Programming or Introduction to Pascal, or by demonstrating equivalent competence to the Physics Department.

Comprehensive Examination
All candidates must pass a written and oral Physics Comprehensive Examination. Students in pure Physics are expected to take this examination in their first year; those in the Applied Physics options, in their second year. The examination covers I. Classical mechanics, II. Electricity and magnetism, and III. Quantum mechanics, modern physics and statistical mechanics at the advanced undergraduate level. In addition Part I includes some elementary thermo-dynamics and Part II elementary optics. Part III is replaced by a section on radiological sciences and protection for students in that option and is based on the advanced undergraduate course requirements in Radiological Health Physics. For students in the Atmospheric Sciences Option, Part III is replaced by a section in atmospheric sciences, demonstrating a basic understanding of atmospheric structure and dynamics.

Graduate Research Admission Examination

Before commencing Ph.D. dissertation research each doctoral candidate must pass two semesters of Advanced Projects in Physics PHYS.7310/7320 and defend this project in an oral examination before a committee of the Physics graduate faculty. Students who have already completed a masters thesis in Physics or a related discipline may apply for a waiver of the Advanced Projects requirement. However, if the M.S. degree is from another institution the student must make an oral presentation of the M.S. work before a committee of the Physics Faculty in order to satisfy the Graduate Research Admission Examination requirement. Alternatively, a one-semester M.S. project may be substituted for one semester of Advanced Project on the recommendation of the student’s research supervisor. The Graduate Research Admission Examination must be passed before a student may submit a Ph.D. dissertation proposal.

Dissertation

The dissertation is to be based upon original research performed under the supervision of a member or adjunct member of the Physics Faculty (or the Faculty of a Department participating in a joint program with the Physics Department) holding an earned doctoral degree. If a student wishes to do a dissertation under the supervision of a faculty member in another department, the student must also have a co-supervisor who is a member of the Physics Faculty. Ph.D. candidates must submit to the Department, for its approval, eleven copies of a typewritten proposal briefly describing the research to be carried out. The proposal must bear the written approval of the research supervisor. A student may not register for Ph.D. Dissertation Research, until the Comprehensive Examination and the Graduate Research Admission Examination have been passed. Furthermore, the dissertation proposal must be submitted prior to or during the first semester in which the student is registered for Ph.D. dissertation research. Students registered for Ph.D. Thesis must submit a brief progress report on the research to the Graduate Coordinator each semester unless a thesis is submitted. After completing the work, the student must submit four copies of a typewritten dissertation to the Department. The student must then pass an oral examination, administered by a Dissertation Committee appointed by the Physics Graduate Coordinator, based on, but not necessarily limited to, the dissertation work.

Physics

The Physics program includes the following areas of study:

- Nuclear Physics
- Solid State Physics
- Laser Physics
- Photonics
- Optics
- Submillimeter Wave Science Technology
- Advanced Materials
- Nonlinear Optics
- Nanomaterials and Technology
- Theory of Elementary Particles
- Atomic Physics
- Quantum Field Theory

The following courses are required:

- PHYS.6050/6060 Mathematical Methods of Physics I,II (3-0)(3-0)6
- PHYS.6110 Classical Mechanics (3-0)3
- PHYS.6150/6160 Quantum Mechanics I,II (3-0)(3-0)6
- PHYS.6570/6580 Electromagnetic Theory I,II (3-0)(3-0)6
- PHYS.6170 Advanced Quantum Mechanics I (3-0)3
- PHYS.7310L* Advanced Projects in Physics I,II (3-0)(3-0)6

*This requirement may be waived for students who have written a Masters thesis in Physics or a related discipline. Electives may be chosen from the list of courses acceptable for graduate credit in Physics. Some graduate courses offered by other departments may also be acceptable for graduate credit in physics, but only with the approval of the Physics Department.

Applied Physics Options

Students in Applied Physics Options may select a program of study and research in one of the following areas:

1. Physics/Energy Engineering Option (a) Nuclear Energy(b)
Solar Energy
2. Physics/Applied Mechanics Option
3. Atmospheric Sciences Option
4. Physics/Radiological Sciences Option

The above options are official degree program options and will be so noted on the transcript. Areas 1, 2 and 3 are interdisciplinary programs with the Department of Chemical and Nuclear Engineering, the Department of Mechanical Engineering, and the Department of Environmental, Earth, and Atmospheric Sciences, respectively. Area 4 is an extension of the Master of Science degree program in Radiological Sciences and Protection.

General Required Courses

Every student in an Applied Physics Ph.D. Option must satisfy the following course requirements:

(a) PHYS.5130 Classical Mechanics (3-0)3
PHYS.5530/5540 Electromagnetism I,II (3-0)(3-0)6
PHYS.5350 Intro Quantum Mechanics I (3-0)3
PHYS.6050 Mathematical Methods of Physics I (3-0)3

(b) Six or eight credits from among the following courses, or their equivalents, as appropriate for each option:
PHYS.6110 Classical Mechanics (3-0)3
PHYS.5210 Statistical Thermodynamics (3-0)3
PHYS.5610/6620 Nuclear Physics I,II (3-0)(3-0)6
PHYS.6150/6160 Quantum Mechanics I,II (3-0)(3-0)6
PHYS.6170/6180 Advanced Quantum Mechanics I,II (3-0)(3-0)6
PHYS.6570/6580 Electromagnetic Theory I,II (3-0)(3-0)6
PHYS.6600 Quantum Mechanics of Many Particle Systems (3-0)3

(c) PHYS.7310L/7320L Advanced Projects in Physics I,II (3-0)(3-0)6 or the equivalent in the department appropriate to the students chosen field of concentration. This may be waived for students who have completed a masters thesis.

Physics/Energy Engineering Option

In addition to the general requirements, students in this option must take
PHYS.5360 Intro Quantum Mechanics II (3-0)3
PHYS.6060 Mathematical Methods of Physics II (3-0)3 and at least seven additional courses from among the Physics, Energy Engineering, and Mechanical Engineering offerings at the graduate level. These seven courses should include required courses appropriate to either the Solar or Nuclear energy specialization.

Applied Mechanics Option

In addition to the general requirements, students in this option must take
PHYS.5360 Intro Quantum Mechanics II (3-0)3
PHYS.6060 Mathematical Methods of Physics II (4-0)4 and at least two graduate courses from the Mechanical Engineering Department, the courses to be determined by the students and their academic and research advisors.

Atmospheric Sciences Option

In addition to the general requirements, 12 credits of core courses and 15 credits of elective courses. One credit is for atmospheric/environmental seminar. For core and elective course descriptions, see Environmental Studies (Atmospheric Sciences Concentration).

Radiological Sciences Option

In addition to the general requirements, students in this option must take the following courses:
PHYS.5360 Intro Quantum Mechanics II (3-0)3
PHYS.6060 Mathematical Methods of Physics II (4-0)4
PHYS.5610/6620 Nuclear Physics I,II (3-0)(3-0)6 and at least twelve credits from among the following graduate level Radiological Sciences and Protection courses, assuming the core courses for the Master of Science Degree in Radiological Sciences and Protection have already been completed.
RADI.5220 Envir. Radiation &Nuc. Site Criteria (3-0)3
RADI.5610/5620 Special Topics in Radiological Sciences(3-0)3
RADI.6630 Intro. to Radiation Chemistry (3-0)3
RADI.6080 Environmental Toxicology &Epidemiology (3-0)3
RADI.6130 Environmental Monitoring &Surveillance (3-0)3
RADI.6140 External Radiation Dosimetry (3-0)3
RADI.6150 Internal Radiation Dosimetry (3-0)3
RADI.6160 Data Reduction for Rad. Sci. &Protection (3-0)3
RADI.6200 Environmental Impact Statements (3-0)3
RADI.6250 Medical Health Physics (3-0)3
RADI.6460 Accelerator Health Physics (3-0)3
RADI.6510 Intro to Electronic Product Radiation (3-0)3
RADI.6660 Reactor Health Physics (3-0)3
RADI.6810 Medical Physics (3-0)3
RADI.6820 Medical Physics Laboratory (0-9)3

Note: It is expected that the requirements for the Master of Science degree in Radiological Sciences and Protection will be met during the first four semesters if the student has not already earned an M.S. degree.

Medical Physics Doctor of Philosophy Degree

There are two paths towards earning a Ph.D. degree in Medical Physics at UMass Lowell: Via the Department of Physics and Applied Physics Ph.D. Program with Radiological Sciences Medical Physics option and via the University's interdisciplinary doctoral program in Biomedical Engineering/Biotechnology (BMEBT) with Medical Physics/Radiological Sciences specialization. The Ph.D. in Physics path invariably appeals to traditional physics students. Students with engineering background often choose the BMEBT path. While retaining their respective Physics and Biomedical Engineering ancestry, these programs offer a common Medical Physics curriculum, which is based on the required courses in the MS curriculum.

Both Ph.D. programs, via Physics or BMEBT, offer an en-route MS degree option: Students who entered the program with a BS or non-Medical Physics MS degree and pass the Comprehensive Examination may be eligible for the MS degree in Medical Physics if he/she has satisfied the relevant MS degree requirements as detailed above.

Sample curricula available as pdfs

- Leading to the Ph.D. Degree in Physics Medical Physics Option, entering with BS in Physics (https://www.uml.edu/docs/Typical%20PhD-BS_tcm18-64826.pdf)
- Leading to the Ph.D. Degree in Physics Medical Physics Option, entering with MS in Physics (https://www.uml.edu/docs/Typical%20PhD-MS_tcm18-64827.pdf)
- Leading to the Ph.D. Degree in BMEBT Medical Physics Specialization, entering with BS in a technical discipline (https://www.uml.edu/docs/Typical%20PhD-BMEBT_tcm18-64825.pdf)

Detailed description of the programs of study is published each year by the Department of Physics and Applied Physics, which includes the Medical Physics Programs, and it is available from the Physics Graduate Coordinator.

Graduate Certificates in Physics

The Department of Physics offers two Graduate Certificates:

- Medical Physics
- Photonics & Opto-Electronic Devices
- Radiological Health Physics & General Work Environment Protection

Medical Physics

Department of Physics

Contact: Erno Sajo (mailto:erno_sajo@uml.edu), Ph.D., 978-934-3288

This 12-credit certificate is open to matriculated students who have completed the required core courses for the M.S. in Radiological Sciences. Students who have a graduate degree in Radiological Health Physics or Physics may apply to the certificate program if they meet the core requirements.

Required Courses:

- RADI.5960 Medical Physics
- RADI.6760L Graduate Medical Physics Internship
- RADI.5330 External Radiation Dosimetry and Shielding
- RADI.5340 Internal Radiation Dosimetry and Bioassay Assessment

Photonics & Opto-Electronic Devices

Physics Department and Electrical Engineering & Computer Engineering Department (Interdisciplinary)

Contact: Partha Chowdary, Ph.D., 978-934-3730
partha_chowdary@uml.edu
(mailto:partha_chowdary@uml.edu)

This certificate is offered jointly by the Electrical & Computer Engineering & Physics Departments and reflects the strong interests in the physics and technologies of electro-optics. Extensive research facilities include: new materials growth (molecular beam epitaxy) and device fabrication and testing
Required Courses:

- PHYS.5770 Solid State Electronic & Opto-electronic Devices
- PHYS.5390 Electro-optics

OR

- ECE.5950 Solid State Electronics
- ECE.5680 Electro-optics

Elective Courses (choose 2):

- ECE.5070 Electromagnetic Waves and Materials
- ECE.5080 Quantum Electronics
- ECE.5900 Fiber Optic Communications
- ECE.6070 Electromagnetix of Complex Media
- ECE.6690 Opto Electronic Devices
- PHYS.5470 Laser Physics & Applications
- PHYS.6310 Nonlinear Optics
- PHYS.5780 Integrated Optics: Wave Guides & Lasers

Gainful Employment Disclosure Information


Radiological Health Physics and General Work Environment Protection

Contact: Mark Tries, Ph.D. (mailto:mark_tries@uml.edu), 978-934-3353

This certificate is open to matriculated students who have completed the required core courses for the MS in Radiological Sciences. Students who already hold a graduate degree in Radiological Health Physics or Physics may also apply to this certificate program if they meet the core requirements.

The program is a collaborative endeavor between the University’s Physics and Radiological Sciences Program and the Work Environment Program. No other college or university in New England offers this type of program.

This certificate requires 14 credits of course work earned by taking four courses.
PHYS.4780 Integrated Optics: Wave Guides and Lasers (Formerly 95.478/578) - Credits: 3

This course is a continuation of 95.477 and serves as an introduction to solid state electronic and optoelectronic devices. The course will cover bipolar junction transistors, field effect transistors, integrated circuits, lasers, switching devices, and negative conductance microwave devices. Three or four practical demonstrations will also be performed with the analysis of the generated data assigned as homework. (offered as 95.548 for graduate credit)

PHYS.5010 Energy, Force and Motion (Formerly 95.501) - Credits: 3

An introduction to the most fundamental area of physics: the nature of motion, what affects it, and how it is measured. We examine Newton’s laws, including the law of gravity, and how forces produce acceleration. The course also examines the nature of energy - potential and kinetic - and how it relates to motion and forces. We will concentrate on how to analyze physical situations and solve the basic equations of motion. This course is intended to help teachers develop their understanding of the physics of motion.

PHYS.5170 Space Science Mission Design (Formerly 95.417/517) - Credits: 3

This one-semester, 3-credit course intended for junior level science and engineering majors, is centered around the conceptual design of a spaceflight mission. In this project-based and team-based class, students will apply their science and technical knowledge to develop a spacecraft and mission concept tailored to answer a specific science question. Students will perform quantitative trade studies consistent with real-life constraints such as cost, schedule, manufacturability, team-expertise, operational environment, mission lifetime, etc. Students will 1) learn the fundamentals of key subsystems involved in a space flight mission and 2) apply their skills of inquiry, research, critical thinking to design a complete space science mission to solve a real-world problem while working within a multidisciplinary team.

PHYS.5210 Statistical Thermodynamics (Formerly 95.421/521) - Credits: 3

An integrated study of the thermodynamics and statistical mechanics, review of the experimental foundations and historical development of classical thermodynamics; probability and statistical methods of studying macroscopic systems; atomic basis of the laws of thermodynamics and microscopic definitions of thermodynamics quantities using the method of ensembles; entropy and related quantities; TdS equations, Maxwell relations, equation of state, and applications: canonical and grand canonical ensembles; phase transitions; quantum statistics; application to radiation, magnetism, specific heats. (offered as 95.521 for graduate credit)

PHYS.5360 Introductory Quantum Mechanics II (Formerly 95.536) - Credits: 3

The three dimensional Schroedinger equation, the deuteron nucleus, angular momentum, spin, the hydrogen atom, spin-orbit interaction, Zeeman effect, Pauli exclusion principle, atomic structure, multi-electron atoms, the Fermi gas, X-rays.

PHYS.5380 Physical Optics and Waves (Formerly 95.538) - Credits: 3

Wave nature of light, mathematics of wave motion, electromagnetic theory of light propagation, reflection and refraction, Fresnel coefficients, polarization, interference, Young’s experiment, fringe visibility and coherence, various interferometers, Newton’s rings and applications, Fraunhofer diffraction by single and multiple apertures and diffraction gratings, Fresnel diffraction.

PHYS.5390 Electro-Optics (Formerly 95.439/539) - Credits: 3

Optical properties of materials, including dispersion, absorption, reflection and refraction at the boundary of two media. Crystal optics and induced birefringence and optical activity. Polarization states and Jones matrices. Applications to electro-optic devices. Experiments and projects involving the study of optical sources and detectors, spectroscopy, polarization, birefringence, Pockels’ effect, optical fibers, and optical communication. (offered as 95.539 for graduate credit)

PHYS.5400 Image Processing (Formerly 95.540) - Credits: 3

Basic physics of television and other imaging systems: representation and manipulation of images in digital form; Fourier analysis and filtering images: detection of image features such as edges and regions, pattern recognition, three-dimensional visual perception in man and machine, examples of image processing tasks from such areas as medicine, industrial inspection and robotics. Ability to program a computer is required.

PHYS.5450L Characterization of Materials (Formerly 96.445/545) - Credits: 2

A one-semester course designed to teach the student several of the important techniques for characterizing the structural, optical, and electronic properties of materials. Experiments will
include x-ray diffractometry, hardness measurements, ellipsometry, visible and near infrared spectroscopy, far infrared spectroscopy, and raman spectroscopy.

PHYS.5520 Contemporary Physics - Credits: 3
PHYS.5550 Introduction to Space Physics (Formerly 95.555) - Credits: 3

The course introduces the present knowledge of space phenomena and the physical understanding of the plasma environment from the sun to the earth's ionosphere and in the heliosphere. Regions in space to be discussed include the solar surface, solar wind, bow shock, magnetosheath, magnetosphere, magnetotail, radiation belts, ring currents, and the ionosphere. Among space plasma physic theories, single particle theory, kinetic theory, and magnetohydrodynamics, which describe charged particle motion in electromagnetic fields and its consequences, are introduced and applied to the space environment.

PHYS.5560 Radiative Processes in Astrophysics (Formerly 95.456/556) - Credits: 3

Our knowledge of the universe beyond the Solar System is derived almost entirely from our interpretation of the radiation we receive from the universe; Our knowledge of the Earth's upper atmosphere and the atmospheres of other solar system objects is heavily dependent on observations of electromagnetic radiation. To understand the atmospheres of Earth and other planets, stars, galaxies and the universe, we need to understand the processes which produce electromagnetic radiation, and how radiation interacts with matter and propagates through space. This course describes the basic processes which create and alter such electromagnetic radiation before it's detected here in the Solar System. The course will consist of a combination of lectures, problem sets and class discussion sessions. The lectures will be expanded from the material in the text and will include additional material on the astrophysical and planetary context of radiative processes, drawn primarily from the following list of references. The discussion sessions will often be based on recent problem sets - regular participation of students in class discussions is expected.

PHYS.5530 Computational Methods in Physics - Credits: 3

The course aims to provide an overview of the main and common computational methods currently used in physics research. The course will cover the topics of basic concepts of computational physics, first and second order methods of integration of advection equations, kinetic methods and N-body methods, Monte Carlo and Particle in Cell (PIC) methods, finite elements, finite volume and Computational Fluid Dynamics (CFD), spectral methods, girding methods and Adaptive Mesh Refinement (AMR), and introduction to parallel computing.

PHYS.5640 Particle Astrophysics (Formerly 95.464/564) - Credits: 3


PHYS.5670L Automation Techniques (Formerly 96.567) - Credits: 3

PHYS.5690 Plasma Physics - Credits: 3

The course aims to provide upper level undergraduate and graduate students from Physics and Engineering background in plasma physics, focusing on the fundamental physics principles, not any specific application or field of research. The course will cover the topics of basic plasma concepts, single-particle motion in an electromagnetic field, magnetohydrodynamics, plasma waves, plasma instabilities, plasma kinetics, and some advanced topics in plasma physics.

PHYS.5830 Astronomy and Astrophysics I (Formerly 95.583) - Credits: 3

Physics based introduction to modern Astronomy and Astrophysics. Aimed at students who have already studied E&M Modern Physics, and Calculus. Focus on fundamentals of Stellar Astrophysics and Galactic Astronomy.

PHYS.5870 Cloud Physics (Formerly 95.587) - Credits: 3
This course explores the essentials of cloud physics, beginning with the basic laws of thermodynamics of both dry and moist atmospheres. Condensation, nucleation, and drop growth are studied in detail at an advanced level.

**PHYS.5930L Graduate Physics Laboratory (Formerly 96.593)** - Credits: 2
Experiments in various branches of physics including optics, atomic physics, solid state physics and nuclear physics.

**PHYS.6050 Mathematical Methods of Physics I** (Formerly 95.605) - Credits: 3
Vector analysis; matrices and determinants; theory of analytical functions; differential equations, Fourier series, Laplace transforms, distributions, Fourier transforms.

**PHYS.6060 Mathematical Methods of Physics II** (Formerly 95.606) - Credits: 3
Partial differential equations, boundary value problems, and special functions; linear vector spaces; Green’s functions; selected additional topics; numerical analysis.

**PHYS.6110 Classical Mechanics (Formerly 95.611)** - Credits: 3
Knowledge of Lagrangian mechanics assumed. Central force problem, scattering, rigid-body mechanics, normal modes and special relativity. Hamiltonian dynamics, canonical transformations, Hamilton-Jacobi theory and action-angle variables. Continuous systems and fields, Simplectic formulation, stochastic processes, and chaos theory.

**PHYS.6150 Quantum Mechanics I (formerly 95.615)** - Credits: 3

**PHYS.6160 Quantum Mechanics II (formerly 95.616)** - Credits: 3

**PHYS.6170 Advanced Quantum Mechanics I** (formerly 95.617) - Credits: 3
Dirac equation as a single particle wave equation, free particle spinors and plane waves, matrices and relativistic covariance, nonrelativistic approximation and the fine-structure of the H atom. Quantization of the e.m. field in the coulomb gauge; interaction of an atom with the quantized radiation field; radiative transitions in atoms; Thomson scattering; classical and quantized Lagrangian field theory; symmetries and conservation laws; quantization of the real and complex Klein-Gordon field; Dirac Field and the covariant quantization of the e.m. field; Feynman propagators; the interaction picture and the S-matrix expansion in perturbation theory and the Wick’s Rule. Feynman diagrams and rules for calculating S-matrix elements in QED; formulas for cross-section and spin and photon polarization sums; calculation of cross-sections for (1) e++e- l++ l - (2) e++e- e++e- (3) Compton scattering and (4) scattering of electrons by an external e.m. field.

**PHYS.6190 Physics of Quantum Information - Credits: 3**
Introduction of physical concepts behind quantum information processing; Quantum description of physical systems, such as a harmonic oscillator and a single qubit, from an information processing point of view; More complex systems composed of entangled qubits; General tools, rooted in density-matrix formalism, used to describe entanglement and decoherence; Quantum error correction and how it can correct for qubit decoherence to realize fault tolerant computation; Recent advances in engineering quantum information processing platforms, teleportation, and quantum annealing.

**PHYS.6310 Nonlinear Optics (formerly 95.631)** -
Credits: 3
Wave propagation in a linear anisotropic medium; Wave propagation in a nonlinear optical medium. Classical model for the origin of nonlinear optical effects; Second order nonlinear optical effects - second harmonic generation, sum and difference frequency generation, linear electro-optical effect; Third order nonlinear optical effects, Kerr effect and intensity dependent nonlinear index of refraction, stimulated Raman and Brillouin scattering; Photorefraction; Nonlinear optical devices.

PHYS.6570 Electromagnetic Theory I (formerly 95.657) - Credits: 3
Electrostatics and magnetostatics with special attention to boundary value problems. Quasistatic fields and displacement currents. Maxwell's equations, special relativity, wave-guides, scattering, radiation from accelerated charges, propagation in material media and plasmas, Kramers-Kronig relations.

PHYS.6580 Electromagnetic Theory II (Formerly 95.658) - Credits: 3
Electrostatics and magnetostatics with special attention to boundary value problems. Quasistatic fields and displacement currents. Maxwell's equations, special relativity, waveguides, scattering, radiation from accelerated charges; propagation in material media and plasmas, Kramers-Kronig relations.

PHYS.6620 Nuclear Physics II (Formerly 95.662) - Credits: 3
The nucleon-nucleon force; nuclear models; nuclear reaction theory and partial wave analysis of scattering; fast neutron physics.

PHYS.6650 Space Physics (Formerly 95.665) - Credits: 3
This course provides in depth knowledge of space phenomena and physical understanding of the plasma environment form the sun to the earth's ionosphere and in the heliosphere. Regions in space include solar surface, solar wind, bow shock, magnetosheath, magnetosphere, magnetotail, radiation belts, ring currents, and upper ionosphere. Among space plasma physics theories, single particle theory and magnetohydrodynamics are discussed in depth.

PHYS.6830 General Relativity - Credits: 3
Special relativity and Lorentz transformations; Scalar and electromagnetic fields; Curved spacetime and the metric tensor; The equivalence principle; Geodesics, covariant derivatives, and Killing vectors; Einstein's field equations; The energy conditions; Relativistic cosmology and the expanding Universe; (Special topics: Schwarzschild solution and black holes; Penrose-Carter diagrams; Quantum gravity)

PHYS.7010 Physics Colloquium (Formerly 95.701) - Credits: 0-1
A series of invited lectures on current research topics in Physics.

PHYS.7020 Physics Colloquium (Formerly 95.702) - Credits: 0-1
A series of invited lectures on current research topics in Physics.

PHYS.7040 Seminar in Nuclear Physics (Formerly 95.704) - Credits: 0-1
involve presentations by students, faculty members, and visiting scientists of advanced topics, original research or journal articles.

PHYS.7050 Seminar in Solid State/Optics (Formerly 95.705) - Credits: 0-1
involve presentations by students, faculty members, and visiting scientists of advanced topics, original research or journal articles.

PHYS.7051 Supervised Teaching - Physics (Formerly 96.705) - Credits: 0

PHYS.7060 Seminar in Solid State/Optics (Formerly 95.706) - Credits: 0-1
involve presentations by students, faculty members, and visiting scientists of advanced topics, original research or journal articles.

PHYS.7090 Seminar in Accelerator Physics (Formerly 95.709) - Credits: 0-1
A weekly series of presentations and discussions by students and faculty concerning research in progress and planned research at the 5.5 MV Van de Graaff Accelerator. Enrollment in the course is limited to students whose research projects involve the Van de Graaff accelerator.

PHYS.7100 Seminar in Experimental Optics (Formerly 95.710) - Credits: 0-1
A weekly series of presentations and discussions concerning experimental optics research in the University of Massachusetts Lowell Department of Physics and Applied Physics.

PHYS.7110 Graduate Seminar in Physics (Formerly 95.711) - Credits: 0-1
Presentations by students of progress in their research projects.

PHYS.7120 Graduate Seminar in Physics (Formerly 95.712) - Credits: 0-1
Presentations by students of progress in their research projects.

PHYS.7130 Seminar in Theoretical Research (Formerly 95.713) - Credits: 0-1
PHYS.7140 Seminar in Experimental Research (Formerly 95.714) - Credits: 0-1
PHYS.7150 Seminar in Terahertz Technology (Formerly 95.715) - Credits: 0-1
Course involves presentations by students, faculty members, and visiting scientists of advanced topics, original research for journal articles relevant to technologies at terahertz frequencies.

PHYS.7160 Seminar in Biomedical Optics (Formerly 95.716) - Credits: 0-1
Seminar in Biomedical Optics, offered at the Advanced Biophotonics Laboratory by Dr. Anna N. Yaroslavsky, covers topics related to recent advances in biomedical optics. Examples include, but are not limited to, the development of individualized, image-based methods of light dosimetry and planning for cancer treatments, concepts and implementation of full inverse Monte Carlo technique for reconstruction of tissue optical properties, investigation of light scattering by complex biological structures and live tissues, development of steady-state and time-resolved polarization, fluorescence and elastic scattering methods for diagnostics and treatment of pathology.

PHYS.7160L Special Problems in Physics (Formerly 95.716) - Credits: 1-9
Reading in preparation for research, or research not for thesis. If results of the research are to be subsequently incorporated into a thesis, credits earned in this course may be used to satisfy thesis credit requirements in M.S. or Ph.D. Thesis Research with the written permission of the thesis supervisor, provided such permission is granted at the time of registration for this course. If the results are incorporated in an M.S. project, not more than 3 credits are allowed.

PHYS.7170 Seminar in Heavy Ion Physics (Formerly 95.717) - Credits: 0-1
Involves presentations by students, faculty members, and research scientists on advanced topics in heavy-ion spectroscopy, including both original research and journal articles.

PHYS.7180 Seminar in Space Physics (Formerly 95.718) - Credits: 0-1
This course is a weekly seminar covering the areas of conventional "space physics" and extending to "astrophysics" and "Upper atmospheric physics". Each seminar is focused on a topic that is currently at the cutting edge in these fields while an extended introduction will be given based on diverse background knowledge at graduate level in physics and engineering.

PHYS.7190 Seminar in Nanoscale Physics and Technology (Formerly 95.719) - Credits: 0-1
Students will study the scientific literature on topics and concepts in nanoscale physics and technology, including nanoscale thermal properties, micro- and nano-fluidity, nano-optics, quantum confinement to electronic states, and other phenomena. Students will make presentations and lead discussions on these studies at the frontiers of the field. The presentations will help them to generate new ideas for their own graduate research. Every student will have the opportunity to lead more than one discussion session.

PHYS.7200 Medical Physics Seminar - Credits: 0-1
Current research topics in medical physics, discussed by faculty, students and invited speakers.

PHYS.7210 Selected Topics in Physics (Formerly 95.721) - Credits: 3
Selected topics courses cover recent advances and more advanced topics, not covered in the regular courses in these areas. Subject matter varies, depending on the interests of the instructor and the needs of the students. Subject matter varies sufficiently that these courses may be taken more than once for credit without repeating topics.

PHYS.7230 Selected Topics in Nuclear Physics (formerly 95.723) - Credits: 3
Selected topics courses cover recent advances and more advanced topics, not covered in the regular courses in these
areas. Subject matter varies, depending on the interests of the instructor and the needs of the students. Subject matter varies sufficiently that these courses may be taken more than once for credit without repeating topics.

PHYS.7250 Selected Topics in Solid State (formerly 95.725) - Credits: 3

Selected topics courses cover recent advances and more advanced topics, not covered in the regular courses in these areas. Subject matter varies, depending on the interests of the instructor and the needs of the students. Subject matter varies sufficiently that these courses may be taken more than once for credit without repeating topics.

PHYS.7270 Selected Topics in Theoretical Physics (formerly 95.727) - Credits: 3

Selected topics courses cover recent advances and more advanced topics, not covered in the regular courses in these areas. Subject matter varies, depending on the interests of the instructor and the needs of the students. Subject matter varies sufficiently that these courses may be taken more than once for credit without repeating topics.

PHYS.7310 Advanced Projects In Physics I (formerly 96.731) - Credits: 3

Research project leading to the Graduate Research Admission Examination (for Ph.D. candidates only.)

PHYS.7320 Advanced Projects In Physics II (formerly 96.732) - Credits: 3

Research project leading to the Graduate Research Admission Examination (for Ph.D. candidates only.)

PHYS.7330 Graduate Project - Physics (formerly 96.733) - Credits: 3

PHYS.7460 Master’s Thesis Research Physics (formerly 96.746) - Credits: 0-9

PHYS.7560 Doctoral Dissertation/Physics (formerly 96.756) - Credits: 1-9

Note: Courses with 98 prefix are described in the Radiological Sciences and Protection section of this catalog.

PHYS.7610 Continued Grad Research (formerly 96.761) - Credits: 1

Continued Grad Research
PSMA.5000 Professional Science Master's (PSM) Professional Development (Formerly PSM 500) - Credits: 0
Professional Science Master's students who are preparing to participate in an internship enroll in this Professional Development Seminar prior to the semester of their work period. This seminar will provide them with resources and skills to manage an internship search, secure a position and work successfully in a professional environment.

PSMA.5010 Professional Science Master's (PSM) Reflective Seminar. (Formerly PSM 501) - Credits: 1
Reflective seminar following the internship which will enable Professional Science Master's (PSM) students to share and learn from the experiences of colleagues in other settings. The seminar is be conducted on campus and will include writing and oral presentation of experience.

PSMA.5100 Professional Science Master's (PSM) Internship (Formerly PSM 510) - Credits: 0
The internship component is expected to be 350 hour minimum and 3-6 month duration. The student will work within a business, government agency or research institute directly related to their area of study. Through this experience the student engages in real world work situations involving technical problems, teamwork, communication skills and decision-making. A student must have completed a minimum of 18 credit hours before commencing the internship. This course records the internship experience and carries zero credits.

PSMA.5350 Project Management for Scientists (Formerly PSM 535) - Credits: 3
This course is designed to provide skills to prepare students to take on the role of project manager. The necessity for project Management is now realized by most companies where the entire business including most of the routine activities can be regarded as a series of projects. Project Management principles provide a systematic approach to running a business; both large and small businesses as well as a scientific laboratory.

PSMA.5550 Professional Leadership in Science and Engineering (PSM 555) - Credits: 3
This course is designed to provide awareness and skills to prepare students to take on the role of leader. Part of a technically competent professional's responsibilities or opportunities for advancement may include leading small projects or work groups. This course will be organized around thematic video interviews with industry leaders to impart knowledge of and experience in leadership topics that support professional development.
Radiological Sciences and Protection

The Profession of Radiological Health Physics

Radiological Health Physics (RHP) involves the study of the effects of radiation and radioactivity on life processes. It also can be called radiation protection science and is particularly involved with the effects of radiation on the human body and the control of such radiation.

Many graduates of this curriculum at the University of Massachusetts Lowell (UML) enter the profession of health physics, which is devoted to the protection of man and the environment from the harmful effects of radiation while at the same time making it possible for our advancing civilization to enjoy all of the benefits resulting from uses of radiation.

Radiation control in its professional aspects requires the skills and knowledge from many disciplines. It has common scientific interests with many areas of specialization: biophysics, physics, biochemistry, chemistry, biology, genetics, ecology, nuclear engineering, metallurgy, medicine, physiology, industrial hygiene, and toxicology.

Other aspects of the profession include a working knowledge of labor relations, public relations, teaching, philosophy, and administration. The wide spectrum of knowledge required of the health physicist makes this profession both challenging and rewarding.

The Profession of Medical Physics

Medical Physics (MP) involves the application of physics to the diagnosis and treatment of disease. The use of radiation producing devices and radioactivity in medical physics is extensive. Many graduates of the Radiological Sciences and Protection curriculum at the University of Massachusetts Lowell (UML) enter the profession of medical physics. Graduate students who intend to enter this profession are encouraged to seek internships and research venues at nearby hospitals for which they can receive graduate credit towards the masters degree.

Employment and Scholarship Opportunities

Health physicists are employed by federal agencies (such as the Nuclear Regulatory Commission and Department of Energy) at related industries such as engineering support companies; industries which use radioisotopes or x-ray equipment to detect flaws or defects in manufactured products, prepare or reprocess nuclear fuels, control nuclear wastes, or produce or use radioactive materials or devices; universities (in teaching, research, and equipment monitoring); hospitals and medical centers that use radionuclides, x-ray equipment, and accelerators in the diagnosis and treatment of patients; and consulting firms which advise the organizations that do not employ full-time health physicists.

Scholarships are available for graduate students who choose the Radiological Sciences Program. These are available from the Nuclear Regulatory Commission (NRC), the Department of Energy (DOE), the National Academy for Nuclear Training, the Health Physics Society (HPS), the American Nuclear Society (ANS), and other organizations concerned with radiation protection.

Teaching Assistantships and Research Assistantships are available on a limited basis for UML graduate students.

Students may gain valuable applied work experience while also earning graduate credit and money through various summer internship programs. They also may gain experience and academic credit through an internship course at the UML Radiation Laboratory. This course is conducted under the direction of the health physics staff who have responsibility for the radiation safety programs at the nuclear reactor facility; accelerator facility, radioisotope research laboratories and x-ray facilities at the University of Massachusetts Lowell.

Radiological Sciences and Protection - Master of Science Degree Program

With the increasing use of radiation and radioactive material in society, there is a growing need for research and advanced education in Radiological Sciences and Protection.

The excellent facilities, equipment and supporting staff available at the University of Massachusetts Lowell’s Radiation Laboratory and faculty in the Radiological Sciences Program and in other allied departments give students at the University of Massachusetts Lowell (UML) a unique opportunity to
obtain rewarding careers in and make significant research contributions to the radiation protection field and to the use of radiation physics in medicine.

The Master of Science Degree Program in Radiological Sciences and Protection is interdisciplinary in nature and should be attractive to engineering students and students in the biological and physical sciences.

Master of Science - Radiological Sciences and Protection

Admission Requirements

A student should have a reasonable minimum preparation, including courses in mathematics, chemistry, physics, biology and in nuclear and radiological sciences similar to the University of Massachusetts Lowell Radiological Health Physics undergraduate curriculum. Because there is no advanced test in the field of Radiological Sciences and Protection, and because various undergraduate backgrounds are suitable for graduate study in the program, students are not required to take the Advanced GRE tests. The GRE Aptitude Test, however, is required. It is important that the mathematical preparation of students include differential and integral calculus through differential equations. Physics preparation up to and including Modern Physics is required. Preparatory courses are available at UMass Lowell for applicants who are deficient in these areas.

Master of Science in Radiological Sciences and Protection

Plan of Study

The program allows a student to select courses and a research project consistent with his/her desired area of professional development. Various opportunities for research and professional development are possible through the use of the Radiation Laboratory of the University and through cooperative programs with hospitals, nuclear reactor facilities, government laboratories, and other radiation facilities. A research advisor, other than a University of Massachusetts Lowell faculty member, may be approved for the conduct of research at facilities outside the University. Two M.S. degree options are available: thesis option or project option. In addition to a core curriculum, a master’s thesis or project report must be submitted and approved.

Thesis Option

Under the thesis option, a student must complete a minimum of 21 credits of formal courses and a minimum of 9 credits of graduate research. The master's thesis generally will consist of a scholarly laboratory or theoretical investigation in the field of Radiological Sciences and Protection. Proposed research must be approved by the Program Graduate Committee. The format for the final written thesis shall conform to the requirements of the University. The thesis proposal and report requirements may be obtained from the Program Coordinator.

Project Option

Under the project option, a student must complete a minimum of 27 credits of formal courses and 3 credits of graduate research to yield a total of 30 credits. In addition to the project report, the student must pass a comprehensive examination. The master’s project consists of a scholarly investigation such as a review, report, design, etc., in the field of Radiological Sciences and Protection. The subject of the project must be approved by the student’s advisor in advance. The final report must be approved by the Program Graduate Committee and conform to the format specified by the University.

Oral Defense of Thesis

A thesis committee is appointed to read a student’s thesis and to listen to an oral presentation and defense by the student. In general, the committee will include the thesis advisor and two additional members chosen from the Physics faculty or from other departments in which the candidate has taken graduate studies.

Comprehensive Examination for the Project Option

Degree candidates electing the project option are required to pass a Comprehensive written examination administered by the Program Graduate Committee. This examination normally will be administered during the semester in which the student completes his/her course requirements for the M.S. degree. The comprehensive examination may be waived for a student who can document that he/she has passed Part I of the American Board of Health Physics Certification Examination.

Residency and Foreign Language Requirements

No residency or foreign language requirements are specified by the Department.

Core Curriculum

A core curriculum consisting of seven courses and Thesis Research or Graduate Project in Radiological Sciences and Protection are required of all students pursuing the Master’s Degree in Radiological Sciences and Protection. These core courses are listed below. If a student has already had a course or courses similar to those listed, then the requirement for such courses may be waived. Courses in Nuclear Engineering, Physics and Applied Physics, Environmental Studies, Biology, Mathematics, Meteorology, Chemistry, Work Environment, and others may be selected for graduate credit with the approval of the Department.

Required Core Courses
• RADI.5060 Nuclear Instrumentation (4 credits)
• RADI.5010L Radiation Safety and Control I (4 credits)
• RADI.5020L Radiation Safety and Control II (4 credits)
• RADI.5330 External Radiation Dosimetry and Shielding (3 credits)
• RADI.5340 Internal Radiation Dosimetry and Bioassay Assessment (3 credits)
• RADI.5620 Radiation Biology (3 credits)
• RADI.7110/7120 Graduate Seminar in Radiological Sciences and Protection (3 credits)
• Plus departmental electives as required

Total = 30 credits

The Professional Science Master's Option within the Radiological Sciences Program

The development of Professional Science Masters (PSM) degree programs represents a growing trend in the United States with currently 120 such degrees offered at 60 colleges and universities. PSMs maintain a strong science core while incorporating professional communication (oral, written) skills, multidisciplinary training, management courses, and a professional internship into the curriculum. Applicants to PSMs include individuals with baccalaureate degrees currently employed at companies as well as new bachelor degree recipients from the United States and abroad who desire to combine in-depth science education with workplace skills important for their career development.

The Professional Science Master’s Option within the Radiological Sciences Program in the Department of Physics and Applied Physics shares the same core courses as the current masters degree program and, in lieu of a research component, requires courses selected from the foundation courses of the MBA degree program, a communications course, and a professional internship in Radiological Sciences.

Core Courses for Radiological Sciences and Protection

The required core courses for all options for the M.S. Degree in Radiological Sciences and Protection are:

• RADI.5060 Nuclear Instrumentation (4 credits)
• RADI.5010L Radiation Safety and Control I (4 credits)
• RADI.5020L Radiation Safety and Control II (4 credits)
• RADI.5330 External Radiation Dosimetry and Shielding (3 credits)

The required plus courses for the PSM option to the M.S. Degree in Radiological Sciences and Protection are:

• ACCT.5010 Financial Accounting (2 credits)
• POMS/MIST.5010 Operations Fundamentals (2 credits)
• MGMT.5010 Organizational Behavior (2 credits)
• BMBT.6010 Professional Writing &Communication (3 credits)
• RADI.xxxx Radiological Sciences Internship (1 credit)

Total = 34 credits

Students may request alternative courses from the MBA curriculum at UML. Approval from the Radiological Sciences Graduate Coordinator is required in advance for alternative courses.

Professional Internship in Radiological Sciences

The professional internship is required for all students matriculating in the PSM option. The internship should provide a broad experience performing real world tasks related to radiation protection for a minimum of 340 hours. Paid internships with companies and organizations that use radiation are preferred but volunteer on-campus internships with the university’s radiation safety office also will be available to students. Internships have to be approved in advance by the graduate committee of the Radiological Sciences Program, including approval of a qualified supervisor for off-campus internships. The graduate committee will provide oversight of all internships. A written report, signed by the internship supervisor, must be submitted by the student upon completion of the internship. An oral presentation by the intern as a Radiological Sciences seminar also is required. For students already employed in Health Physics, the professional internship will be tailored to meet the needs of both employee and employer.

Comprehensive Examination

Candidates for the PSM option to the M.S. Degree in Radiological Sciences and Protection must pass the Comprehensive Masters Examination that is based on the required graduate courses and administered once each semester.
Graduate Certificates in Radiological Sciences

Graduate Certificate Programs in Radiological Sciences:

- Medical Physics
- Radiological Health Physics and General Work Environment Protection

Download Graduate Certificate Application Form (pdf) (https://www.uml.edu/docs/Graduate%20Certificate%20App%20Only%20082016_tcm18-3292.pdf)

Medical Physics Certificate Program

Erno Sajo
Tel. 978-934-3288
Erno_Sajo@uml.edu (mailto:erno_sajo@uml.edu)

Program Description and Requirements.

Radiological Health Physics and General Work Environment Protection

Mark Tries
Tel. 978-934-3353
Mark_Tries@uml.edu (mailto:mark_tries@uml.edu)

Program Description and Requirements.

Bachelor’s-Master’s Program

In recognition of the need for advanced training beyond the bachelor of science level in radiological sciences, the following represents a program by which outstanding undergraduates can pursue an accelerated course of study leading to the B.S. and M.S. degrees in Radiological Sciences and Protection.

1. Undergraduate students who express an interest in this program will be evaluated by the graduate selection committee. Those students deemed commendable by the committee will be advised relative to the correct procedure for successful completion of their B.S. degree as well as a course of study toward the M.S. degree.

2. The first three years of undergraduate study is identical to that specified for students enrolled in the current four year B.S. program.

3. During the second semester of the junior year and upon approval and recommendation by the graduate selection committee, the student will file formal application to the Graduate School. This does not require the student to have taken the Graduate Record Examination. The committee decision will be based on (a) overall grade-point average, (b) grade-point average in selected subjects, (c) recommendations by program faculty, and (d) a one year minimum enrollment requirement at the University of Massachusetts Lowell. Upon approval, the student may be conditionally accepted to the Master’s on Physics, Radiological Health Physics option pending successful completion of the bachelor’s degree with a minimum 3.0 cumulative GPA.

4. During the senior year, the student is permitted to take up to six graduate-level courses (two three-credit courses) which can be double-counted towards the M.S. degree, provided the courses have an earned grade of B or better.

5. Upon completion of the fourth year of bachelor's study, assuming that all program and University requirements have been met, and the student has filed for graduation with the baccalaureate degree, the student will be awarded the B.S. degree and then may be recommended for full matriculation status by the graduate selection committee prior to the full matriculation status by the graduate selection committee prior to the full matriculation into the Master’s program. For University policy regarding to the BS?MS degree, please see

6. Although the options exist for taking an overload in any semester and/or registering for one or more summer sessions, they are not a requirement of this program. However, students wishing to gain a full research experience will be encouraged to initiate their research as early as possible (e.g., during the junior to senior year summer session), which is a distinct advantage of this accelerated program.

7. During the fifth year, as in the standard M.S. degree program, the student may choose the thesis option (9 semester hours of graduate research) or the project option (3 semester hours of graduate project). In either case, the student is required to take two one-credit graduate seminar courses and other courses required for the M.S. degree in radiological sciences that satisfy the 30 credit minimum M.S. degree requirement. Upon completion of all program and graduate school requirements, the student will be awarded the M.S. degree in Radiological Sciences and Protection.

More information on the Bachelor’s/Master's Program
RADI.5000 Introduction to Radiological Sciences  
(Formerly 98.500) - Credits: 3

This course is designed to introduce students to the working practices encountered in the health physics and medical physics profession. This is accomplished through field trips to local facilities that use radioactive materials, use and calibrations of radio-logical instrumentation, laboratory exercises, and class discussions. This class exposes the student to basic health and medical physics procedures, vocabulary, and equipment.

RADI.5010L Radiation Safety and Control I (Formerly 98.501) - Credits: 3-4

This course provides a theoretical basis for radiological sciences and protection, with a rigorous review of the fundamentals of radiation physics including nuclear reactions, radioactivity and the kinetics of radioactive decay, natural and man-made radiation sources, the characteristics of ionizing radiation, radioactive analysis, radiation dose quantities and measurement, external and internal radiation dosimetry, and radiation protection techniques.

RADI.5011L Biomedical Engineering and  
Biotechnology Seminar (Formerly 99.501) - Credits: 1

RADI.5020L Radiation Safety and Control II (Formerly 98.502) - Credits: 3-4

This course provides a continuation of the theoretical and practical aspects of radiation protection provided in Radiation Safety and Control I (98.501). Topics include the statistical analyses and data reduction techniques that are used to analyze radiation measurements pertaining to the field of radiation protection. Laboratory sessions on alpha and gamma radiation measurements and air sampling will reinforce class lectures. Students also will experience applied radiation protection and dose assessment through a contamination control exercise that involves the use of protective clothing and respiratory protection.

RADI.5060 Nuclear Instrumentation (Formerly 98.506) - Credits: 3

This course provides the operating principles and applications of nuclear radiation detection systems, including detector theory, electronic signal processing, and measurement and data reduction techniques. The systems covered include gas-filled detectors (ion chambers, proportional counters, and Geiger-Mueller counters), inorganic and organic scintillators, and high-purity germanium detectors, for the detection of alpha, beta, gamma, and neutron radiation. This course also covers hypothesis testing, detection limits, and detector dead time.

RADI.5090 Nuclear Instrumentation (Formerly 96.409) - Credits: 3

This course provides the operating principles and applications of nuclear radiation detection systems, including detector theory, electronic signal processing, and measurement and data reduction techniques. The systems covered include gas-filled detectors (ion chambers, proportional counters, and Geiger-Mueller counters), inorganic and organic scintillators, and high-purity germanium detectors, for the detection of alpha, beta, gamma, and neutron radiation. This course also covers hypothesis testing, detection limits, and detector dead time. This course is adapted for Nuclear Engineering and Medical Physics majors. (offered as 98.509 for graduate credit).

RADI.5220 Environmental Radiation and Nuclear Site Criteria (Formerly 98.522) - Credits: 3

This course provides an overview of the sources, distribution, environmental transport, dose projections, and environmental impact of radiations associated with the nuclear fuel cycle.

RADI.5230 Air Resource Management (Formerly 98.523) - Credits: 3

RADI.5240 Environmental Health Physics (Formerly 98.524 & 94.424) - Credits: 3

Natural and man-made sources of environmental radioactivity and radiation; environmental transport in air, water, and soil; exposure pathways; environmental standards and regulations; environmental monitoring and surveys (MARSSIM); contaminated site characterization, and site remediation; environmental radiological impact of industry, accidents, and natural and man-made disasters.

RADI.5330 External Dosimetry and Shielding  
(Formerly 98.533) - Credits: 3

This course provides the theory and application of dosimetry and shielding for ionizing radiation sources outside the human body. Differential cross-sections, energy transfer and absorption coefficients, kerma, attenuation, and buildup are discussed for photons. Cross-sections, kerma factors, removal coefficients, diffusion, and point-source dose functions for fissioning sources are discussed for neutrons. Beta dosimetry concepts include stopping power, point-source dose functions, and the effects of attenuating materials. Heat generation and temperature profiles are discussed for irradiated materials and radioactive substances. Dosimetry concepts and barrier requirements also are described for particle accelerators, radiotherapy facilities, and medical x-ray imaging facilities.
RADI.5340 Internal Dosimetry and Bioassay (Formerly 98.534) - Credits: 3
This course provides the theory and application of several analytical techniques, including precipitation, solvent extraction, ion exchange chromatography, and electrodeposition, to the separation and analysis of radioactive substances in various samples. This course also covers some common radiation detection systems, measurement and data reduction techniques, radionuclide and isotope dilution techniques, neutron activation analysis, and radioimmunoassay.

RADI.5410 Radiochemistry (Formerly 98.541) - Credits: 3

RADI.5620 Radiation Biology (Formerly 98.562) - Credits: 3
Effects of ionizing radiation on cellular, molecular and organ systems levels of biological organization; Study of x-rays, gamma rays, accelerator beams, and neutrons in interaction with living systems; Cohesive treatment of radiation biophysics with applications in health physics and radiation oncology. (offered as 98.562 for graduate credit)

RADI.5650 Introduction to Radiation Therapy Physics (Formerly 98.565) - Credits: 3
Introduction to the fundamental physics of radiation therapy, with emphasis on external beam photon and electron therapy and on brachytherapy. For these modalities, the basic operation of delivery equipment, treatment planning principles, methods of dose calculations, determination of time of irradiation from dose prescription, dose measurements, and quality assurance will be studied. This knowledge will prepare the student for an introduction to the practice of clinical physics in radiation therapy, for advanced radiation therapy physics, and research in radiation therapy physics.

RADI.5750 Certification Preparation in Radiological Sciences (Formerly 98.575) - Credits: 3
Advanced problem solving in radiological sciences including strategies for preparing for and taking professional certification examinations.

RADI.5820 Numerical Methods In Radiological Sciences (Formerly 98.582) - Credits: 3
This course provides a more advanced mathematical treatment of the topics covered in 98.481, with extensive application of computer techniques to numerical problem solving that is applicable to radiological sciences and protection.

RADI.5980 Introduction to Medical Imaging (Formerly 98.598) - Credits: 3
Key topics of modern medical imaging: principles of medical imaging, image formation, Fourier analysis, image reconstruction, digital image processing with applications in computed tomography, radioisotope imaging, magnetic resonance imaging, positron emission tomography, ultrasound imaging, and optical imaging. Strengths and limitations of imaging modalities.

RADI.6050 Radiation Interactions and Transport (Formerly 98.605) - Credits: 3
Photon, neutron, and electron interactions and energy deposition; the Boltzmann equation, elementary analytical solutions; deterministic computational methods, including spherical harmonics and discrete ordinates techniques; continuous slowing down and Fokker Planck approximations.

RADI.6060 Monte Carlo Simulation of Radiation Transport (Formerly 98.606) - Credits: 3
Radiation transport simulation by the Monte Carlo method: phase space tracking, dose response estimators, biasing methods; integral form of the Boltzmann equation; condensed history method for charged particles; neutron, photon, and electron transport calculations for medical physics and health physics applications.

RADI.6160 Data Redn for RSP (Formerly 98.616) - Credits: 3

RADI.6310L Professional Health Physics Internship (Formerly 98.631) - Credits: 1-3

RADI.6650 Advanced Radiation Therapy Physics (Formerly 98.665) - Credits: 3
The student will be introduced to the physics of advanced treatment techniques used in radiation therapy, which include external beam electron, proton, and photon therapy and internal brachytherapy. For these techniques, the principles of the techniques such as clinical applications, radiation delivery equipment, treatment planning methods, methods of dose calculations, determination of time of irradiation from dose prescription, dose measurements, and quality assurance will be studied. This knowledge will prepare the student for an introduction to the clinical practice of medical physics applied to complex treatment techniques used in radiation therapy. Also, this should help prepare the student for research in radiation therapy physics.

RADI.6710L Graduate Accelerator HP Internship
(Formerly 98.671) - Credits: 3
RADI.6720 Graduate Reactor HP Internship (Formerly 98.672) - Credits: 1-3
RADI.6730L Graduate Reactor HP Internship (Formerly 98.673) - Credits: 3
RADI.6750L Graduate Medical HP Internship (Formerly 98.675) - Credits: 3
RADI.6760L Graduate Medical Physics Internship (Formerly 98.676) - Credits: 1-3

Clinical Rotation under the direction of clinical staff. This course provides the student with exposure to medical physics responsibilities in a radiation oncology department, including simulation, treatment planning and preparation, monitor unit calculations, dose measurements and calculations, treatment delivery techniques, quality assurance, and radiation safety.

RADI.6770L Graduate Medical Physics Internship (Formerly 98.677) - Credits: 3
RADI.6780L Graduate HP Internship (Formerly 98.678) - Credits: 1-3
RADI.6790L Graduate HP Internship (Formerly 98.679) - Credits: 1-3
RADI.6830L Graduate HP Internship (Formerly 98.683) - Credits: 3
RADI.6850L Advanced Medical HP Internship (Formerly 98.685) - Credits: 3
RADI.6860L Advanced Medical Physics Internship (Formerly 98.686) - Credits: 1-9

Clinical Rotation under the direction of clinical staff. This course involves the student in one or more projects that require skill development, extended involvement, and project completion, which includes planning and delivery of advanced radiation therapy treatments.

RADI.6870L Advanced Medical Physics Internship (Formerly 98.687) - Credits: 3
RADI.6890L Advanced Graduate HP Internship (Formerly 98.689) - Credits: 1
RADI.6900L Advanced Graduate HP Internship (Formerly 98.690) - Credits: 2
RADI.6910L Advanced Graduate HP Internship (Formerly 98.691) - Credits: 2
RADI.6920L Advanced Graduate HP Internship (Formerly 98.692) - Credits: 3
RADI.6930L Advanced Graduate HP Internship (Formerly 98.693) - Credits: 3
RADI.7050 Supervised Teaching in Radiological Sciences (Formerly 98.705) - Credits: 0
RADI.7110 Graduate Seminar in Radiological Sciences (Formerly 98.711) - Credits: 0-1
RADI.7120 Graduate Seminar in Radiological Sciences (Formerly 98.712) - Credits: 0-1
RADI.7310L Advanced Project in Radiological Sciences I (Formerly 98.731) - Credits: 3-6
RADI.7320L Advanced Project in Radiological Sciences II (Formerly 98.732) - Credits: 3
RADI.7330 Graduate Project in Radiological Sciences and Protection (Formerly 98.733) - Credits: 3-6
RADI.7430 Master's Thesis in Radiological Sciences and Protection (Formerly 98.743) - Credits: 3
RADI.7460 Master's Thesis in Radiological Sciences and Protection (Formerly 98.746) - Credits: 1-9
RADI.7490 Master's Thesis Research in Radiological Sciences (Formerly 98.749) - Credits: 9
RADI.7530L Doctoral Dissertation in Radiological Sciences and Protection (Formerly 98.753) - Credits: 3
RADI.7560 Doctoral Dissertation in Radiological Sciences and Protection (Formerly 98.756) - Credits: 1-9
RADI.7590L Doctoral Dissertation in Radiological Sciences and Protection (Formerly 98.759) - Credits: 9
RADI.7690 Continued Graduate Research (Formerly 98.769) - Credits: 9
EDUC.5010 Teaching Diverse Populations (Formerly 01.501) - Credits: 3

Students examine, confront and learn to manage the challenge of successfully educating all children, regardless of racial, cultural, linguistic, gender or physical differences.

EDUC.5012 Mathematics for Elementary Teachers III: Basic Principles of Euclidean Geometry (Formerly 04.501) - Credits: 3

This course integrates the study of geometry and measurement and includes lines, angles, investigations of triangles, quadrilaterals, polygons, area and perimeter; congruency, similarity, and Pythagoras’ Theorem. The students will explore mathematical explanation, argument, justification and how these processes connect to geometric proof. Also systems of units and concepts related to measurement will be investigated.

EDUC.5013 Introduction to Leading Professional Learning Communities (Formerly 05.501) - Credits: 1

This course introduces participants to strategies that will enable them to cultivate and lead school-based professional learning communities. During a week-long summer institute, students develop an action plan. In the fall, students will keep in contact (electronically) with peers and the instructor and will attend a final face-to-face session to support their efforts. The grade for the one credit course is awarded at the end of the fall semester.

EDUC.5020 Adolescent Development and Behavior (Formerly 01.502) - Credits: 3

This course provides an overview of adolescent development issues and classroom management practices. Adolescent development is examined through research into major theorists in developmental psychology: Piaget, Vygotsky, and Erikson etc. Classroom management strategies are explicitly taught through case study analyses, and examination of core beliefs, focusing on interpersonal relationships between students, teachers, parents, mentors and supervisors.

EDUC.5021 Issues, Mandates and Ethics in Special Education (Formerly 05.502) - Credits: 3

This course will examine special education laws and ethical practices in K-12 settings.

EDUC.5030 Understanding Child Development in a Diverse Society (Formerly 01.503) - Credits: 3

Examines the major theoretical frameworks of child development and how cultural differences affect development and learning. Focus is on helping students make responsive and culturally relevant pedagogical decisions.

EDUC.5040 Methods of Teaching Students with Moderate Disabilities (Formerly 01.504) - Credits: 3

Examines the methods of teaching students with moderate disabilities. Topics include curriculum (including the Massachusetts frameworks), IEPs, and instructional modifications appropriate for students with special needs.

EDUC.5043 Methods of Teaching Students with Moderate Disabilities - Secondary - Credits: 3

Examines the methods of teaching students with moderate disabilities at the secondary level. Topics include curriculum (including the Massachusetts frameworks), IEPs, and instructional modifications appropriate for students with special needs.

EDUC.5050 Children with Disabilities in the Classroom (Formerly 01.505) - Credits: 3

This course examines the nature of cognitive emotional, developmental, sensory, and physical disabilities that compromise student capacity to make adequate academic progress without special intervention. Legal and ethical responsibilities of the educator in inclusive classroom settings and as an active member of a multidisciplinary learning team are emphasized.

EDUC.5060 Oral Comm.for English Lang.Users I: Pronunciation for List. & Speaking (Formerly 02.506) - Credits: 0

This course offers graduate students the opportunity to increase and refine their understanding and ability to produce discrete sounds, sound combinations and the rhythm of spoken English to add in their comprehension of spoken English and to aid in their personal communication skills. Class activities include pronunciation drills, short extended listening, short presentations, speaking tasks and group discussion. This is not a conversation class but student participants will be required to actively speak in each class. Priority given to TA’s/RA’s an later semester graduate students, but available to all graduate students.

EDUC.5062 Oral Communications for English Language Users II: Academic Oral English - Credits: 0

This course offers graduate students the opportunity to
increase awareness of and to practice features of advanced spoken communication typical of academic environments: academic discussion/debate, conference/classroom/informal presentation, and question/answer sessions. Targeted skills include structure/organization, body language, intonation, dealing with nervousness, and awareness of cross-cultural communication patterns. As a workshop, this course requires active participation in a variety of speaking tasks, presentation preparation outside of class and feedback/discussion of peer communication. Priority given to and required for all TA’s. Some students may be required to successfully complete 02.506/EDUC.5060 prior to enrollment in

EDUC.5063 Advanced English Expression for English Language Users - Credits: 0

This course focuses on the grammar, vocabulary and phrases typically used in formal academic settings. I.E. the language forms required for understanding and producing research papers, journal articles, conference presentations and formal speaking. Students will learn to use online corpora tools to aid in their own language development, as well as analyze sentences and the language in a journal article of their choice. Recommended for graduate students early in their studies.

EDUC.5070 Introduction to Academic Writing for English Second Language Users (Formerly 02.507) - Credits: 0

This course offers an introduction to the complex nature of academic language and academic writing, focusing on effective sentence, paragraph and text structures, purposeful and appropriate word choice, the writing process in writing contexts appropriate for graduate students early in their studies. Through attentive, details and critical reading of various materials, students will enhance their writing skills by applying effective planning, drafting, rewriting and editing strategies. As a workshop class, students are required to write (and write often), participate in a variety of oral/written tasks in class, and engage in constructive peer review. Recommended for graduate students early in their studies.

EDUC.5120 History for Teachers (Formerly 04.512) - Credits: 3

This course examines the major concepts, people and events of US and World history using the ten themes outlined by the NCSS (National Council for the Social Studies). These standards are grouped under the four strands for teaching social studies in the state of Massachusetts (history, economics, geography and civics) and guide the focus for teacher preparation and instruction.

EDUC.5130 Teaching World History (Formerly 04.513) - Credits: 3

In an increasingly globalized and diverse age, courses in world history have become a growing teaching field at the secondary level in the United States. The overarching purpose of this class is to help students prepare to teach classes in world history. This course will introduce the field and concepts of world history. It will familiarize students with available materials such as textbooks, readers, primary documents, academic books and articles, novels, films, websites, and podcasts. The class will introduce and align with the state, national, and AP standards in world history.

EDUC.5150 Practicum in English as a Second Language PreK-6 (Formerly 02.515) - Credits: 3

On-site field experience in an ESL classroom, under the supervision of a qualified ESL teacher and faculty of the Graduate School of Education.

EDUC.5160 Practicum in English as a Second Language 5-12 (Formerly 02.516) - Credits: 3

On-site field experience in an ESL classroom, under the supervision of a qualified ESL teacher and faculty of the Graduate School of Education.

EDUC.5170 Community Organization and Parental Partnership (Formerly 02.517) - Credits: 3

The aim is to prepare school personnel to work effectively with community groups and bilingual parent organization.

EDUC.5200 Teaching Reading and Writing in English (Formerly 02.520) - Credits: 3

This course examines the development of reading and writing necessary for the ESL child to learn to read and write in English. Students gain familiarity with the various perspectives and practices that have been found to be effective in the teaching of reading and writing to students whose first
EDUC.5220 Young Adult Literature (06.522) - Credits: 3
The major emphasis of the course will be discussion and analysis of the goals of a literature curriculum and the exploration of various methods for achieving these goals. The characteristics of the different genres of literature will be discussed in detail.

EDUC.5240 Educational Assessments of Students with Moderate Disabilities (Formerly 02.524) - Credits: 3
A review of the various assessments and standardized tests that are used to identify students with moderate disabilities. The interpretation of assessment results and how to communicate them effectively to parents and school personnel will be examined.

EDUC.5250 Science for Secondary Science Teachers (Formerly 04.525) - Credits: 3
This course emphasizes content knowledge which includes the facts, concepts, laws, theories and organizing frameworks of science and syntactic knowledge which includes values, beliefs and assumptions that the science teacher has about the generation of scientific knowledge.

EDUC.5270 Language Acquisition (Formerly 06.527) - Credits: 3
This course will focus on the study of the acquisition of language and the relationship of language learning to the development of literacy. Students will examine both first and second language acquisition. Students will be expected to apply their knowledge of language acquisition to best teaching practices for enhancing first and second language development in the classroom and to the development of literacy.

EDUC.5280 Assessment of Reading and Language Disabilities (Formerly 06.528) - Credits: 3
This course examines the selection and use of procedures to make an adequate clinical and educational diagnosis. Includes the assessment of function and dysfunction in factors associated with language development; receptive, expressive, writing, reading; and the administration and interpretation of individual and group tests of perceptual, motor, and conceptual functioning in reading and language.

EDUC.5282 Teaching and Assessing Academic Reading and Writing I (Formerly 02.528) - Credits: 3
This course is designed to provide candidates with a broad overview of topics and approaches to teaching English language learners to become competent academic readers and writers who can critically and creatively evaluate, analyze, construct and present their ideas and arguments. Emphasis is on demonstrating teaching methods which are student oriented, pro-active and where writing skills are connected to reading skills; also, effective planning, drafting, rewriting and editing strategies will be emphasized.

EDUC.5290 Treatment Reading and Language Disabilities (Formerly 06.529) - Credits: 3
This course will explore the specific practices in remedial teaching in grades K-12, using published materials, and developing new materials for small group, whole class, and tutoring settings. Students will develop and implement realistic corrective programs based on the interpretation of literacy assessments. These programs will include selecting strategies of instruction and materials, and establishing a framework of time and evaluation.

EDUC.5292 Teaching and Assessing Academic Reading and Writing II (Formerly 02.529) - Credits: 3
This course is a continuation of Teaching Reading and Writing I. The level is advanced; effective teaching methods of writing, reading and editing are emphasized using relevant and real life examples of academic texts. Detailed analyses and discussions of academic texts through analytical, critical and constructive readings will provide candidates with a solid understanding of teaching methods in advanced reading and writing.

EDUC.5300 Interactions and Assessment in Science (Formerly 04.530) - Credits: 3
This course examines the ways in which students interact and learn in the science classroom. Construction of a Science, Technology, and Society (STS) unit plan, as well as the development of assessment tools that align to lesson and unit goals are key features of this course.

EDUC.5301 Reading and Thinking: Secondary School (Formerly 06.530) - Credits: 3
This course examines the relationships among reading, writing, and thinking in high school, particularly in diverse populations and with second language learners. Emphasis will be placed upon practical work in classrooms and the development and assessment of new teaching practices.

EDUC.5312 Internship in English as a Second
Language 5-12 (Formerly 02.531) - Credits: 3
On-Site field experience in an ESL classroom, under the supervision of a qualified ESL teacher and faculty of the Graduate School of Education.

EDUC.5330 Mathematics for Elementary Teachers I: Basic Principles of Arithmetic (Formerly 04.533) - Credits: 3
Participants will be engaged in constructing solid conceptual understanding of the language and operations of arithmetic; topics include place value and the history of counting, inverse processes, a large repertoire of interpretations of operations with numbers, concepts of integers and rational numbers, multi-digit calculations, including standard algorithms and non-standard methods the reasoning behind the procedures.

EDUC.5340 Mathematics for Teachers I (Formerly 04.534) - Credits: 3
This course revisits the content related to the development of number and operation, proportions, ratios and percent; modeling operations with fractions, beginning algebra and geometry. The course emphasizes the meanings of operations and relationships among those operations; multiple representations of concepts and connections across different representations. It also examines basic Number Theory concepts, such as factors and multiples, as well as divisibility tests, at both concrete and abstract levels.

EDUC.5350 Mathematics for Teachers II (Formerly 04.535) - Credits: 3
This course revisits the mathematics content related to the grades 8-12. It examines in depth elementary functions, and different mathematical models such as linear, quadratic, exponential, logarithmic and trigonometric, to describe real life situations. The course includes some topics from Euclidean geometry. The course emphasizes multiple representations of concepts, connections across different representations, as well as different levels of representations form concrete to abstract.

EDUC.5370 Mathematics for Elementary Teachers II: Basic Principles of Algebra (Formerly 04.537) - Credits: 3
The course examines the topics related to ratio and proportion, slope, the notion of function, absolute value, linear and non linear functions, sets, equations, inequalities, simultaneous equations, reading and creating graphs of functions, formulas (in closed and recursive forms), and tables; studying characteristics of particular classes of functions on integers. It will also investigate some topics related to statistical analysis and probability.

EDUC.5390 Pre-Practicum: Alternate Route (Formerly 02.539) - Credits: 0
The pre-practicum occurs in the semester before the practicum. The course focuses on what it means to be a teacher by examining the content, dispositions and skills necessary to succeed in the profession. Students observe other teachers in their school and must spend one day observing in a district with different demographics. While there is no credit assigned to the pre-practicum, it is a required component of the program. Students complete a pre-practicum binder based on their observances.

EDUC.5400 Pre-Practicum (Formerly 02.540) - Credits: 0
The pre-practicum occurs in the semester before the practicum. The course focuses on what it means to be a teacher by examining the content, dispositions and skills necessary to succeed in the profession. Through a combination of site observations in schools of different demographics, personal/professional teaching opportunities and participation in professional seminars, elementary and secondary preservice teachers gain additional information and skills to prepare them for their practicum. While there is no credit assigned to the pre-practicum, it is a required component of the program. A fee is assessed.

EDUC.5410 Teaching Emergent Bilingual Students (Formerly 02.541 & UTL.441) - Credits: 3
The purpose of this course is to prepare new secondary teacher candidates with the knowledge and skills to effectively shelter their content instruction, so that the growing population of English learners (ELs) in PK-12 schools can achieve academic success, and contribute their multilingual and multicultural resources. The course will provide aspiring teachers with practical research-based methods, strategies, and protocols to integrate subject area content, language, and literacy. Successful completion of this course provides SEI (Sheltered English Immersion) endorsement, which is required for teaching in the Commonwealth of Massachusetts. This is a service learning course.

EDUC.5413 Practitioner Action Research (Formerly 07.541) - Credits: 3
This course examines how action research helps educators to learn to explore pressing classroom and school issues in systematic ways. Action research provide educators with opportunities to deepen their knowledge and skills as reflective
practitioners, allowing them to contribute to the achievement of students and the improvement of schools.

EDUC.5414 Teaching English Learners-Elementary - Credits: 3

This course will prepare elementary teacher candidates with the knowledge and skills to effectively shelter content instruction to ensure that the growing population of Massachusetts' English Language Learners (ELLs) can access the curricula, "achieve academic success and contribute their multilingual and multicultural resources as participants and future leaders in the 21st century global economy" (MA DESE, 2013). Successful completion of this course provides SEI (Sheltered English Immersion) endorsement, which is required for teaching in the Commonwealth of Massachusetts.

EDUC.5420 Methods of Early Childhood Education II: Social Studies, Arts, Health and Phys Ed. (Formerly 02.542) - Credits: 3

Students learn basic principles and concepts of history, geography, government, economics, the arts, health and physical education appropriate to the prekindergarten to second grades. Students learn to use project approaches appropriate for teaching young children.

EDUC.5430 Classroom Management and Integrative Techniques (Formerly 02.543) - Credits: 3

This course prepares participants to create and maintain a safe and collaborative learning environment through the development of effective rituals, routines, and appropriate responses in the classroom. With attention to the development of Positive Behavioral Supports, participants will examine and apply basic behavioral theories, evidence-based principles, and relevant policies. Based in the Three Tiered Philosophy, the course learning progresses for Universal Design concepts to more prescriptive individualized interventions and incorporates the practices of personal reflection, professional collaboration and effective communication.

EDUC.5490 Theory and Research: Reading and Language (Formerly 06.549) - Credits: 3

A final course on the national and international research in reading and language and the pertinence and proposed implementation of research findings to instruction and the various roles of the reading supervisor or director.

EDUC.5500 Reading Specialist: Practicum I (Formerly 06.550) - Credits: 3

The Reading Specialist Practicum requires students to use the knowledge gained in their coursework to design, implement, and analyze a program for struggling readers in a clinical experience. The practicum meets both Massachusetts and IRA standards for Reading Specialist/Literacy Coach.

EDUC.5510 Elementary Math Methods (Formerly 02.551) - Credits: 3

New approaches in the curriculum and teaching of mathematics in the elementary school; analysis and use of current materials, national and state standards, multimedia approaches, and inductive and problem-solving techniques.

EDUC.5511 Literacy Coach: Practicum II (Formerly 06.551) - Credits: 3

This is the second of two clinical practicum experiences in the Reading and Language program. Candidates will design a professional development project in their school setting which will allow them to model lessons, observe and co-teach with peers, and provide feedback to teachers and paraprofessionals. The online seminar provides support for implementing the program. The practicum meets the guidelines for the International Reading Association.

EDUC.5530 Language Arts and Childrens Literature (Formerly 02.553) - Credits: 3

Approaches in the teaching and assessment of the language arts in the elementary school will be analyzed. Assorted genres of literature and the development of literature programs for children in multicultural environments will be studied.

EDUC.5531 Lowell and Industrial Revolution (Formerly 04.553) - Credits: 3

Participants in this National Endowment for the Humanities-sponsored Landmarks Workshop, offered through the Tsongas Industrial History Center, examine the causes and consequences of America’s Industrial Revolution, using Lowell as a case study. The course covers the nineteenth-century shift from an agrarian to an industrial society, with a focus on water-powered factory systems, textile production and corporations, the issue of slavery in a cotton textile city, labor and women’s history, environmental impacts, immigration, globalization, and literary responses. Limited to NEH participants only.

EDUC.5540 Creation of a Nation (Formerly 04.554) - Credits: 3

This course will focus on the meeting of three worlds: Africa, Europe and the Americas and will explore the cultural and
ecological interactions.

EDUC.5560 Reading and Reading Disabilities  
(Formerly 02.556) - Credits: 3
A critical analysis of fundamental issues and principles in the teaching of reading, including all phases of the elementary reading program. Analysis and remediation of reading disabilities which explores the use of critical diagnostic tools.

EDUC.5580 Becoming A Nation (Formerly 04.558) - Credits: 3
This course looks at the westward expansion of the United States from the signing of the Constitution to the pre-Civil War period.

EDUC.5592 Teaching Founding Documents (Formerly 04.559) - Credits: 3
This course examines the founding documents and how these documents are relevant in the lives of middle school children.

EDUC.5620 Elementary Social Studies (Formerly 02.562) - Credits: 3
Examines teaching strategies and materials appropriate for the teaching of K-8 social studies. Examines national and state standards for the discipline.

EDUC.5630 Elementary Science Methods (Formerly 02.563) - Credits: 3
Models the teaching of science as guided discovery while exploring developmentally appropriate concepts in science. Examines national and state standards as well as nationally developed curriculum kit-based materials.

EDUC.5680 Internship in Moderate Disabilities 5-12  
(Formerly 02.568) - Credits: 3
Practicum in a special education setting under the supervision of qualified teachers, principal, and university faculty.

EDUC.5720 Curriculum and Teaching: English  
(Formerly 02.572) - Credits: 3
The purpose of this course is to prepare teacher candidates for the content-specific dimensions of their practicum. The course is designed to develop pedagogical skills, curriculum writing and also to encourage prospective English teachers to examine their own beliefs, expectations, and dispositions about the nature of the discipline, the practice of teaching, the process of learning, and the nature of the learners.

EDUC.5730 Curriculum and Teaching History  
(Formerly 02.573) - Credits: 3
Students analyze the content, methods, materials, and management techniques used in teaching History. Examination of national and state standards for the discipline. The course will include micro-teaching and self-evaluation, as well as school-based observation and participation in schools.

EDUC.5750 Curriculum and Teaching Math (Formerly 02.575) - Credits: 3
Students analyze the content, methods, materials, and management techniques used in teaching mathematics, and examine national and state standards for the discipline. The course will include micro-teaching, self-evaluation, school-based observation, and participation in schools.

EDUC.5760 Curriculum and Teaching Science  
(Formerly 02.576) - Credits: 3
Students analyze the content, methods, materials, and management techniques used in teaching science. Examination of national and state standards for the discipline. The course will include micro-teaching and self-evaluation, as well as school-based observation and participation in schools.

EDUC.5761 Promoting Healthy Lifestyles Among Students (Formerly 04.576) - Credits: 3
The focus of this course is on applying nutrition concepts relevant to elementary and middle school children and how these concepts can be integrated into the classroom at an age appropriate level. This course will address a broad range of issues including eating habits, disordered eating, sports nutrition, food allergies and school wellness policies.

EDUC.5780 Teaching Elementary Education and Seminar (Formerly 02.578) - Credits: 6
This full time practicum in the elementary school covers 12 weeks under the supervision of qualified teachers, principals, and faculty of the Graduate School of Education. Weekly seminar and portfolio development address the Massachusetts professional teaching standards. Matriculated students only. All coursework must be completed with a minimum 3.25 GPA. Before beginning the practicum.

EDUC.5790 Internship in Moderate Disabilities PreK - 8 (Formerly 02.579) - Credits: 3
Practicum in a special education setting under the supervision of qualified teachers, principal, and university faculty.

EDUC.5830 Teaching English and Seminar (Formerly 02.583) - Credits: 9

Full time practicum in the elementary, middle or secondary schools under the supervision of qualified classroom teachers and faculty of the Graduate School of Education. Weekly seminar and performance assessment addressing the Massachusetts Professional Standards for Teachers.

EDUC.5840 Teaching History and Seminar (Formerly 02.584) - Credits: 9

Full time practicum in the elementary, middle or secondary schools under the supervision of qualified classroom teachers and faculty of the Graduate School of Education. Weekly seminar and performance assessment addressing the Massachusetts Professional Standards for Teachers.

EDUC.5890 Teaching Mathematics and Seminar (Formerly 02.589) - Credits: 9

Full time practicum in the elementary, middle or secondary schools under the supervision of qualified classroom teachers and faculty of the Graduate School of Education. Weekly seminar and performance assessment addressing the Massachusetts Professional Standards for Teachers.

EDUC.5900 Teaching Biology and Seminar (Formerly 02.590) - Credits: 9

Full time practicum in the elementary, middle or secondary schools under the supervision of qualified classroom teachers and faculty of the Graduate School of Education. Weekly seminar and performance assessment addressing the Massachusetts Professional Standards for Teachers.

EDUC.5910 Teaching Chemistry and Seminar (Formerly 02.591) - Credits: 9

Full time practicum in the elementary, middle or secondary schools under the supervision of qualified classroom teachers and faculty of the Graduate School of Education. Weekly seminar and performance assessment addressing the Massachusetts Professional Standards for Teachers.

EDUC.5920 Teaching Earth Science and Seminar (Formerly 02.592) - Credits: 9

Full time practicum in the elementary, middle or secondary schools under the supervision of qualified classroom teachers and faculty of the Graduate School of Education. Weekly seminar and performance assessment addressing the Massachusetts Professional Standards for Teachers.

EDUC.5922 Principalship: Practicum I (Formerly 05.592) - Credits: 1-3

The first of two practicum experiences in which students assume a broad range of the responsibilities of a principal in order to demonstrate proficiency in meeting the Massachusetts Professional Standards and Indicators for Administrative Leadership. To enroll in the course, students must be employed in a Massachusetts Public School and have identified an administrator (principal or assistant principal) in the school who holds the appropriate Massachusetts Principal License and is willing to act as a mentor. Students must participate in the online course which accompanies the practicum, complete a practicum log, and meet periodically with the program supervisor to discuss their progress.

EDUC.5930 Teaching Physics and Seminar (Formerly 02.593) - Credits: 9

Full time practicum in the elementary, middle or secondary schools under the supervision of qualified classroom teachers and faculty of the Graduate School of Education. Weekly seminar and performance assessment addressing the Massachusetts Professional Standards for Teachers.

EDUC.5932 Principalship: Practicum II (Formerly 05.593) - Credits: 2-3

In order to enroll in Practicum 2, the student must have made satisfactory progress toward meeting the Massachusetts Professional Standards and indicators for Administrative Leadership in Practicum 1 and have logged sufficient hours as established by the program supervisor. In addition to the work required in the accompanying online course, students must complete the responsibilities identified with the mentor and program supervisor. The student’s work in Practicum 1 and 2 must meet the total of 500 hours of leadership activities required by the Massachusetts Department of Elementary and Secondary Education.

EDUC.5940 Teaching General Science and Seminar (Formerly 02.594) - Credits: 9

Full time practicum in the elementary, middle or secondary schools under the supervision of qualified classroom teachers and faculty of the Graduate School of Education. Weekly seminar and performance assessment addressing the Massachusetts Professional Standards for Teachers.

EDUC.5942 Practicum I, Middle School Principal 5-8
EDUC.5950 Practicum II, Middle School Principal (5-8) (Formerly 05.595) - Credits: 2
The practicum is a two-semester (1+2=3 credits) field-based experience in which the student engages in administrative responsibilities at the level of a school principal. These responsibilities are supervised by an on-site supervisor/mentor who holds certification in the appropriate area. A minimum of 300 hours must be completed during the course of the year. The responsibilities must be real and varied enough to allow the student to actively apply their knowledge and skills, thus demonstrating competence in the ‘Standards for Advanced Programs in Educational Administration’ of the ELCC (Educational Leadership Constituent Council).’ In addition to the field-based activities, candidates participate regularly in an on-line seminar with the university supervisor/instructor and meet for 3-4 face-to-face seminar sessions at the university. Students develop a practicum action plan, document their activities in a journal, participate in regular on-line discussions, complete several reflection assignments, and compile a final Practicum Portfolio. The basis of all work in the online seminar relates directly to the issues, experiences, and questions from the candidate’s field-based activities. The Practicum aims to help all students achieve a fuller realization of their professional and personal resources as leaders and learners and strengthen their effectiveness as educational administrators now and into the future.

EDUC.5970 Practicum II, High School Principal (9-12) (Formerly 05.597) - Credits: 2
The practicum is a two-semester (1+2=3 credits) field-based experience in which the student engages in administrative responsibilities at the level of a school principal. These responsibilities are supervised by an on-site supervisor/mentor who holds certification in the appropriate area. A minimum of 300 hours must be completed during the course of the year. The responsibilities must be real and varied enough to allow the student to actively apply their knowledge and skills, thus demonstrating competence in the ‘Standards for Advanced Programs in Educational Administration’ of the ELCC (Educational Leadership Constituent Council).’ In addition to the field-based activities, candidates participate regularly in an on-line seminar with the university supervisor/instructor and meet for 3-4 face-to-face seminar sessions at the university. Students develop a practicum action plan, document their activities in a journal, participate in regular on-line discussions, complete several reflection assignments, and compile a final Practicum Portfolio. The basis of all work in the online seminar relates directly to the issues, experiences, and questions from the candidate’s field-based activities. The Practicum aims to help all students achieve a fuller realization of their professional and personal resources as leaders and learners and strengthen their effectiveness as educational administrators now and into the future.
EDUC.6001 Introduction to Second Language Acquisition (Formerly 02.600) - Credits: 3

This course is designed to facilitate students' understanding of how people learn, or acquire, a second (or third, fourth etc.) language. This understanding then facilitates and benefits language teaching and assessment. In this course, we will examine current second language acquisition (SLA) research; we will study some of the current language teaching approaches and techniques and discuss how to apply them in specific situations. Students will become familiar with SLA terminology, research and data and will be able to connect SLA research with teaching and assessment (i.e. connecting theory with prax), other crucial and relevant topics, such as universal features of SLA (age, critical periods, environmental triggers, cross-linguistic influences), individual factors (aptitude, motivation), social factors (class, gender, social, cultural contexts), etc. will be covered. As part of the learning process in the class, students will be asked to develop their own theory of SLA and SL teaching or to analyze in detail the theory (or theories) they most identify with. Discussions and active participation are crucial in the course.

EDUC.6003 Leadership in Schooling: Residency - Credits: 0

The residency is a required on-campus component of the Ed.D. in Leadership in Schooling. Held during the summer, students spend several full days working with their student cohort and selected faculty on program outcomes. Students establish study groups, conduct preliminary work for the portfolio (for comprehensive exam I) and qualifying paper (for comprehensive exam II), and participate in daily seminars. There is a fee associated with the residency.

EDUC.6010 Leadership, Law & Policy in Higher Education (Formerly 08.601) - Credits: 3

This course examines theory, research and practice that inform us about the problem of scholarship, teaching, change and innovation in higher education. Students study academic life in the larger context of the institutional structure.

EDUC.6011 Seminar: Portfolio Development and Defense (Formerly 05.601) - Credits: 1

The Portfolio Development and Defense seminar provides each doctoral student with a guided experience to develop a portfolio, which demonstrates the ways in which she or he has met established program outcomes for the first phase of the Leadership in Schooling doctoral degree. The one-credit option is for the student who anticipates submitting required materials and defending her or his portfolio over two or more semesters.

EDUC.6012 Introduction to Linguistics (Formerly 02.601) - Credits: 3

All language teachers benefit from understanding of how language in general works. This course is designed to help students to understand and use in their language teaching the basic concepts, methods and approaches of linguistics. The following topics are covered in the course: phonetics (sounds/sound inventory of a language), phonology (how we understand and organize the sounds and patterns), morphology (word structure, morphemes; how smaller units of meaning make up words), syntax (sentence structure, how words make up sentences), semantics (how we understand and parse sentences, structural ambiguity, context within sentences), pragmatics (how context impacts meaning on a textual level), social aspects of language (dialects, sociolinguistics, language change, etc.). Although most of the examples will involve English, for comparative and contrastive purposes other languages will be used (no need to understand them). Students will be encouraged to come up with as many of their own examples as possible.

EDUC.6020 Seminar: Portfolio Development and Defense (Formerly 05.602) - Credits: 2

The Portfolio Development and Defense seminar provides each doctoral student with a guided experience to develop a portfolio, which demonstrates the ways in which she or he has met established program outcomes for the first phase of the Leadership in Schooling doctoral degree. The two-credit accelerated option is for the student who will submit all required materials and defend her or his portfolio in one semester.

EDUC.6030 Seminar: Portfolio Development and Defense (Formerly 05.603) - Credits: 3

The Portfolio Development and Defense seminar provides each
doctoral student with a guided experience to develop a portfolio, which demonstrates the ways in which she or he has met established program outcomes for the first phase of the Leadership in Schooling doctoral degree.

EDUC.6031 Curricular Practical Training (Formerly 04.603) - Credits: 1

CPT provides students with the opportunity to apply their learning from coursework in an educational setting. Candidates are required to submit a culminating assignment before the end of the academic semester.

EDUC.6040 Leadership of Community Engagement I (Formerly 05.604) - Credits: 2

The purpose of Leadership of Community Engagement I is to expose teacher leaders to the variety of issues associated with family and community engagement. Through critical examinations of theory, personal experiences and collective knowledge, teacher leaders will learn how to engage families and community members (i.e., business, health and service agencies and community-based organizations) and recognize the different forms of engagement. This course will highlight collaborative strategies that "shares power" with parents, families, and community organizations in schools.

EDUC.6050 Leadership of Community Engagement II (Formerly 05.605) - Credits: 1

The purpose of Leadership of Community Engagement II is to continue the conversation and exploration of family and community engagement with teacher leaders from 05.604. The second course focus is on the implementation and analysis of the Research Action Plan drafted in the first semester. Teacher leaders will explore the challenges, barriers, successes and unintended consequences of their family and community engagement action plan. This course will highlight collaborative strategies of "critical friend groups" and participatory action research. Teacher leaders will lead group discussions and share ideas and strategies to help them address their family and community engagement issues.

EDUC.6060 Leadership and Learning I (Formerly 05.606) - Credits: 1

"Leadership and Learning: Course One" is the first in a sequence of three one credit courses that provide strategies, practical training, and the intellectual foundation necessary for teachers to cultivate and lead school-based professional learning communities. For Course One, students participate in a three day summer institute (9 AM to 3 PM) and develop an action plan for the coming school year in which they will lead the development of a professional learning community.

EDUC.6070 The Adult Learner (Formerly 01.607) - Credits: 3

This course will focus on the learning and development of adolescent young adults, adults and older adults in both school-based and non-school based settings. Cognitive, emotional, social and professional learning will be addressed as well as differing and changing learning styles across the lifespan and different learning settings.

EDUC.6071 Advanced Academic Writing I (Formerly 02.607) - Credits: 3

This course will enable graduate level English language learners to become competent academic writers who can critically and creatively evaluate, analyze, construct and present their ideas and arguments. This is a student oriented, pro-active course where writing skills are connected to reading skills. Through attentive, detailed and critical reading of various materials students will further enhance their writing skills by applying effective planning, drafting, rewriting and editing strategies.

EDUC.6073 Leadership and Learning II (Formerly 05.607) - Credits: 1

"Leadership and Learning: Course Two” is the second in a sequence of three one credit courses that provide strategies, practical training, and the intellectual foundation necessary for teachers to cultivate and lead school-based professional learning communities. For course two, students participate in three online learning modules and two face-to-face seminars during the fall semester. Students receive coaching and instruction as they pursue action plans developed in Course One and write a reflective journal. Students also read literature comprising the intellectual foundation for the professional learning community and write two critical essays.

EDUC.6074 Methods of Sheltered Language Instruction (Formerly 06.607) - Credits: 3

Different approaches and teaching procedures in Second Language instruction will be discussed as well as the methodological models of English as a Second Language instruction.

EDUC.6075 Academic Writing for English Second Language Users - Credits: 0

This course engages students in forms of academic writing, particularly relevant to scientific areas of study, from proposal and responses to research articles. Topics include (but not
EDUC.6080 Student Development Theory (Formerly 01.608) - Credits: 3

The Student Development Theory course will provide students with a theoretical background in the developmental processes of college students. The course will cover pertinent models of student development pertaining to cognitive, moral, psycho/social, environmental, and identity development. Students will gain an understanding of each theory, and understand their practical application.

EDUC.6081 Leadership and Learning III (Formerly 05.608) - Credits: 1

"Leadership and Learning: Course Three" is the third in a sequence of three on credit courses that provide strategies, practical training, and the intellectual foundation necessary for teachers to cultivate and lead school-based professional learning communities. For Course three, students participate in three online learning modules and two face-to-face seminars during the spring semester. Students receive coaching and instruction as they pursue action plans developed in Course One and write a reflective journal. Students also read literature comprising the intellectual foundation for the professional learning community and write two critical essays.

EDUC.6090 Seminar I: Professional Accomplishments (Formerly 05.609) - Credits: 1

Candidates are asked to document a limited number of verifiable accomplishments outside the classroom from both the professional and local communities. Candidates must explain how each accomplishment impacts student learning. Accomplishments are limited to the last five years. Later in the program, more recent accomplishments may be added to the entry. The portfolio entry is 20 pages in length.

EDUC.6100 Teaching Reading in Content Area (Formerly 06.610) - Credits: 3

This course presents the theoretical foundation and current best practices for content area reading, writing, and study skills. The focus is on motivation, cognition, memory, and verbal processing theories as they apply to methodology. Students learn to develop lessons and units that integrate reading and writing while covering concepts in the content areas.

EDUC.6101 Theories of Learning (Formerly 01.610) - Credits: 3

This course offers a detailed analysis of the major contemporary learning theories, both behavioral and cognitive.

EDUC.6103 Seminar II: Active Learning (Formerly 05.610) - Credits: 2

In this seminar, candidates must analyze an inquiry approach to education and its relation to their current practices. They must examine the connections between inquiry, teaching, learning, and the standards of accomplished teaching. The portfolio entry requires a video in which candidates are asked to document a class meeting where students are learning through inquiry based instruction. Documentation takes the form of a 20 minute video edited into three sections. Section one shows how the lesson is introduced. Section two records students engaged in inquiry learning. Finally, section three records the lesson’s closure. The analysis focuses on the available evidence from the video; specifically, how the candidate’s actions (or inaction’s) resulted in student learning. The portfolio entry is limited to 12 pages.

EDUC.6110 Introduction to Higher Education Administration (Formerly 05.611) - Credits: 3

EDUC.6120 Topics in Language Arts and Literacy (Formerly 06.612) - Credits: 3

This is an elective course in the doctoral program that covers a range of topics in language arts and literacy.

EDUC.6125 Global Perspectives on Higher Education - Credits: 3

This course explores why higher education today is in the midst of a global revolution. We will examine trends in our current age of globalization and how these trends have impacted the college campus. We will also ask hard questions about why students, faculty, universities, and entire nations seek international exchanges, what they get out of all this movement, and how it relates to the expanding significance of global citizenship. Our goal is to move beyond the "food, flags, and festivals" view of global learning and toward meaningful research agendas about the role of higher education in an age of global opportunities and global challenges.

EDUC.6130 Leading the Professional Learning Community (Formerly 05.613) - Credits: 3

It is well documented that teachers who habitually examine their shared work based on inquiry, observation, analysis of data, dialogue, and experimentation tend to be more effective...
than those who are not reflective and work in isolation. How do we help all teachers become highly effective: How do we spread reflective practice from isolated pockets to all teachers in a school? The answer lies in the transformation of a school’s professional staff from isolated practitioners into a professional learning community. A professional learning community is a work culture in which educators regularly learn with and from each other through collaborative inquiry. This course provides the practical know-how and deep understanding need for educators to introduce and lead collaborative inquiry within their school or district and transform the teaching staff into a professional learning community. Furthermore, this course introduces the idea of collaborative inquiry by transforming participants into a professional learning community during the course. Thus, participants focus collaborative inquiry on their shared practice, read and reflect on selected authors, and develop action plans to help them introduce or advance collaborative inquiry in their own work settings.

EDUC.6150 Seminar II: Teaching Cycle (Formerly 05.615) - Credits: 1

This seminar focuses on the teaching cycle (planning, implementing, assessing) in conjunction with the standards of accomplished teaching in specific content areas. The portfolio entry emanates from the day to day work of each teacher and requires teachers to document the decisions and choices which directly impact the student learning experience. The entry includes lessons plans associated with specified learning objectives, detailed assignments, examples of student work form two of those assignments representing high and low achieving groups, and an analytical reflection of how the teachers work fostered (or did not foster) student understanding. The portfolio entry is 12 pages in length.

EDUC.6170 Seminar IV: Whole Class Discussion (Formerly 05.617) - Credits: 2

Candidates develop the knowledge, skills, and dispositions necessary to foster student engagement. They will examine formal and informal assessment techniques associated with whole class discussions and analyze the importance of an equitable learning environment in fostering student participation. Candidates are required to submit a second, 20 minute unedited video of a whole class discussion. They closely analyze the video and interpret the student exchanges and teacher actions according to the standards of accomplished teaching. The portfolio entry is limited to 12 pages in length.

EDUC.6220 Managing Resources and Finances (Formerly 05.622) - Credits: 3

This course will provide students with an understanding of the financial principles and budget management in the operation of our public schools. We will analyze economic and demographic data, review local/state and federal education budgets, examine the legal principles of school finance, review local, state and federal laws and policies on public education and evaluate case studies in the operation of public schools. Students will prepare budget documents, develop financial forecasts and prepare policy briefs on various topics related to school finance.

EDUC.6221 Science, Mathematics and the Educated Mind (Formerly 04.622) - Credits: 3

Examination of interaction of Science and Mathematics in the growth of knowledge, and current considerations of literacy.

EDUC.6225 Education Reform in Science, Technology, Engineering, & Mathematics - Credits: 3

This blended course explores the ongoing efforts to improve the equity and quality of Science, Technology, Engineering, and Mathematics (STEM) education. By examining a series of STEM education reform efforts form the local, state, and national levels, students will gain a practical and theoretical understanding of both the historical role policy plays in education and its chronic shortcomings. Students will investigate an example of a local example of STEM reform and report on it to the class from a reform perspective. Finally, the educator’s role in implementing effective reform is considered.

EDUC.6226 Leadership and Research in STEM Education - Credits: 3

Educators in this course will explore and analyze current research in STEM education, investigate how student performance data informs school and district program decision making, learn how to lead and empower teachers in the mapping of STEM curriculum across grade levels, and develop strategies to develop effective district-wide STEM professional development for K-12 educators.

EDUC.6227 Foundations of Student Learning in STEM fields - Credits: 3

This course examines key crosscutting issues that enable STEM teachers to understand how knowledge is obtained and verified. During the course you will explore the theoretical foundations and research that would help you to better understand the nature of cognitive processes, the development of STEM reasoning abilities, and applications for teaching.

EDUC.6230 School Policy and Law (Formerly 05.623) - Credits: 3

This course will provide students with an understanding of the law and legal basis for making decisions in our public schools.
We will analyze court decisions, state and federal constitutional provisions and laws and public policies and regulations as they pertain to the operation of the public schools in the United States. With a solid understanding of the legal framework of governance at the federal, state and local level and the decisions derived though court cases, educators will be better equipped to respond to the numerous challenges and decisions they face throughout the school year.

EDUC.6231 Policy & Practice in Sci., Tech., Eng., & Mathematics Education (Formerly 04.623) - Credits: 3
This course explores the dynamic relationship between educational policy and classroom teaching. By comparing the similarities and differences for this relationship within each of these fields, students will gain a practical and theoretical understanding of both the historical role policy plays in education and its chronic shortcomings. Finally, the educator’s role in implementing effective change in these fields is considered.

EDUC.6240 Assessment of Learning (Formerly 04.624) - Credits: 3
Students examines various approaches to the formative and summative assessment of learning. This course examines the importance of assessment in planning curricula and individual lessons.

EDUC.6250 Organization of Schools and School Systems (Formerly 01.625) - Credits: 3
This course is designed to help students understand the organizational dynamics of schools. The knowledge gained should assist students in identifying and suggesting alternatives to programmatic and behavioral regularities found in a school or human service organization.

EDUC.6251 Teaching of Writing (Formerly 06.625) - Credits: 3
The Teaching of Writing examines theories and research in writing instruction at all levels. The course focuses, particularly, on teaching/learning strategies and activities that improve students’ writing.

EDUC.6260 Developments of concepts in Science (Formerly 04.626) - Credits: 3
Students explore the historical development of selected science concepts and the emergence of the philosophy of science. Progress in science is examined together with views of the nature of science.

EDUC.6270 Second Language Acquisition and Assessment (Formerly 06.627) - Credits: 3
A Study of the general schools of thought that have formed the basis of teaching English as a Second Language. This course is designed to assist students in conceptualizing the foundations of second language acquisition. The course will also inform students about appropriate procedures for assessing the skill development of second language learners.

EDUC.6271 Development of Mathematics Concepts (Formerly 04.627) - Credits: 3
Participants will analyze the nature of mathematics content knowledge and the nature of mathematics process knowledge, as well as the nature and process of knowledge acquisition. A conceptual framework will emerge from the synthesis of existing information.

EDUC.6280 Reasoning and Problem Solving in Science (Formerly 04.628) - Credits: 0
An analysis of the development of procedural knowledge, with particular emphasis on reasoning and problem solving, as they are currently conceptualized in educational and psychological literature.

EDUC.6300 Educating Diverse Populations (Formerly 01.630) - Credits: 3
As the world becomes increasingly diverse, educators must be prepared to examine, confront, and manage the factors that affect the education of all children. This course addresses several central issues focusing on how teachers address the problems that confront students who differ from the majority population in language, ethnicity, culture, gender, and sexual orientation. Ensuring that their families and communities are actively involved in the educational process is also an important component of the course.

EDUC.6301 Reasoning and Problem Solving (Formerly 04.630) - Credits: 3
The course is designed to direct and encourage critical examination of the theory of problem solving. Students analyze current research literature relating to reasoning, problem solving and critical thinking. Synthesis of this literature serves as a foundation for examining curriculum decisions.

EDUC.6302 Leadership and Educational Policy (Formerly 05.630) - Credits: 3
The course provides students in the Ph.D. in Leadership in Education the opportunity for in-depth consideration of fundamental questions, seminal research, and theoretical perspectives related to education policy at all levels. Students who successfully complete this course will be able to explain major theoretical perspectives related to educational policy; discuss seminal research relevant to education policy; discuss contemporary education policy trends at state, federal and international levels; critique education policy proposals from a distinct theoretical perspective; and formulate and defend policy recommendations, within a distinct political/economic/cultural context.

EDUC.6320 The Inclusive School (Formerly 01.632) - Credits: 3

School leaders must create environments that are welcoming to all students and their families and that capitalize on the strengths students bring to the learning environment as well as address the needs of students. As the population of students in our schools has continued to become more diverse, building an inclusive environment in which all are valued and in which all student can succeed has become increasingly complex. Participants in this course will explore their values and beliefs as well as the dominant culture and prevailing belief systems present in the majority of today’s public schools. Participants will learn about ways in which many students, their families, and their communities may differ from this dominant culture, and the possible effects of this mismatch. Through readings and interactive discussions, participants will examine ways to build a school culture that is inclusive for all students and their families. Participants will develop detailed plans of action to actively and meaningfully involve parents and community members in all aspects of the school.

EDUC.6350 Dynamics of Curricular Change (Formerly 04.635) - Credits: 3

This course considers alternative perspectives of curriculum and explores issues and strategies involved in the process of changing the curricular visions and practices of schools.

EDUC.6360 Sociocultural Contexts of Educational Communities (Formerly 01.636) - Credits: 3

Examines the social, cultural and political forces that shape the educational environment and provide context for teaching and learning. The existing and desired relationships among schools, families, and communities will be discussed.

EDUC.6370 History & Theory of Curriculum (Formerly 04.637) - Credits: 3

This course examines the historical development of American curriculum from the colonial period to the present, with a focus on theories that shaped what was taught in schools, and how those theories reflected social, cultural and political values and conflicts. Particular attention will be paid to curriculum theories that have shaped contemporary curriculum, and to examination of programs that reflect those theories.

EDUC.6380 Curriculum Design K-12 (Formerly 04.638) - Credits: 3

A review of state mandates which, by law, shape the curriculum of the school. Examination of "new" curricula and their sources, as well as the development of a rationale for curriculum design and an evaluation of the personnel and techniques by which these curricula can be developed.

EDUC.6381 Planning, Technology and School Improvement (Formerly 05.638) - Credits: 3

This course helps educators develop a broad grasp of the educational possibilities and concerns the Internet raises, for K-12 educators as well as those in higher education. Through the course, students develop in-depth knowledge of Internet resources and problems related to a specific issue of professional interest.

EDUC.6410 Issues in Staff Development (Formerly 05.641) - Credits: 3

Includes understanding of how to work with adult learners who are peers, as well as techniques for assessing staff needs, design of programs to improve staff performance and strategies to ensure productive in-service education.

EDUC.6421 Principles of Supervision (Formerly 05.642) - Credits: 3

This course is designed to help current and aspiring supervisors explore the skills, knowledge and personal attributes central to instructional leadership and supervision. A paradigm shift away from an historical/traditional view of supervision towards a more collegial model is emphasized. Students will complete field work including two observations of a colleague and pre and post-lesson conferences.

EDUC.6423 Program Evaluation (Formerly 07.642) - Credits: 3

Evaluation tasks will be identified and the policy issues attendant to evaluation will be examined. Students will identify and discuss several models of program evaluation, understand what needs to be considered and addressed in needs assessment, learn to identify an appropriate design for a new evaluation. Students will be expected to conduct program
EDUC.6430 The Skillful Teacher (Formerly 04.643) - Credits: 3
This course is designed to help teachers and educational leaders view teaching from a reflective stance. Video material of teaching situations will be examined for the application of skills discussed in the course.

EDUC.6431 Principalship PK - 12 (Formerly 05.643) - Credits: 3
This course is designed to help aspiring principals explore the skills, knowledge and personal attributes central to effective leadership. The course aims to acquaint students with research, theories, and frameworks from the knowledge base on school leadership; explore the issues, daily experiences, and decisions of the principal within the action context of the school; assist students to think critically and systematically about leadership; help students become more conscious of their own values, assumptions and purposes as school leaders; further develop leadership skills, insight, and vision for schooling; assist students to think of themselves as educators for transformation.

EDUC.6440 Foundations for Practitioner Scholars (Formerly 01.644) - Credits: 3
This course will introduce students to seminal and recent work in the fields of philosophy, history, and psychology as they relate to education. Students will critically examine research and scholarly theory in these fields and their relationship to PK-12 Practice.

EDUC.6441 Models of Teaching (Formerly 04.644) - Credits: 3
This course will investigate researched-based instructional models that have been proven to facilitate learning in any academic content area. Each model addresses academic content as well as attainment of instructional goals and objectives. All models support the 21st learner by focusing on the needed skills for school, life, and work. This course will benefit teachers who teach at any grade level.

EDUC.6450 Perspectives and Visions of Schooling I (Formerly 01.645) - Credits: 3
Open to matriculated doctoral candidates only. This foundational course provides new doctoral students with an understanding of differing perspectives on the purpose of public education in the United States during the last 150 years. The philosophical and political perspectives which influenced educational reform during this period will be examined. The course will culminate in reading and discussion of contemporary visions for schooling. This course must be taken before 01.646.

EDUC.6451 Directed Study Curriculum and Instruction (Formerly 04.645) - Credits: 3
EDUC.6460 Perspectives and Visions of Schooling II (Formerly 01.646) - Credits: 3
This course examines how psychology and education have been intertwined throughout the history of American education. Various psychological perspectives for educational practice will be considered. The role of research in education, including the use of psychological research methods will be considered as you begin preparing to conduct educational research. Visions of educational psychologists for utilizing psychological research findings in creating future educational practice and policies will also be explored.

EDUC.6490 Directed Study: Administration (Formerly 05.649) - Credits: 3
Through frequent consultation with the instructor, the student will investigate and define a problem for research and will present the findings in a significant paper. The directed study may not be substituted for a required course.

EDUC.6500 Capstone TESOL (Formerly 02.650) - Credits: 3
The capstone project requires participants to apply the theories and strategies they have learned throughout the TESOL program to analyze a case study. Participants will be presented with a case study and will apply principles of learning, linguistics, second language acquisition, and methods of ESL (or sheltered) instruction to analyze the case and provide a comprehensive instructional play to address the needs of the case student. The final project for the capstone is a comprehensive paper of approximately 25 pages. Participants will be graded on the content of the project as well as the quality of writing.

EDUC.6501 Capstone Project: Advanced Programs (Formerly 04.650) - Credits: 3
Students will have the opportunity to develop a teacher work sample consisting of work in six major areas: (1) contextual factors, (2) learning goals, (3) assessment plan, (4) design for instruction, (5) analysis of student learning, and (6) reflection.
Reform (Formerly 05.650) - Credits: 3
Addresses the way in which an instructional leader initiates changes in organizations—whether curricular or in the systems which make organizations function.

EDUC.6510 Web-based Tech. in the Learning Environment: Teaching and Learning (Formerly 03.651) - Credits: 3
Students will research, discuss and examine web-based educational technologies and the pedagogical practices associated them. We will also interrogate the way that these technologies and their requisite literacies have changed, are changing and will change the nature of institutional instruction. In addition, we will investigate the policy implications that arise from the existence of these technologies. This course is taught online. It is suitable for students at the Masters, Ed.S or Doctoral level.

EDUC.6511 Transformative Leadership in Education (Formerly 05.651) - Credits: 3
This course considers ways in which school leaders can facilitate transformative change in all aspects of education. Focusing on theory, research, and pragmatic strategies, the course examines approaches to educational design and redesign for educational institutions undergoing significant change.

EDUC.6520 Managing Change and Conflict (Formerly 05.652) - Credits: 3
Examines theories in the changing process, strategies for effective adoption and implementation of innovations and conflict resolution.

EDUC.6530 Capstone Alternative (Formerly 04.653) - Credits: 3
This Capstone Alternative is the culminating course for students who are not in regular PK-12 classroom settings, particularly those who are in the Autism Studies program. Candidates in this course will apply information that they have learned during their coursework to an action research project in a classroom or small group setting. In addition, candidates will develop a professional portfolio with products developed during coursework.

EDUC.6540 Student Development & Leadership in Higher Education (Formerly 08.654) - Credits: 3
This course will examine the role of higher education in student development theory and practice, this course will engage participants in reflective and critical exploration of leadership theories, frameworks, concepts and skills that focus on social justice and purposeful change. The course is designed to provide foundational grounding in the study of leadership theory and research, with a focus on the leadership paradigms emphasizing transformation, collaboration and empowering group members in an effort to improve the world in which we live. During this course you will read current ideas about student development and the nature of leadership, you will engage in class activities and assignments which challenge you to think critically with multiple perspectives and frameworks and you will undertake a self-examination about who you are and what you believe as someone who will facilitate student development and leadership in student affairs and within higher education.

EDUC.6550 Directed Study Curriculum and Instruction (Formerly 04.655) - Credits: 3
Through frequent consultation with the instructor, the student will investigate and define a problem for research and will present the findings in a significant paper. The directed study may not be substituted for a required course.

EDUC.6560 Ed.S Seminar (Formerly 04.656) - Credits: 3
Candidates undertake an in-depth study of issues pertinent to PK-12 education and develop a product to address these issues. Candidates must complete 24 credits prior to registering for the Ed.S Seminar.

EDUC.6570 Early Childhood Education (Formerly 04.657)

EDUC.6571 Readers Responses to Literature (Last Term 2009 Spring) (Formerly 06.657) - Credits: 3
An in-depth study of theory and research on the work in readers’ responses to literature. Attention is given to past findings and methodologies as well as to future research in this area.

EDUC.6580 Role of the Curriculum and Instructional Leader (Formerly 05.658) - Credits: 3
This course provides prospective leaders with the theoretical and empirical bases for understanding the instructional core and how to create the conditions needed for high quality teaching and learning to occur in their schools. Course participants will explore how to (i) establish a vision that promotes high standards for learning and is shared by all stakeholders; (ii) promote a positive school culture that is...
anchored in professional behavior and trusting relationships; (iii) promote effective instructional programs and the application of best practices to student learning; (iv) make decisions grounded in reliable data integrity, fairness, and ethical conduct.

EDUC.6590 Strategies for Instruction in Higher Education (Formerly 08.659) - Credits: 3

A variety of theories, methods and multi-media techniques of teaching will be explored in order to familiarize students with the many options available to facilitate learning by adults.

EDUC.6600 Ethnographic Inquiry (Formerly 07.660) - Credits: 3

This course provides the theoretical underpinnings of the nature, principles and processes of ethnographic research which focuses on the understanding of human cultures. Students will study how an ethnographic research project is developed and will conduct an aspect of a study during the semester. There will be particular emphasis on collecting and analyzing data in ethnographic research.

EDUC.6601 Diversity in Higher Education (08.660) - Credits: 3

Focuses on the preparation, admission, retention, and achievements of minorities in higher education, both past and present.

EDUC.6701 Practicum I: Higher Education Option (Formerly 08.670) - Credits: 3

The Practicum I: Higher Education is the first of two culminating requirements for those students striving to earn the M.Ed. in Education Administration: Higher Education Option. Practicum I and II require students to engage in a project that demonstrates the practical application of their knowledge and skills in real-life higher education leadership activities and responsibilities over the course of two semesters; both semesters involve significant leadership work in partnership with a supervisor/mentor in an appropriate higher education site. Selection of the focus and scope of the project will be tailored to students area of focus in the Higher Education Option and their current work responsibilities.

EDUC.6710 Practicum II: Higher Education (Formerly 08.671) - Credits: 3

Practicum II: Higher Education is the second in the series of two culminating requirements for those students striving to earn the M.Ed. in Education Administration: Higher Education Option. Similar to Practicum I (08.670), Practicum II (08.671) requires students to engage in the continuation of the project form Capstone I that demonstrates the practical application of their knowledge and skills in real-life higher education leadership activities and responsibilities over the course of the semester. Both Practicum semesters involve significant leadership work in partnership with a supervisor/mentor in an appropriate higher education site. Practicum II content will be tailored to students’ area of focus in the Higher Education Option and their current work responsibilities.

EDUC.6733 Ethics and Decision-Making in Higher Education - Credits: 3

This course will explore ethical theories and their application to higher education. The course will rely heavily on in class discussion and learning from all participants: faculty and students. A case study approach will be used in order for students to gain hands-on experience dealing with ethical issues that arise in the Higher Education setting.

EDUC.6740 Research into Learning in Science (Formerly 04.674) - Credits: 3

In this course, we shall be reading research articles and examining how the research was carried out. You will conduct an “action research” project. Those who engage in action research have a commitment to bring about change. In this case, you will be investigating something in your own classroom or school that concerns you and therefore the results of your research will help you to think about what might be done to change the situation. Through the collection and sorting of data we can gain insights into situations that were previously muddy. Teachers often have to make judgments based on experience, but this is not persuasive to outsiders. With data we can convince others that the course of action we choose is justified.

EDUC.6750 Leadership in Science Education (Formerly 04.675) - Credits: 3

There are many issues in science education that can be clarified as a result of reading current literature and engaging in discussion with other teachers. In this course, we will examine some of the most pressing issues that face us as science teachers e.g. What is science literacy? What role should inquiry play in a science curriculum? What is the role of technology in science education? Is ability grouping appropriate for learning in science? Each week we will examine a different issue and share our expertise, as we explore what it means to be a leader in science education. You will share your own science teaching expertise by developing an article to be submitted to an NSTA publication via a peer review process. Additionally, you will put your program learning into practice and will be assessed through written evidence captured in a professional portfolio.
EDUC.6751 History, Theory, & Contemporary Issues in Lang, Literacy & Culture (Formerly 06.675) - Credits: 3
The purpose of this course is to engage students in the complexities and debates regarding theoretical perspectives and research on language, literacy, and culture that have affected language and literacy learning. This course will begin with an introduction to the history of research done on concepts of language, literacy and culture. Students then look at the evolution of sociolinguistic and stenographic research language, literacy and culture as well as other modes of inquiry on language and literacies. Most of the course is spent closely examining studies for how they conceptualize the mutual construction of language, literacy, and culture, and for what they can tell us about the nature of literacy learning. In addition, students will explore the questions those studies raise such as cultural diversity, identity, learning, curriculum and instruction school-community relationships and social justice in literacy and language learning.

EDUC.6760 Exploring the Nature of Science (Formerly 06.676) - Credits: 3
If you were asked to describe the characteristics of science what would you say and would you know whether professional scientists agree with you? National professional societies such as the NSTA and the AAAS, believe that if middle and high school students understand how science has been and is practiced, they will be more likely to question their own thinking, recognize the power of scientific theories and understand that there are no absolute truths. This course will take you on an exploration of some fascinating discoveries in the history of science, engage you in debate about controversial issues in science, and involve you in raising your own scientific questions.

EDUC.6761 History, Theory, and Research in the Teaching of Writing (Formerly 06.676) - Credits: 3
This course covers the history of the teaching of composition from the ancient Greeks to the present day, the development of both theory and pedagogy, and the current research into how writers learn, which teaching methods work best, and which issues continue to be of concern. Students will learn to critique writing pedagogy, to place programs and issues into historical perspective, and to analyze and design research into the teaching of writing.

EDUC.6770 Theories of Verbal Communication (Formerly 06.677) - Credits: 3
The course will examine various theories and models of verbal communication appropriate for study in the Language Arts and Literacy. The specific theories and models will be determined each semester.

EDUC.6780 History, Research and Contemporary Issues in Reading Instruction (Formerly 06.678) - Credits: 3
Students will trace the history of reading instruction in the United States from The New England Primer in the 1600s to the present with special attention to the ways in which those milestones may have impacted reading instruction today. Each of the key philosophical orientations to reading instruction will be explored from the point of view of the research that informs that instruction. Contemporary issues in reading instruction will be examined with ties to both the research and the history. Contemporary issues will be drawn from, but not limited to, politics, curriculum design, instructional materials, and instructional design.

EDUC.6800 Leadership of Community Engagement I (Formerly 05.680) - Credits: 2
This course will examine the intricacy of community engagement. Parent and community engagement in education is widely recognized as important, yet very few teacher leaders are taught how to foster engagement more broadly and deeply in schools. Teachers will learn community-based relational approach and other theories related to parent and community engagement. Through action plans, they will create opportunities for community partnerships necessary for promoting the success of all students.

EDUC.6810 Leadership of Community Engagement II (Formerly 05.681) - Credits: 1
In this course, students will implement and evaluate their community engagement action plan from Leadership of Community Engagement I. Students will begin to unravel and document best practices seminal to community and school partnerships. Through the sharing of important resources such as social networks and community capital. Teachers will create a learning community to support each other and colleagues engaged in this important work.

EDUC.6820 Peer Leadership I (Formerly 05.682) - Credits: 1
This is the first in a sequence of three one credit courses that provide strategies, practical training, and a foundation in adult learning theory necessary for teachers to cultivate and lead school-based professional learning communities. For Course One, students participate in a three day summer institute (9am-3pm) and develop an action plan for the coming school year in which they will lead the development of a professional learning
community. Students are invited to participate in an ongoing research study of professional learning communities.

EDUC.6830 Peer Leadership II (Formerly 05.683) - Credits: 1

This is the second in a sequence of three one credit courses that provide strategies, practical training, and intellectual foundation necessary for teachers to cultivate and lead school-based professional learning communities. For Course Two, students participate in three online learning modules and two face-to-face seminars during the fall semester. Students receive coaching and instruction as they pursue the action plans developed in Course One and write a reflective journal. Students also read literature comprising the intellectual foundation for the professional learning community and write two critical essays.

EDUC.6840 Peer Leadership III (Formerly 05.684) - Credits: 1

This is the third in a sequence of three one credit courses that provide strategies, practical training and the intellectual foundation necessary for teachers to cultivate and lead school-based professional learning communities. For Course Three, students participate in three online learning modules and two face-to-face seminars during the spring semester. Students receive coaching and instruction as they pursue action plans developed in Course One and write a reflective journal. Students also read literature comprising the intellectual foundation for the professional learning community and write two critical essays.

EDUC.6850 Accomplished Teaching Seminar I; Professional Accomplishments (Formerly 05.685) - Credits: 1

Candidates are asked to document a limited number of verifiable accomplishments outside the classroom from both the professional and local communities. Candidates must explain how each accomplishment impacts student learning. Accomplishments are limited to the last five years. Later in the program, more recent accomplishments may be added to the entry. The portfolio entry is 20 pages in length.

EDUC.6860 Accomplished Teaching Seminar II; Active Learning (Formerly 05.686) - Credits: 2

In this seminar, candidates must analyze an inquiry approach to education and its relation to their current practices. They must examine the connections between inquiry, teaching, learning, and the standards of accomplished teaching. The portfolio entry requires a video in which candidates are asked to document a class meeting where students are learning through inquiry based instruction. Documentation takes the form of a 20 minute video edited into three sections. Section one shows how the lesson is introduced. Section two records students engaged in inquiry learning. Finally, section three records the lesson’s closure, The analysis focuses on the available evidence from the video; specifically, how the candidate’s actions (or inaction’s) resulted in student learning. The portfolio entry is limited to 12 pages.

EDUC.6870 Accomplished Teaching Seminar III; Teaching Cycle (Formerly 05.687) - Credits: 1

This seminar focuses on the teaching cycle (planning, implementing, assessing) in conjunction with the standards of accomplished teaching in specific content areas. The portfolio entry emanates from the day to day work of each teacher and requires teachers to document the decisions and choices which directly impact the student learning experience. The entry includes lesson plans associated with specified learning objectives, detailed assignments, examples of student work from two of those assignments representing high and low achieving groups, and an analytical reflection of how the teachers work fostered (or did not foster) Student understanding. The portfolio entry is 12 pages in length.

EDUC.6880 Accomplished Teaching Seminar IV; Whole Class Discussion (Formerly 05.688) - Credits: 2

Candidates develop the knowledge, skills, and dispositions necessary to foster student engagement. They will examine formal and informal assessment techniques associated with whole class discussions and analyze the importance of an equitable learning environment in fostering student participation. Candidates are required to submit a second, 20 minute unedited video of a whole class discussion. They closely analyze the video and interpret the student exchanges and teacher actions according to the standards of accomplished teaching. The portfolio entry is limited to 12 pages in length.

EDUC.6910 Developing Inclusive School Contexts (Formerly 05.691) - Credits: 3

This course will introduce students to theory and research about structural inequities, barriers to education, and promising practices for addressing these barriers. Students will examine theory and research and implications for practice in PK-12 Leadership.

EDUC.6911 Applied Research Design (Formerly 07.691) - Credits: 3

This course is designed to provide PK-12 practitioners with an understanding of the principles of research design and the
Participants will learn about the ethical responsibilities of conducting a research study. Participants will become skilled at reading, evaluating, and judging the trustworthiness of studies using different methodology approaches. They will design a practitioner-oriented research study.

EDUC.6920 Law, Policy, and Finance ( Formerly 05.692) - Credits: 3

This course will examine scholarship and research in the areas of law, policy and finance as these affect educational practice. They will analyze law, policy and finance and its implications for leaders in PK-12 schools and school systems.

EDUC.6921 Quantitative Data Analysis for Practitioner Leaders (Formerly 07.692) - Credits: 3

The primary focus of this course is to prepare practitioner leaders to understand, interpret, and analyze quantitative data as it relates to their identified problem of practice.

EDUC.6930 Organizational Learning (Formerly 05.693) - Credits: 3

This course will introduce students to research and theory in the field of organizational learning and its application to PK-12 practice. Students will study the origins, evolution, and contemporary findings of research in this field. Students will explore the practical implications of organizational learning for PK-12 leadership.

EDUC.6931 Qualitative Data Analysis for Practitioner Leaders (Formerly 07.693) - Credits: 3

This course will introduce practitioner leaders to the field of qualitative research and prepare them with the skills, techniques and knowledge necessary to conduct qualitative investigation in a practitioner-oriented research study.

EDUC.6940 Systems Leadership I (Formerly 05.694) - Credits: 3

Drawing on organizational, management, and educational scholarship, this course introduces students to concepts and practices associated with strategic systems leadership. Students will apply their understandings of how to leverage both formal and informal sources of influence in their analysis of relevant teaching cases and the data they collect in an extensive field study project.

EDUC.6950 Systems Leadership II (Formerly 05.695) - Credits: 3

EDUC.6960 Strategic Partnering with Families and Communities (Formerly 05.696) - Credits: 3

This course will critically examine the variety of issues associated with partnering with parents, families, and community organizations. Through analysis of theory, research and collective knowledge, doctoral students will learn how to strategically engage parents, families and community organizations and recognize the different forms of engagement. This course will emphasize collaborative strategies that "shares power" with key stakeholders in U.S. schools.

EDUC.6990 Doctoral Research Seminar (Formerly 07.699) - Credits: 1

This seminar, for all doctoral students and faculty in the Research and Program Evaluation Ph.D. program gives students the opportunity to learn about research and evaluation practice directly from faculty and other students speaking about their research and evaluation experiences. Students will learn how to: understand research and evaluation presentations; ask educated questions and make substantive suggestions and comments about research; and create and deliver a presentation of their research evaluation projects.

EDUC.7000 Introduction to Research Design and Methods (Formerly 07.700) - Credits: 3

In this course students will be introduced to: Principles of research design in social sciences; Understanding how to plan for research using quantitative and/or qualitative data collection methods; Ethics of research conduct; Understanding and preparing for the Institutional Review board (IRB) process; Evaluating the trustworthiness of research; How to critically review research; The historical and philosophical issues undergirding qualitative research; Paradigms; Sampling procedures; Types of measurement error; Methodologies appropriate for educational research; Recent developments in education research.

EDUC.7002 Conducting Research in Literacy Studies I - Credits: 3
This course provides doctoral students prior to their dissertation research with an opportunity to develop a research proposal through an intensive literature review, writing and discussions. Based on a solid understanding of current research trends on literacy, culture and communication students will identify research questions and articulate theoretical perspectives that frame their research. Developing research design and analysis tools will also be a core element of this course as a part of the students; research proposals. Students will go through IRB application using the proposal developed in this course to actually conduct their research in the next semester.

EDUC.7010 Cognitive & Info Processing Theories of Learning, Dev & Inst (Formerly 01.701) - Credits: 3

This course covers the fundamentals of human memory and cognition. In addition to modern memory theory, imagination, problem solving, invention, complex learning and complex skills performance will be explored.

EDUC.7011 Seminar: Qualifying Paper Development (Formerly 05.701) - Credits: 1

The Qualifying Paper Development seminar provides the student with constructive feedback and scaffolding as he or she develops the qualifying paper. The one-credit option is for the student who anticipates developing the qualifying paper over two semesters, and submitting the paper at the end of the second semester.

EDUC.7012 Data Analysis (Formerly 07.701) - Credits: 3

Prerequisite: A descriptive statistics or research methods course satisfactory to the Program Faculty. This course covers basic statistics used in the analysis of educational research.

EDUC.7014 Conducting Research in Literacy Studies II - Credits: 3

This course will focus on the actual conduct of a research project. It may not be possible to complete a research project (data collection and analysis) in a single semester; however, some important aspects of a research project are expected, such as sample data collection using the research instruments developed in the previous semester, ongoing analysis and preliminary findings. Students are expected to receive approval from the IRB prior to the course and will begin data collection as soon as the semester begins.

EDUC.7020 Research Methods and Design (Formerly 07.702) - Credits: 3

Methods of data collection suitable for answering a variety of educational research questions. Considers both qualitative and quantitative strategies for research and evaluation needs. Prerequisite: 07.701 or acceptable substitute.

EDUC.7021 Seminar: Qualifying Paper Development (Formerly 05.702) - Credits: 2

The Qualifying Paper Development seminar provides the student with constructive feedback and scaffolding as he or she develops the qualifying paper. The two-credit accelerated option is for the student who anticipates developing and submitting the final draft of the qualifying paper in one semester.

EDUC.7030 Seminar: Qualifying Paper Development (Formerly 05.703) - Credits: 3

The Qualifying Paper Development seminar provides the student with constructive feedback and scaffolding as he or she develops the qualifying paper.

EDUC.7040 Qualitative Research Methods (Formerly 07.704) - Credits: 3

This course concentrates on the use of qualitative methods for educational research. Strategies for conducting qualitative studies are described and techniques for analyzing and reporting findings are emphasized.

EDUC.7050 Survey Research (Formerly 07.705) - Credits: 3

Focusing on survey research methods, this course will familiarize students with the strategies, techniques, tactics, and issues in developing and administering questionnaires and interviews.

EDUC.7054 Introduction to Higher Education Research - Credits: 3

This course offers a critical examination of the research designs, paradigms, and methods used by scholars in the field of higher education. Students will be introduced to classic and contemporary research questions, traditional and alternative research methods, and frequently used resources in higher education scholarship.

EDUC.7060 Intermediate/Advanced Data Analysis (Formerly 07.706) - Credits: 3

Mixed methods research and evaluation uses both quantitative and qualitative data and information to answer research and
evaluation questions. Mixed methods research and evaluation integrates these two general methodologies to design more complete and powerful scholarship and produce more informative answers to research, instructional, and educational questions of both the formative and the summative kind. These questions may be research hypotheses, instructional program effects, or educational program and policy evaluations. This course is designed to meet the needs and goals of the students who enroll in it and is conducted by a learning contract model. Advanced univariate and multivariate design and statistical techniques will be selectively covered, including: meta-analysis, instrument design and development. It includes various qualitative techniques and analytical models, such as development and use of protocols, interviewing, content and discourse as well as text analysis, analytic and observational scoring procedures and systems, document analysis, policy analysis. Scholarly text development such as histories, white papers, or professional literature reviews will be included.

EDUC.7070 Writing for Professional Publication (Formerly 07.707) - Credits: 3

In this course students will learn about the processes and the resources relevant to writing, publishing and presenting manuscripts for professional journals and conferences. There will be an emphasis on student-developed work based upon relevant topics in the students field of study. Instructor permission required.

EDUC.7082 Introduction to Discourse Analysis - Credits: 3

Discourse analysis has been increasingly used as a basic analytic tool of qualitative research. This research methods course focuses on the use of language in society at the level of multiple interlocutors and contexts. This course is by nature interdisciplinary, and the goal is to provide graduate level students in all disciplines with practical guidelines to doing discourse analysis in qualitative research and mixed methods research.

EDUC.7090 Measurement & Evaluation (Formerly 07.709) - Credits: 3

Basic measurement and evaluation theories and techniques are surveyed, including achievement, attitudes, opinions, abilities, personality, skills and trait variables. Emphasis is given to methods of establishing reliability and validity of various measures.

EDUC.7100 Research Planning: Leadership (Formerly 05.710) - Credits: 3

Research Planning: Leadership is a scaffolded-experience to guide students in the development of their qualifying paper (the second comprehensive exam), a structured review of the literature. Only students who are at the appropriate stage of their program may enroll with permission of the instructor.

EDUC.7101 Qualitative Research: Advanced Topics in Analysis - Credits: 3

This course provides advanced knowledge of qualitative research and the opportunity for candidates to conduct a pilot study utilizing appropriate qualitative methodologies.

EDUC.7110 Research Experience I - Credits: 3

The goals of Research Experience I are to provide students in the Research and Evaluation in Education Program with mentored experience in a hands-on research project. Appropriate research experiences are those that allow the students opportunities to increase their skills, Knowledge, and experiences in the program goal areas. Students will work approximately 10 hours a week on the designated research project, meeting a minimum of 1 hour per week with the research mentor.

EDUC.7120 Research Experience II - Credits: 3

Research Experience II will provide students in the Research and Evaluation in Education program with mentored experience in a hands-on research project. The project may be a continuation of the work begun in Research Experience I or may represent a different line of inquiry with different mentor. Appropriate research experiences are those that allow the student opportunities to increase their skills, knowledge, and experiences in the program goal areas. Student will work approximately 10 hours a week on the designated research project, meeting a minimum of 1 hour per week with the research mentor.

EDUC.7130 Research Writing Seminar - Credits: 3

The purpose of the Research Writing Seminar is to Provide students with guidance in the preparation of their final qualifying exam.

EDUC.7290 Directed Study-Doctoral Education (Formerly 05.729) - Credits: 3

Participants will develop a focused line of investigation with the supervision of a faculty member in the college. Approval of advisor is required.

EDUC.7291 Directed Study: Language and Literature (Formerly 06.729) - Credits: 3
Students will work on individually designed projects in language arts and literacy in close cooperation with a faculty member.

EDUC.7292 Directed Study: Mathematics and Science Education (Formerly 04.729) - Credits: 3

Participants will develop a focused line of investigation with the supervision of a faculty member in the college. Approval of advisor is required.

EDUC.7420 Foundations of Program Evaluation - Credits: 3

In this course the following topics will be considered: Fundamentals of Evaluation Theory; Evaluating Evaluation Approaches and Models; Explication and Application of Specific Models; Evaluation Design; Evaluation Ethics; Evaluation Procedures; Meta-evaluation.

EDUC.7430 Program Evaluation in Practice - Credits: 3

This course will further your knowledge of program evaluation by focusing on such topics as: Assessing the need for program evaluation; Working with stakeholders; Identifying, measuring and monitoring outcomes; Assessing impact; Social context of evaluation.

EDUC.7440 Program Evaluation and Public Policy - Credits: 3

The focus of this course includes: The relationship between evaluation and educational policies; Standards-Based evaluation; Responsive Evaluation; Evidence Based Evaluation; cost Benefits Analysis Evaluation; Large Scale Evaluations: Issues in Planning; Large Scale Evaluations: Analyses; Evaluation of Public Programs and Related Policy; Utilization of Findings in Policy.

EDUC.7501 Dissertation in Practice - Credits: 3

Ed.D. students will design their study, complete their proposal, conduct their study and defend their dissertation in practice, while enrolled in dissertation credit. This course is for Ed.D. cohort students only.

EDUC.7560 Doctoral Dissertation/Education (Formerly 05.756) - Credits: 6

doctoral candidates who have passed both required doctoral examinations (Comprehensive/Qualifying examinations) may register for dissertation credit. Candidates work with their chair and/or a committee member to advance their research. Part time candidates who wish to register for 6 credits of dissertation study in one semester must gain the permission of the instructor.

EDUC.7590 Doctoral Dissertation/Education (Formerly 05.759) - Credits: 9

Doctoral candidates who have passed both required doctoral examinations (comprehensive/qualifying examinations) may register for dissertation credit. Candidates work with their chair of a committee member to advance their research. Only, full-time candidates, including TAs and RAs, and international students may register for 9 credits of dissertation study. Permission of Instructor is required.

EDUC.7600 Dissertation Research (Formerly 05.760) - Credits: 1

Doctoral candidates must be enrolled in this course if they have completed their required dissertation research and wish to defend their dissertation.

EDUC.7660 Continued Graduate Research (Formerly 05.766) - Credits: 6


Manning School of Business

The mission of the Manning School of Business is to support regional business development. We accomplish this by engaging our students in affordable, internationally accredited management education programs, innovative course delivery, conducting research that emphasizes the practical application of knowledge, and serving a dynamic community through outreach activities.

Graduate Programs Offered

Ph.D in Business Administration:
(http://www.uml.edu/Catalog/Graduate/Business/Doctoral-Program.aspx)

1. Accounting
2. Entrepreneurship
3. Finance
4. International Business
5. Leadership/Organization Studies
6. Management Information Systems

Master’s Programs:

1. Master of Business Administration (MBA) (available online or on-campus) General
2. Master of Science in Entrepreneurship
3. Master of Science in Accounting
(http://www.uml.edu/Catalog/Graduate/Business/master
s/Accounting.aspx)
4. Master of Science in Business Analytics
5. Master of Science in Finance
(http://www.uml.edu/Catalog/Graduate/Business/master
s/MSFinance.aspx)

Business Management Curriculum for the Doctor of Engineering (D.Eng.) Program

American competitiveness in world markets requires both technical innovation and the business skills to bring these innovations to market profitability. The management component of the University of Massachusetts Lowell’s Doctor of Engineering Program is designed to complement the technical training of the engineer with knowledge and skills in team management, financial decision making under market uncertainty, sensitivity to market needs, leading edge manufacturing techniques, and winning business strategies.

The philosophy and goals of the management component of the Doctor of Engineering program is to develop a person who can effectively extend the limits of technology both as a member of a professional work team and as a member of a global society. Today’s professionals will find that, over their work lives, they will hold several different types of positions in fields using their professional education in the business world, in academia, or in other endeavors. Regardless of the environment, a core of management skills will be required for success. The professional must be able to understand the external and internal work environment, understand the criteria that form the basis for decisions, and understand and evaluate the implications of those decisions.

The management curriculum for the Doctor of Engineering program is six 2-credit courses and is intended to provide flexibility for the engineering students. Students may select four of the 2-credit Graduate Certificate courses which most appropriately meet their professional and educational needs. Students are encouraged to complete the remaining two courses to qualify for the Graduate Certificate in the Foundations of Business. These courses do not assume a previous knowledge of business or management subjects by the engineering student.

Graduate Certificates:

- Foundations of Business
- Technology Venture Creation
- Financial Management

- Supply Chain and Operations Management
- Business Analytics

Manning School of Business course listings

Accreditation

All degree programs offered by the Manning School of Business are accredited by the Association to Advance Collegiate Schools of Business - International (AACSB
(http://www.aacsb.edu/)).

- Faculty in the Manning School of Business
(https://www.uml.edu/MSB/faculty/default.aspx)
The UMass Lowell Manning School of Business offers four Master’s programs:

- Master of Business Administration (MBA)
- Master of Science in Accounting
- Master of Science in Business Analytics
- Master of Science in Finance
- Master of Science in Entrepreneurship

Master of Science in Finance

The Finance Department at The Manning School of Business (MSB) offers a graduate degree program in Master of Science in Finance (MSF) in addition to a finance options in the MBA and doctoral degree programs. All degree programs offered by the Finance Department, along with all programs offered by the MSB are accredited by the Association to Advance Collegiate Schools of Business (AACSB). This accreditation is the highest level of accreditation for a business school, and documents the commitment of the Finance Department, the Manning School of Business, and the University of Massachusetts Lowell to excellence in education and continuous improvement of programs to keep them rigorous and relevant.

Curriculum

For undergraduate business majors, the MSF curriculum consists of 10 courses (30 credits): five required courses in Finance and five electives (two of which are recommended to be in Finance). For applicants who earned an undergraduate degree in an area other than business, this program is preceded by three prerequisite courses (with grades of B- or better) representing key foundation material in Accounting, Economics, and Finance. These prerequisite course credits will not count toward the MSF degree. The curriculum plan for the MSF is as shown in the curriculum outline.

Admission Requirements

1. Undergraduate Degree: Official transcripts. A minimum overall GPA of 3.0 is required.
2. GMAT (minimum 500): can be waived for UMass Lowell undergraduates with a GPA of 3.2 and above and upon receipt of a recommendation by an UMass Lowell faculty member; also can be waived if the undergraduate GPA is 3.5 and above at an AACSB accredited (or equivalent) university.
3. TOEFL for international students: (600+ paper-based, 250+ computer-based, or 100+ Internet-based).
4. Successful completion of all other Graduate Admissions Office requirements, including three letters of recommendation.

Curriculum Outline: Master of Science in Finance (MSF)

Major Required (Core) Courses (Total courses required = 5)

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>FINA.6010</td>
<td>Corporate Finance</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6110</td>
<td>Financial Statements Analysis</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6210</td>
<td>Security Analysis &amp; Portfolio Management</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6750</td>
<td>Financial Derivatives</td>
<td>3</td>
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<tr>
<td>FINA.6910</td>
<td>International Financial Management</td>
<td>3</td>
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<td></td>
<td><strong>Subtotal # Core Credits Required</strong></td>
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Concentration Course Choices (Total courses required = 5)

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<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ACCT.6010</td>
<td>Accounting Information for Management Decisions</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6020</td>
<td>Advanced Corporate Finance</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6100</td>
<td>Global Financial Markets &amp; Monetary Policy</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6220</td>
<td>Advanced Portfolio Management</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6240</td>
<td>Fixed Income Securities</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6510</td>
<td>Bank Management</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6610</td>
<td>Financial Risk Management</td>
<td>3</td>
</tr>
<tr>
<td>FINA.6990</td>
<td>Finance Seminar</td>
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</tr>
<tr>
<td></td>
<td><strong>Other Courses approved by the MSF Program Coordinator</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Subtotal # Concentration Credits Required</strong></td>
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</tr>
</tbody>
</table>

Curriculum Summary

- Total Number of Courses required for the degree: 10
- Total credit hours required for the degree: 30

Prerequisite Course Requirements

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCT.3010</td>
<td>Financial Accounting (2 credits)</td>
<td></td>
</tr>
<tr>
<td>FINA.5010</td>
<td>Business Financial Analysis (2 credits)</td>
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<tr>
<td>ECON.2010</td>
<td>Microeconomics (3 credits)</td>
<td></td>
</tr>
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</table>
Academic and Graduation Requirements

Academic and graduation requirements are similar to those of the other graduate programs in the MSB. Specifically, no more than six (6) MSF course credits of grades below a B may be counted toward the MSF, and no graduate degree will be awarded to any student whose overall cumulative grade point average is below 3.0. Other policies, as contained in the UMass Lowell graduate Catalog, will also apply as appropriate.

MSF Program Coordinator:

Prof. Chan Wung Kim

Phone: 978-934-2516

Email:

MSF@uml.edu

Graduate Certificates in the Manning School of Business

The College of Management offers graduate certificates in:

- Foundations of Business (MGFB)
- New Venture Creation (NVNG)
- Financial Management (FNMG)
- Supply Chain and Operations Management (SCOM)
- Business Analytics

You will need a Graduate Certificate Application Form (https://www.uml.edu/docs/Post%20Bachelor%20Certificate%20Application_tcm18-229777.pdf) as well.

Foundations of Business

Contacts:

Lauren Hildreth (mailto:Lauren_Hildreth@uml.edu), or
Ryan Masson (mailto:ryan_masson@uml.edu) 978-934-2848

Graduate students in the certificate program who are subsequently accepted into the UMass Lowell AACSB accredited MBA program may apply certificate courses with grades of B or better to their MBA degree.

Required Core Courses:

12 Credit Hours ? six courses at two credit hours each.

- ACCT.5010 Financial Accounting
- FINA.5010 Business Financial Analysis
- MKTG.5010 Marketing Fundamentals
- POMS.5010 Operations Fundamentals
- MGMT.5010 Organizational Behavior
- MGMT.5110 Global Enterprise and Competition


Students must hold an undergraduate degree for admission into a certificate program. A GMAT exam is not required for certificate programs. An undergraduate transcript must be supplied by student when applying.

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information. (https://www.uml.edu/gainful-employment/Foundations%20of%20Business%20-2052.0201-Gedt.html)

New Venture Creation

Contact: Ashwin Mehta (mailto:ashwin_mehta@uml.edu), 978-934-2728

This certificate assists the aspiring entrepreneur, inventor and mid-career professional in understanding and applying the process associated with starting a new business or creating new business opportunities within established organizations. This program is specifically focused on the creation of technology-based ventures and is designed to assist professionals with undergraduate and career experience in science, engineering, technology or business fields in better understanding the venture creation process.

The program consists of two required courses (New Venture Creation, Innovation & Emerging Technology) and two electives (selected in consultation with the Program Coordinator). Graduate students in the certificate program who are subsequently accepted into the UMass Lowell MSITE program may apply certificate courses with grades of B or better to their MSITE degree.

Required Courses: (6 Credit hours, two 3 credit courses)
Elective Courses (select two in consultation with Program Coordinator): 6 Credit hours, two 3 credit courses:

- ENTR.5650 - Technological Entrepreneurship
- ENTR.5650 - Financing Innovation & Technology Ventures
- ENTR.6700 - Global Entrepreneurship (3 credits)
- MKTG.6300 - Market Research for Entrepreneurs
- ENTR.6550 - Corporate Entrepreneurship
- ENTR.6800 - Practicum I New Venture Planning
- MGMT.6400 - Building and Managing Teams
- ENTR.6350 - New Product Development
- MIST.6350 - Project Management

Admissions Requirements: Undergraduate degree and related experience in science, engineering, technology or business (other areas will be considered in consultation with the program coordinator).

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information. (https://www.uml.edu/gainful-employment/New%20Venture%20Creation%20-%20%201301-Gedt.html)

Financial Management - Certificate

Contact: Chun Wang Kim (mailto:ChunWang_Kim@uml.edu), 978-934-2516

The Graduate Certificate in Financial Management is a 12 credit program (three two-credit courses and two three-credit courses) designed for non-financial mid-management professionals in the private and public sectors who wish to advance to decision-making positions within their organizations.

Individuals with undergraduate degrees in fields other than business management with finance as the major who wish to acquire additional academic credentials to advance within their organization or who wish to change career paths and improve their competitive position in the job market will benefit from this program. Especially, for many employees working in the technical and scientific fields without an operations or industrial engineering background, the Financial Management certificate will provide them with the knowledge needed for decision-making roles within their technical or scientific fields.

Prerequisite:

Required Courses: (9 credits)

- FINA.6010 Corporate Finance
- FINA.6020 Advanced Corporate Finance
- FINA.6100 Global Financial Markets and Monetary Policy

Elective (3 credits)

One course from a list of approved courses, which may include courses such as:

- FINA.6675 Financial Derivatives
- FINA.6710 Financial Statement Analysis
- FINA.6880 Current Topics in Finance
- FINA.6770 Independent Study: Finance
- MIST.7060 Data Analytics
- ACCT.6010 Accounting Information for Management Decisions

Graduate students in the certificate program are encouraged to extend their education further by applying for admission to the M.B.A. program may apply certificate courses with grades of B or better towards their M.B.A. degree requirements.

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information.

Supply Chain and Operations Management

Contact: Yao Chen, 978-934-2764, Yao_Chen@uml.edu (mailto:Yao_Chen@uml.edu)

This certificate assists individuals who wish to acquire additional academic credentials to advance within their organization or who wish to change their career paths and improve their competitive position in the job market. Especially, for many employees working in the technical and scientific fields without an operations or industrial engineering background, the program will provide them with the knowledge needed for decision-making roles within their technical or scientific fields. The program is to meet the needs of those mid-career professionals in non-operations positions, who require a greater understanding of operations to advance towards decision-making positions in their organizations, to communicate effectively with operations managers, to pursue new careers in industrial engineering or operations management, or to demonstrate the contribution of their unit...
and/or ideas to the organizations value chain.

The certificate requires students to complete 12 hours of graduate study. This consists of four three-credit Supply Chain and Operations Management courses. Graduate students in the certificate program who are subsequently accepted into the UMass Lowell MBA program may apply certificate courses with grades of B or better to their MBA degree.

Prerequisite Coursework (prior to certificate coursework)

- Microeconomics (ECON.2010)
- Statistics (ECON.2110)
- Operations Fundamentals (POMS.5010)

Required: 3-credit courses

- POMS.6010 Operations Management
- POMS.6020 Global Supply Chain Management
- POMS.6030 Service Management
- MIST.6450 Information Technology Project Management

Admissions Requirements: Undergraduate degree and related experience in science, engineering, technology or business (other areas will be considered in consultation with the program coordinator).

Gainful Employment Disclosure Information

Completion rates, median loan debts and program costs are outlined in the Graduate Certificate Employment Disclosure Information.

Graduate Certificate in Business Analytics

Contact: Thomas Sloan (mailto:thomas_sloan@uml.edu) - 978-934-2857

The Graduate Certificate in Business Analytics is a 12-credit program designed for working professionals in various fields (e.g., business, engineering, health sciences, or computer science) who need to gain analytical skills to advance their educational and/or professional goals. Appropriate, successfully completed coursework taken as part of this graduate certificate program can later be applied and transferred either to the MBA degree program (as part of the Business Analytics option) or to the M.S. in Business Analytics degree program.

Admissions Requirements: Undergraduate degree and related experience in business, science, engineering, or technology is required. In addition, all students are required to have taken the following courses:

- Introductory Statistics, such as ECON.2110 Statistics for Business and Economics I, MATH.2830 Introduction to Statistics, or equivalent.
- Management Information Systems (MIS), such as MIST.2010 or MIST.6010 Management Information Systems, MIST.2010 Business Information Systems, or equivalent
- All Applicants must submit an application, application fee, and official transcript to the Office of Graduate Admissions.

Graduate Certificate in Business Analytics Curriculum Outline

Required Elective Courses - Two from each group listed (total Courses required = 4)

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Group 2</th>
<th>Total Credits Required: 12</th>
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<tbody>
<tr>
<td>MIST.6030 Database Management</td>
<td>POMS.6120 Statistics for Predictive Analytics</td>
<td>3</td>
</tr>
<tr>
<td>MIST.6060 Business Intelligence &amp;Data Mining</td>
<td>POMS.6220 Decision Analytics</td>
<td>3</td>
</tr>
<tr>
<td>MIST.6150 Data Engineering for Business Analytics</td>
<td>POMS.6240 Analytical Decision Making Tools</td>
<td>3</td>
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</tbody>
</table>

Curriculum Summary

<table>
<thead>
<tr>
<th>Total Number of courses required for certificate</th>
<th>Total Credit Hours required for certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>

All courses listed above are currently offered on-campus; many of them are also offered on-line. The certificate can be earned through on-campus classes or a combination of on-campus and online classes.

Students who complete the certificate and choose to pursue an MBA degree or MS Business Analytics degree would need to apply for, and meet the requirements of, those respective programs.
Master of Science in Accounting

- Program of Study
- Admissions Requirements
- Curriculum

Program of Study

The Master of Science in Accounting (MSA) program in the Manning School of Business at UMass Lowell provides an economically affordable opportunity for qualified students to meet the licensing requirements to become Certified Public Accountants (CPAs) and prepare for success in a competitive environment and a respected profession, one whose members continue to be in high demand from public accounting firms, financial institutions, industry, government agencies, municipalities, schools, hospitals and charitable organizations. The Massachusetts Board of Public Accountancy has classified the MSA program at Manning School of Business as Level 1 and deemed the program to be substantially equivalent to AACSB standards. Any student who earns a graduate degree in accounting from a Level 1 program is judged to have satisfied the educational requirements to take the CPA exam. Students who earn degrees from non-Level 1 programs must demonstrate that they have satisfied such educational requirements. Therefore, our MSA programs Level 1 status makes it easier for UMass Lowell accounting graduates to eventually become CPA's.

The MSA program can be completed on a full-time or part-time basis and all courses are available online. For a full-time student, the 10-course, 30-credit program can typically be completed in one calendar year (e.g., four courses in the fall, four in the spring, and two in the summer). Part-time students will, on average, complete the program in about three years. We accept students with undergraduate accounting, business and non-business degrees. Students without an accounting undergraduate degree from an accredited U.S. institution will have to complete a series of up to eight accounting prerequisite courses prior to starting the MSA program.

Admission Requirements

- GPA - Minimum undergraduate GPA of 3.0 (overall); comparable accounting GPA.
- GMAT (500+); can be waived if the undergraduate GPA is at least 3.5 at an AACSB-accredited school and upon receipt of a recommendation by a faculty member; GMAT can also be waived for students in the UMass Lowell Plus 1 Program with an undergraduate GPA of 3.0 or greater.
- Successful completion of all other University of Massachusetts Lowell Graduate Admissions requirements including three letters of recommendation and Master of Science in Accounting TOEFL minimums.
- Exceptions or modifications to the above will be considered on a case-by-case basis.
- An internship or other relevant employment in the field is strongly encouraged, either before or during the program.

Curriculum

- MSA Core Courses (5 courses required)
  - ACCT.6050 Governmental and Non-Profit Accounting
  - ACCT.6120 Advanced Cost Management
  - ACCT.6300 Taxation of Business Entities
  - ACCT.6400 Financial Accounting Theory and Research
  - ACCT.6550 Advanced Auditing
- MSA Elective Courses (2 courses required)
  - ACCT.6020 Advanced Management and Sustainability Accounting
  - ACCT.6220 Globalization and Accounting
  - ACCT.6230 Contemporary Accounting Issues
  - ACCT.6450 Fraud Examination and Forensic Accounting
- MSA non-Accounting Business elective courses (3 courses required)
  - Courses are generally selected from the UMass Lowell MBA program; other courses can be selected with the approval of the MSA Coordinator.

Students without an accounting undergraduate degree granted by an accredited US institution will be required to complete a series of up to eight accounting prerequisite courses prior to starting the MSA courses. Details on the prerequisites can be found online or by contacting Stefanie Tate, MSA Coordinator.

ACADEMIC AND GRADUATION REQUIREMENTS

- Academic and graduation requirements will be similar to those of the Manning School of Business MBA program.
- No more than six course credits of grades below a B may be counted toward the MSA.
- No graduate degree will be awarded to any student whose overall cumulative grade point average falls below 3.0.
- Other policies, as contained in the UMass Lowell graduate...
For a full-time student, the 10-course, 30-credit MSA program can typically be completed in one calendar year (e.g., four courses in the fall, four in the spring, and two in the summer).

- Part-time students will proceed at a slower and more varied pace (on average, about three years).
- The Manning School of Business will accept up to six graduate credits from other AACSB institutions on a case-by-case basis.

For more information about the Master of Science in Accounting, contact:

Stefanie Tate, CPA, Ph.D.
MSA Coordinator
Phone: 978-934-2815
Email: Stefanie_Tate@uml.edu
ACCT.5010 Financial Accounting (Formerly ACCT/60.501) - Credits: 2

An introduction to financial accounting within the context of business transactions and business decisions. This course is a broad introduction to using accounting information from the user's perspective with little emphasis on traditional debits, credits, journal entries and ledgers. Emphasis is placed on preparing and understanding financial statements.

ACCT.6010 Accounting Information for Management Decisions (Formerly ACCT/60.601) - Credits: 3

Prerequisite: Student must be matriculated and must have completed foundation core courses. Focuses on the manager's view as opposed to the accountant's view of the decision process and related quantitative and qualitative information needs. The course material examines accounting information that will achieve faster, better, and cheaper operations. New strategic cost management models, such as ABC and target costing, are explored and contrasted with traditional cost approaches.

ACCT.6020 Advanced Management and Sustainability Accounting (Formerly ACCT/60.602) - Credits: 3

In the new environment of change, accountants are increasingly called on to support strategy through increasing efficiencies and reducing costs. This course will examine the different ways that accountants can add value through an understanding of value chain activities, use of technology, and extending value chain activities to develop a sustainability strategy.

ACCT.6030 Accounting Information Systems (Formerly ACCT/60.603) - Credits: 3

Presents accounting as a system designed to meet the needs of external and internal users. Accounting information system concepts are emphasized. Topics include accounting transaction cycles, internal controls, and systems development processes.

ACCT.6050 Government and Non-Profit Accounting (Formerly ACCT/60.605) - Credits: 3

This course introduces students to financial accounting and reporting issues related to state and local government and non-profit organizations. Students will learn how to prepare, analyze, and interpret these entities financial statements.

ACCT.6120 Advanced Cost Management (Formerly ACCT/60.612) - Credits: 3

An examination of cost data in ambiguous situations to assist managers in decision-making and strategy implementation. Emphasis is placed on advanced cost management for strategic planning, management control and, performance evaluation in multinational business entities.

ACCT.6210 Tax Factors in Business Decisions (Formerly ACCT/60.621) - Credits: 3

ACCT.6220 Globalization and Accounting (Formerly ACCT/60.622) - Credits: 3

ACCT.6230 Contemporary Accounting Issues (Formerly ACCT/60.623) - Credits: 3

Significant and rapid changes in accounting rules are impacting the financial reporting and analysis that management uses to make business decisions. This course will explore contemporary accounting topics that accounting professionals will face in the workplace and how the accompanying requirements are changing the way that companies and their business partners use, report, analyze, and interpret financial data. Subjects covered will vary as conditions change but may include International Financial Reporting Standards (IFRS), Fair Value Measurements, Post-Retirement Benefits, Revenue Recognition, or other current accounting topics.

ACCT.6300 Taxation of Business Entities (Formerly ACCT/60.630) - Credits: 3

This course provides coverage of gross income and business deductions, and provides a comprehensive overview of the taxation of corporations, partnerships, and sole proprietorships. This course will also cover the history of federal taxation, estate and gift taxes, and how the taxation of business entities fits into the entire tax system.

ACCT.6400 Financial Accounting Theory and Research (Formerly ACCT/60.640) - Credits: 3

A comprehensive exposure at an intermediate level to accounting theory and practice. Emphasis is placed on applying underlying accounting theory to complex accounting measurement problems. The effects of alternative methods are considered throughout the entire course.

ACCT.6410 Corporate Financial Reporting II (Formerly ACCT/60.641) - Credits: 3

Corporate Financial Reporting - II is a comprehensive analysis of financial accounting topics involved in preparing financial statements and in external reporting that began in Corporate
Financial Reporting- I. It includes topics such as current and long term liabilities and contingencies; stockholders' equity; dilutive securities and earnings per share calculations; investments; pensions; leases, financial statement analysis; the statement of cash flows; and full disclosure in financial reporting.

ACCT.6450 Fraud Examination and Forensic Accounting (Formerly ACCT/60.645) - Credits: 3

Fraud is an extremely costly business problem. Wells, Chairman of the Association of Certified Fraud Examiners, estimates that all forms of corporate dishonesty from "cooking the books" to embezzling could run as high as $660 billion annually. Business owners, executives, managers and accountants will benefit from understanding the causes, types and scope of fraud, fraud prevention, fraud detection, and fraud investigation. This course will cover management fraud, employee embezzlement and other types of fraud. The principles and methodology of fraud prevention, detection and investigation (e.g., forensic accounting) will be discussed.

ACCT.6500 International Accounting (Formerly ACCT/60.650) - Credits: 3

This course integrates International Financial Reporting Standards (IFRS) into a financial accounting course and leverages comparisons between US GAAP and IFRS (the two most commonly applied sets of accounting standards in the world) to enhance the development of a "critical thinking" approach to financial accounting and reporting. The goal of the course is to enhance student understanding of the links between the underlying transactions, the application of reporting standards for those transactions, and the financial reports obtained from a global/international perspective. Accounting standards set in the US and internationally (US GAAP and IFRS) are guided by general concepts but the specifics of the standards, and national cultures across different countries and geographical areas. In this course, we will consider those differences to better understand both US GAAP and IFRS accounting standards and the financial reports produced by them. In addition, the course will provide students with a basic understanding of IFRS, a relatively new set of accounting standards gaining wide acceptance throughout the world and being considered for adoption within the US.

ACCT.6550 Advanced Auditing (Formerly ACCT/60.655) - Credits: 3

This course provides a more in-depth study of auditing topics including audit planning, evidence gathering and evaluation, professional standards and regulatory agencies, and a practical approach to accounting and auditing research. Applications will be drawn from public and private sector audits.

ACCT.6770 Directed Study: Accounting (Formerly ACCT/60.677) - Credits: 3

ACCT.6990 Accounting Internship (Formerly ACCT/60.699) - Credits: 3

ACCT.7510 Accounting Research Methodology (Formerly ACCT/60.751) - Credits: 3

This course situates accounting and organization management research in the context of scientific inquiry generally, and social science in particular. It introduces students to the philosophical background of epistemological and metaphysical issues, the framing of scientific research, theory development, and the formulation of testable hypotheses. Operationalization, measurement and validity issues are studied, and a wide range of research paradigms and methodologies for accounting and organization management research are introduced and illustrated.

ACCT.7620 Empirical Financial Accounting Research II (Formerly ACCT/60.762) - Credits: 3

This is part II of a two part doctoral seminar in Empirical Financial Accounting Research. This course introduces and develops a broad understanding of empirical accounting research in financial reporting. The intent is to provide an overview of archival research and an in-depth analysis of current financial accounting research. This course will focus on the types of questions and innovative methods accounting academics are currently pursuing and developing.

ACCT.7720 Auditing and Corporate Governance Research (Formerly ACCT/60.772) - Credits: 3

This course is designed to expose doctoral students to major research areas in auditing and corporate governance research, with an emphasis on primarily archival research and secondarily judgment and decision making research. In line with Empirical Financial Accounting Research, emphasis will be placed on a significant number of research topics and methods by participating in active discussions about challenging research opportunities and auditing and corporate governance research.

ACCT.7960 Doctoral Dissertation (Formerly ACCT/60.796) - Credits: 1-9

Doctoral dissertation research.

ACCT.7970 Managerial Research Seminar (Formerly ACCT/60.797) - Credits: 0
The course will involve an on-going monthly presentation from across scholarly disciplines. Speakers will be drawn from local, national, and international universities. Attendance will be mandatory; PhD students should gain an appreciation for high level scholarship and corporate governance research.
BUSI.7010 Doctoral Curricular Practical Training
(Formerly BUSI 701) - Credits: 1

An internship, practicum or other type of employment that is either required by the student's academic program or an experience for which a student receives academic credit. To be eligible the student must be in legal F-1 status and have been enrolled full-time for one academic year. CPT work experience must be in the student's field of study and contain a curricular component.
FINA.5010 Business Financial Analysis (Formerly FINA/61.501) - Credits: 2

Introduces students to the finance function in a firm. Students are exposed to a variety of analytical techniques and to theory applied to financial decision making. Study will include effects of major financial decisions such as investment, financing and dividends on the value of a firm, in the light of their risk-return relationship under the assumption that the maximization of shareholder wealth is the goal of management. Pre-requisites: MBA or Certificate Programs or Permission of MBA Director.

FINA.6010 Corporate Finance (Formerly FINA/61.601) - Credits: 3

Relates working capital strategy, capital investment analysis, long-term financing, and capital structure decisions in a risk-return framework to the dynamics of the firm and the market in which it operates.

FINA.6020 Advanced Corporate Finance (Formerly FINA 602/61.621) - Credits: 3

This course covers advanced topics of financial decision-making concepts such as financial restructuring, mergers and acquisitions, different forms of debt and equity financing, leasing, and real options. The course includes techniques to incorporate uncertainty in financial analysis, to hedge corporate risk, and to restructure a firm through leveraged buyouts or under bankruptcy protection. It also includes advanced topics such as real options, theories of behavioral corporate finance, and the process to navigate extraordinary financial situations such as financial restructuring and liquidation.

FINA.6050 Mergers, Acquisitions, and Corporate Restructuring (Formerly FINA 605) - Credits: 3

This course examines the process by which takeovers and other corporate control transactions take place. Of particular interest will be the empirical evidence of capital market reactions to control transactions, to defensive measures by management against takeover bids and the valuation effects of these activities. We will also investigate restructuring activities that have significant effects on firm assets, liabilities, and equity claims, as well as their underlying economic motives. A Major focus will be the interaction of strategic planning, valuation, financial strategies, and investment decisions in the life cycle of the firm. This course is indispensable for those who plan to pursue careers in corporate finance, investment banking, private equity, and management consulting.

FINA.6100 Global Financial Markets and Monetary Policy (Formerly FINA 610/61.610) - Credits: 3

This course examines the interactions between changing perceptions of macroeconomic conditions and movements in the prices and yields on financial market instruments. The orientation of this course is heavily institutional with emphasis on helping students develop a "Wall Street" perspective on asset choice and the likely impact of macroeconomic conditions and policies on financial market prices. At the same time, the dependence of macroeconomic policy outcomes on global financial markets’ expectations of future real growth in the US and in the world economy, expectations of inflation, sovereign default risk and of interest rates will be stressed.

FINA.6110 Financial Statement Analysis (Formerly FINA 611) - Credits: 3

This course introduces students to a comprehensive financial statement analysis and valuation framework that integrates financial reporting, financial analysis and valuation, and the application of this framework to fundamental analysis. This course provides students with hands-on experience in financial statement analysis. Students will be introduced to general tools of financial analysis, theoretical concepts, and practical valuation issues. By the end of the course, students should be comfortable with using firms financial statements to develop an understand of their performance and to establish a basis for making reasonable valuation estimates.

FINA.6210 Security Analysis and Portfolio Management (Formerly FINA 621/61.721) - Credits: 3

This course introduces the student to the main theories and practice of investments and portfolio management. The student will learn about various investment opportunities including real and financial assets; the investment environment including the money and capital markets; the investment process including identification of goals, data gathering and analysis etc.; and, decision making under a changing market environment. The material covered will include: selection of assets - with special emphasis on securities selection through technical analysis and fundamental analysis, computation of risk and return of individual assets, asset allocation and portfolio formation, computation of risk and return of portfolios, measurement of portfolio performance and rebalancing of portfolios. Also included in the material will be topics such as the "pyramid" approach, forecasting and the use of indicators and, market and industry indexes, models such as the CAPM, bond and stock valuation, mutual funds, domestic versus global investment etc.

FINA.6220 Advanced Portfolio Management (Formerly FINA 622/61.735) - Credits: 3

This course develops investment theory as applicable to
portfolio management and securities selection. Topics covered include identification of investor goals, identification of investment opportunities in real and financial assets under volatile capital market conditions as well as analysis and decision making under conditions of certainty and uncertainty. Related concepts include technical analysis and fundamental analysis, pyramid approach to investing, changing risk and return through asset allocation and portfolio formation, valuation of basic securities and rebalancing of portfolios.

FINA.6240 Fixed Income Securities (Formerly FINA /61.624) - Credits: 3
Financial securities whose valuation depends on interest rates, such as Treasury securities, municipal bonds, and corporate bonds are called Fixed Income Securities. In this course, students will learn how to value and manage the risk of these securities.

FINA.6530 Financial Institutions and Markets (Formerly FINA 653/61.732) - Credits: 3
Analysis of the theory and practice of financial intermediation by institutions in the financial markets, including debt, equity, and foreign exchange markets. Study of the role of financial intermediaries including commercial banks, investment banks, and brokers. Other topics include financial market policy making and regulation; financial markets with an aim to understanding the rationale and nature of such policies and regulations.

FINA.6550 Global Financial Regulation and Compliance - Credits: 3
This course will provide an in depth survey of some of the major regulatory regimes within which the global financial services industry operates. Participants will learn the principles and techniques required to establish and maintain an effective compliance regime consistent with a strong ethical corporate culture. The course will rely upon examination of real-world examples; and, students will participate in a significant case study, requiring them to design an effective compliance program for a hypothetical firm operating in multiple jurisdictions.

FINA.6610 Financial Risk Management (Formerly FINA 661) - Credits: 3
This course deals with the theoretical and practical approaches to effective financial risk management. It covers risk management techniques for corporations and for management of equity, bond, derivatives and investment portfolios. Topics include measurement of corporate risk exposure, portfolio risk exposure and value at risk (VAR) for financial institutions; risk and diversification, modern portfolio theory, concentrated equity positions, portfolio benchmarking, the importance of asset allocations; market risk management, currency risk exposures, credit risk management, interest rate risks, and operational &integrated risk management; and computer applications.

FINA.6750 Financial Derivatives (Formerly FINA/61.675) - Credits: 3
The primary emphases in this course are the valuation and practical application of derivatives for both hedging and speculation. Topics include the characteristics of options, forward contracts, futures, and swaps; arbitrage and the valuation of derivatives; creating value and profit diagrams; and the structure of the derivatives markets. Ethical and economic issues associated with the use of derivatives as reported in the current financial press are also covered.

FINA.6770 Independent Study: Finance (Formerly FINA/61.677) - Credits: 3
Pre-Requisites: MBA Foundation Core and 61.601, or permission of MBA Coordinator.

FINA.6880 Current Topics in Finance (Formerly FINA/61.688) - Credits: 3
Topics of current interest in Finance. Subject matter to be announced in advance. For a current semester course title, please log on to ISIS, the Inter-Campus Student Information System.

FINA.6910 International Financial Management (Formerly FINA/61.691) - Credits: 3
The international dimension of the finance function of the firm. Financial constraints of the international environment and their effect on the standard concepts of financial management. The techniques of adapting risk analysis to the international situation. Study of international currency flows, monetary systems, forward cover and international banking policies.

FINA.7200 Financial Economics and Research (Formerly FINA 720) - Credits: 3
This doctoral-level course will introduce students to financial economics and the research methodology that supports advancement in the field. One major course objective is to provide the core theoretical foundations on which the various subfields, such as corporate finance and investments, rely upon. The second objective is to become familiar with financial data and the methodology to test the empirical evidence to validate theoretical arguments. Topics will include utility theory under
uncertainty, stochastic dominance, state preference theory, mean-variance portfolio theory, asset pricing, and contingent claims pricing. Topics that support corporate finance, such as information asymmetry and agency theory, will also be introduced.

FINA.7400 Corporate Finance Theory (Formerly FINA/61.740) - Credits: 3
This course covers topics in corporate finance including agency theory, theory of the firm, market for corporate control, financing policy, and dividend policy, among others.

FINA.7410 Investments Theory (Formerly FINA/61.741) - Credits: 3
This course covers topics in optimal portfolio choice and asset pricing including discrete-time and continuous time models for portfolio choice and security prices, Black-Scholes model of asset pricing, and general-equilibrium asset pricing models, among others.

FINA.7430 Seminar in Corporate Finance (Formerly FINA/61.743) - Credits: 3
This course is a doctoral level seminar covering both theoretical and empirical research in the area of corporate finance.

FINA.7440 Seminar in Investment Analysis (Formerly FINA/61.744) - Credits: 3
This course is a doctoral level seminar covering both theoretical and empirical research in the area of investments and asset pricing.

FINA.7820 Financial Derivatives Theory (Formerly FINA/61.782) - Credits: 3
This course is an in-depth analysis of contingent claims valuation. Financial assets considered will include European and American style options, forwards, futures, swaps, real options, and corporate securities.

FINA.7830 Research in International Finance (Formerly FINA/ 61.783) - Credits: 3
This course investigates issues in corporate financial management for multinational firms including foreign exchange forecasting and risk management, multinational capital budgeting, multinational capital structure, and international financial markets.

FINA.7840 Special Topics in Finance (Formerly FINA/61.784) - Credits: 3
This is a doctoral level course covering both theoretical and empirical research in an area of finance as determined by the instructor.

FINA.7960 Doctoral Dissertation (Formerly FINA 796) - Credits: 1-9
Doctoral dissertation research.

FINA.7970 Managerial Research Seminar (Formerly FINA 797) - Credits: 0
The course will involve an on-going monthly presentation from across scholarly disciplines. Speakers will be drawn from local, national, and international universities. Attendance will be mandatory; PhD students should gain an appreciation for high level scholarship and corporate governance research.

FINA.8010 Technology Adoption Finance (Formerly FINA/ 61.801) - Credits: 3
Ph.D in Business Administration

- Ph.D in Business Administration
- Program of Study
- Concentration
  - Accounting
  - Entrepreneurship
  - Finance
  - International Business
  - Leadership/Organization Studies
  - Management
  - Information Systems
- Prerequisites and Admissions Requirements
- Transfer Credit for the Ph.D. in Business Administration
- Degree Requirements
- Doctoral Qualifying Exam
- Doctoral Dissertation

Ph.D. in Business Administration

Manning School of Business at University of Massachusetts Lowell offers a Ph.D. degree in Business Administration. The Ph.D. program is designed for highly qualified students who are committed to scholarly research and teaching, and are motivated to pursue an academic career at business schools. The program also appeals to working professionals who aspire to an advanced degree to enhance their credentials in their current or future industry role or for entrance to academic. The program focuses specifically on the development of relevant, interdisciplinary research skills applied to current and future business problems and challenges. Students in each of the Accounting, Entrepreneurship, Finance, International Business, Leadership/Organization Studies and MIS concentrations will study the theoretical framework of their functional area with the option of exploring timely, related interdisciplinary areas. They will master traditional academic research methodologies appropriate to their respective fields, grounded in current industry trends and issues and will understand the benefits of advancing knowledge while recognizing the practical application of that knowledge in advancing economic and regional development locally, nationally and internationally. Graduates will be prepared for academic careers, research careers and upper level executive positions in both public and private companies.

Program of Study

The Ph.D. program includes six concentrations: Accounting, Entrepreneurship, Finance, International Business, Leadership/Organization Studies and MIS. The curriculum consists of a minimum of 36 credits of in-class coursework and 22 credits of dissertation, in addition to the prerequisite courses.

The Ph.D. can be taken on a full or part time basis. Fall and spring sessions begin with the traditional semesters and the summer session begins shortly after the completion of the spring session. The expectation is that full time students will finish the program within four years; while part time students will require no more than seven years.

Prerequisites and Admissions Requirements

Applicants are expected to have successfully demonstrated graduate level knowledge in seven functional areas: Accounting, Finance, Marketing, Organizational Behavior, MIS, Operations Management and Strategic Management. Additionally, they will demonstrate undergraduate competency in Calculus, Statistics and Micro/Macroeconomics. Applicants who have deficiencies in any of these areas will be required to successfully complete coursework to fulfill these prerequisites prior to matriculating into the Ph.D. program.

Admissions Requirements:

To qualify for admission into the Ph.D. program, applicants are expected to be graduates of an accredited U.S. college or university or an approved foreign equivalent institution and have earned grade point averages of 3.0 or better in all prior undergraduate and graduate studies.

All applicants must also submit a full Graduate Application, including an official GMAT or GRE score taken within the last five years, official undergraduate and graduate academic transcripts from all previously attended institutions, application form, statement of purpose, application fee, resume, and three letters of recommendation.

If an international transcript does not adequately demonstrate that an applicant has the equivalent of an American bachelor's or master’s degree, the applicant must obtain such verification by an independent service such as the Center for Educational Documentation, Boston, MA (617-338-7171). In addition, international students are expected to at least meet the minimum UMass Lowell TOEFL requirements and must submit an official score report.

The faculty admissions committee will review all of the above admissions materials in a portfolio approach.

The program admits new students every other year. Applicants are accepted for the fall only.

Transfer Credit for the Ph.D. in Business Administration

Up to six credits from other AACSB institutions may be transferred on a case by case basis. The faculty committee for the Ph.D. in Business Administration can accept transfer credit for graduate courses from an accredited university with a grade of B or better which meet the University policy for graduate transfer credit.

Degree Requirements for each Ph.D. in Business
Administration Concentration

Four Required Foundation Courses (Common to all Ph.D. concentrations) - 3 credits each

1. MGMT.7300 Research Design Methods I
2. ECON.7310 Statistics
3. ECON.7330 Econometrics I
4. ECON.7300 Microeconomic Theory

Plus one non-credit course - Managerial Research Seminar

Accounting Concentration Overview

The accounting concentration will concentrate on relevant bodies of knowledge, such as financial accounting, managerial accounting, auditing and taxation. The curriculum is designed to develop a high level of student technical and research competence in a specifically defined program area of business. Strong attention will be paid to linking accounting research with accounting practice, specifically guidance relative to best and evolving practices in the accounting field.

In addition to the Four Required Foundation Courses common to all Ph.D. concentrations, students must take:

Two Required Advanced Research Design/Methods Courses

1. ECON.7340 Econometrics II
2. MIST.7370 Multivariate Statistical Methods

Six Concentration Courses

1. Accounting Research Methodology
2. Empirical Financial Accounting Research I
4. Auditing and Corporate governance Research
5. Two approved Doctoral level electives
6. And complete all dissertation credits and requirements.

Additional information and concentration coordinator information may be found at: Doctoral Program Fields of Accounting Concentration (https://www.uml.edu/MSB/Departments/Accounting/programs/PhD-accounting.aspx)

Entrepreneurship Concentration Overview

The Entrepreneurship concentration will develop scholars who are thought leaders in advancing theory and practice within the discipline of entrepreneurship. Ph.D. students will gain a thorough understanding of the existing research on both the micro and macro levels. In particular, the core emphasis is placed on technological commercialization, new venture strategy, corporate entrepreneurship and growth at the firm level.

Course Work

In addition to the Four Required Foundation Courses common to all Ph.D. concentrations, students must take:

Two Required Advanced Research Design/Methods Courses

1. MGMT.7330 Research Design Methods II
2. ECON.7340 Econometrics II OR ECON.7370 Multivariate Statistical Methods

Six Concentration Courses

1. ENTR.7430 Seminar in Innovation and New Product Development
2. ENTR.7410 Seminar in Entrepreneurship research
3. ENTR.7420 Seminar in Corporate Entrepreneurship
4. ENTR.7440 Current topics in Innovation and Entrepreneurship
5. Two approved Doctoral Level electives

And complete all dissertation credits and requirements. Additional information and Concentration information may be found at: Doctoral Program Entrepreneurship Concentration (https://www.uml.edu/MSB/Departments/Marketing-Entrepreneurship-Innovation/Programs/PhD-Entrepreneurship.aspx)

Finance Concentration

The Finance concentration will develop scholars with a deep understanding of financial market, investment theories, financial innovations and strategies and the current challenges facing financial specialists. This program will be grounded with course content, research methodologies and projects developed collaboratively by faculty and financial industry partners to meet the research challenges facing the financial community.

Course Work

In addition to the Four Required Foundation Courses common to all Ph.D. concentration, students must take:

Two Required Advanced Research Design/Methods Courses

1. ECON.7340 Econometrics II
2. MIST.7370 Multivariate Statistical methods.

Six Concentration Courses

1. FINA.7200 Theory of Finance
2. FINA.7400 Corporate Finance Theory
3. FINA.7430 Seminar in Corporate Finance
4. FINA.7410 Investment Theory
5. One approved Doctoral level elective
6. And complete all dissertation credits and requirements.

Additional Information and Concentration Coordinator information may be found at Doctoral Program Finance Concentration (https://www.uml.edu/MSB/Departments/Finance/Programs/PhD-Finance.aspx).

**International Business Concentration**

The international business concentration will prepare scholars who have interest in the theory, research and practice of management with a cross-border or cross-cultural dimension. Given the trend of globalization and the importance of emerging economies, international business has become one of the fastest-growing area of interest by both academic researchers and practitioners.

**Course Work**

In addition to the Four Required Foundation Courses common to all Ph.D. concentrations, students must take:

Two Required Advanced Research Design/Methods Courses

1. MGMT.7330 Research Design Methods II
2. ECON.7340 Econometrics II OR Qualitative Research Methods OR MIST.7370 Multivariate Statistical Methods

Six Concentration Courses

1. International Business Research
2. International Marketing Research
3. International Finance Research
4. International Management Research
5. International Business Research Methods
6. One approved Doctoral level elective

And complete all dissertation credits and requirements. Additional information and Concentration Coordinator information may be found at: Doctoral Program Leadership/Organization Studies Concentration (https://www.uml.edu/MSB/Departments/management/Programs/Leadership.aspx).

**Management Information Systems Concentration**

The MIS concentration will focus on innovative and competitive IT / IS management theories, strategies and practices and their impact on organizations and society. Consistent with the other specialization, the MIS specialization will concentrate on current IT/IS challenges facing the industry today. IT / IS industry input and collaboration will be continually sought to develop appropriate projects and maintain currency in this program.

**Course Work**

In addition to the Four Required Foundation Courses common to all Ph.D. concentration, students must take:

Two Required Advanced Research Design/Methods Courses

1. MIST.7370 Multivariate Statistical Methods
2. ECON.7340 Econometrics II OR MGMT.7330 Research
Design Methods II

Six Concentration Courses

1. MIST.7060 Data Analytics
2. MIST.7070 Electronic Commerce
3. MIST.7080 Enterprise Systems
4. MIST.7500 Seminar in Information Systems Research
5. MIST.7880 Current Topics in MIS
6. One approved Doctoral level elective

And complete all dissertation credits and requirements. Additional information and Concentration Coordinator information may be found at: Doctoral Program MIS Concentration (https://www.uml.edu/MSB/Departments/Operations-Info-Systems/Programs/PhD-MIS.aspx).

Curriculum Summary

- Total number of courses required for the degree, 36 Credits
- Dissertation, 22 Credits
- Total credit hours required for degree, 58 Credits

First-Year Summer Paper

Ph.D. students will be required to submit one summer research paper at the end of the first year. The paper must be the student’s own work; that is the student must be either the single author or the first author of the paper if it is based on a research project with MSB faculty member(s). The quality of the summer paper will be evaluated by the concentration faculty and a grade of “pass/fail” will be granted. Students who fail the summer paper may, at the discretion of their concentration Committee members, be permitted a second and final opportunity to resubmit the summer paper before the end of the first semester of the second year. Ultimately, if the student cannot meet this requirement, the student will be dismissed from the program.

Doctoral Qualifying Exam

Students must take a comprehensive doctoral exam, which must be passed prior to students enrollment in dissertation credits.

Doctoral Dissertation (minimum 22 credits)

The minimum number of dissertation credits is 22. During each semester of the dissertation stage, students will register for 1, 3, 6, or 9 credits of direct supervision with their dissertation advisor. Students must successfully pass oral defenses of both the dissertation proposal and of the completed dissertation and submit a complete, approved dissertation to the library for publishing.

Master of Business Administration (MBA) Degree Program

- Entrance Requirements
- Part-time/Full-time Study
- Admission to MBA Courses
- Residency Requirement
- Curriculum Requirements
- Options

American business is facing a very different internal and external environment today. This environment is characterized by rapid technological change, increased international competitiveness in manufacturing and other sectors, and a labor force which expects a higher quality of work life than did previous generations of employees. These changes directly affect the health and vitality of any regions economy.

The UMass Lowell Master of Business Administration (MBA) program is designed primarily as a part-time evening program to serve middle level working professionals and others seeking management careers in business and industry. The program is designed to prepare students to manage effectively in rapidly changing regional, national, and global competitive environments. The MBA program not only requires a thorough understanding of the traditional functional areas of business, but also provides a detailed, integrated examination of issues faced by contemporary managers.

The unifying theme of industry analysis addresses the challenges posed by global competition, such as, accelerated change and complexity of technology, globalization of markets, increasing cultural diversity of human resources, ethical concerns, changing political processes, increasing role of governments in business, evolving organizational structures, and other similar issues. With this philosophical framework as its driving force, the MBA program at the University of Massachusetts Lowell prepares graduates to become leaders in a wide variety of commercial, industrial and governmental settings.

Additionally, three elective courses allow students to tailor their program to their specific professional needs. The awarding of the MBA degree signifies that the student has developed integrative skills in problem solving and decision making and can relate these skills to all functional areas of business. The development of this expertise entails an examination and application of advanced analytical tools.

Entrance Requirements
Application to the MBA program utilizes a rolling admissions policy and is open to students who have earned a 4-year baccalaureate degree. An aptitude for management decision-making and demonstrated academic ability are the most important qualifications for admissions. It is also required that applicants have an adequate mathematics background. Applicants should submit, along with their graduate school application, an official transcript of grades from their undergraduate institution(s), an official Graduate Management Admission Test (G.M.A.T.) score (the Graduate Record Examination is an acceptable alternative), three letters of recommendation, (letters of recommendation from work related sources are preferred), a resume, and a one-page written statement of academic and career goals. Students for whom English is not their national language must also submit an official score report for the Test of English as a Foreign Language (TOEFL).

Part-time and Full-time Study

MBA students may attend either full-time or part-time. On campus courses meet during the evening hours beginning at 6:30 PM. Most courses are currently also offered in an online format. Courses are offered in the fall, spring, and summer semesters. A minimum full-time course load is considered to be 9 credits. Full-time students usually complete their degree requirements in two years. Part-time students must complete their degree requirements within five years.

Admission to MBA Courses

MBA advanced core courses are open only to Manning School of Business graduate students who are fully matriculated degree candidates.

Residency Requirement

To be recommended for the MBA degree, students are required to complete a minimum of ten courses (30 credits) beyond the Foundations Core in the MBA program at the University of Massachusetts Lowell. Only under special circumstances, and with prior approval, are students permitted to complete courses at other institutions.

Curriculum Requirements

The MBA program consists of twelve credit hours of foundation core courses which may be waived through previous undergraduate work, and thirty credit hours (10 courses) of advanced courses and electives, for a total of 42 credit hours.

Recommended MBA Preparation Coursework (no longer required):

- Microeconomics (ECON.2010)
- Statistics (ECON.2110)

Foundations Core Courses (8-week Courses):

(six 2-credit courses - 12 credits total)

- ACCT.5010 Financial Accounting
- FINA.5010 Business Financial Analysis
- MKTG.5010 Marketing Fundamentals
- POMS.5010 Operations Fundamentals
- MGMT.5010 Organization Behavior
- MGMT.5110 Global Enterprise and Competition

Guidelines for Graduate Equivalency Credit of Foundation Core Courses:

The maximum number of courses that can be given equivalency credit is 12 credits. A student accepted to the UMass Lowell MBA program may request equivalency credit for any of the core courses listed above. These courses may be credited with exemption (meaning a replacement course is not required) if the equivalent undergraduate course work was completed with a grade of "B" or better within the past ten years. Additionally, up to two courses for 6 credits can be transferred in from an AACSB-accredited MBA program only.

Required Advanced Core Courses:

(seven 3-credit courses - 21 credits total):

- ACCT.6010 Accounting Information for Management Decisions
- FINA.6010 Corporate Finance
- MKTG.6010 Analysis of Customers and Markets
- MIST.6010 Management Information Systems
- POMS.6010 Operations Management
- MGMT.6010 Managing Organization Design and Change
- MGMT.6910 Strategy Formulation and Implementation

Electives or Options:

(three 3-credit courses - 9 credits total):

- Download a Program Outline
  (https://www.uml.edu/docs/MBA%20Program%20Outline%203.5.%20032018_tcm18-168453.pdf)
- Download MBA Options
Options

Students may choose General Business or concentrate in a particular field by taking three electives in a given area. To take electives, students must have completed the foundation core and be matriculated.

Options are offered in:

- Accounting
- Business Analytics
- Entrepreneurship
- Finance
- Healthcare
- Information Technology
- International Business
- Managerial Leadership
- Marketing

Master of Science in Business Analytics (MSBA)

About MSBA
Admissions Requirements
Curriculum

Admissions Requirements

The following are general admissions requirements for MSBA. Exceptions will be considered on a case-by-case basis. To begin your application online, please go to the Graduate Admissions webpage (http://www.uml.edu/Grad/default.aspx) and click the link for the online application at the bottom of the page.

1. The Graduate Admissions Application form and application fee.
2. Bachelor's degree from an accredited college or university with a minimum overall GPA of 3.0. A CED foreign credential evaluation (http://www.cedevaluations.com/) is required for degrees earned outside of the United States.
3. GMAT (minimum 500) or GRE (with equivalent minimum score). The GMAT/GRE may be waived based on certain criteria. To apply for a GMAT Waiver, please complete the GMAT Waiver Form (https://www.uml.edu/docs/GMAT%20Waiver%207-18-2016_tcm18-206299.pdf) (pdf) and email it to msba@uml.edu (mailto:msba@uml.edu).
4. Introductory-level business course prerequisites in the following areas:
   - Statistics Examples: ECON.2010 Statistics for Business and Economics I
     MATH.2830 Introduction to Statistics, or equivalent.
   - MIS Examples: MIST.6010 Management Information Systems,
     MIST.2010 Business Information Systems, or equivalent.
   - Operations Examples: POMS.5010 Operations Fundamentals,
     POMS.2010 Managerial Decision
Making, or equivalent.

Finance Examples: FINA.5010 Business Financial Analysis,
FINA.3010 Financial Management, or equivalent.

Marketing Examples: MKTG.5010 Marketing Fundamentals,
MKTG.2010 Marketing Principles, or equivalent.

Students must exhibit sufficient recent knowledge of statistics. Students, with a grade of C or below or who have not taken a statistics course in the last 5 years prior to admission, will be required to pass a competency exam in statistics.

Three letters of recommendation from instructors who have taught you, ideally in the field of study for which you are applying. Letters may also be from employers or supervisors who are in a position to compare your performance with that of your peers.

6. Statement of Purpose: Submit a 500 - 750 word statement indicating your immediate and long-range goals and any areas of specific interest or experience that may be relevant to the graduate program.

7. Resume or CV that lists your education and work experience.

8. TOEFL for international students (600+ paper-based, 250+ computer-based, or 100+ Internet-Based). A waiver may be given to candidates who have completed at least two semesters of full-time college/university work in the United States by the date of submission of the application.

Curriculum

The Master of Science in Business Analytics requires 10 courses (30 credits). Students complete a core of 7 required courses (21 credits) and then complete three courses (9 credits) within one of four tracks (Big Data, Managerial Decision Making, Marketing Analytics or Finance Analytics).

Required (Core) Courses

Total number of courses required = 7 (21 credits)

MIST.6030  Database Management
MIST.6060  Business Intelligence and Data Mining
MIST.6150  Data Engineering for Business Analytics
POMS.6120  Statistics for Predictive Analytics
POMS.6220  Decision Analytics
POMS.6240  Analytical Decision Making Tools
MIST.6490 / POMS.6490  Business Analytics Capstone Project

Big Data Analytics Track
Select 3 of the following courses (9 credits)

MIST.6080  Enterprise System Management
MIST.6140  Social and Economic Networks
MIST.6160  Advanced Data Mining
POMS.6210  Advanced Statistics for Business

Managerial Decision Making Track
Select 3 of the following courses (9 credits)

MIST.6450  Information Technology Project Management
POMS.6020  Global Supply Chain Management
POMS.6030  Service Management
POMS.6040  Managerial Quality Control

Marketing Analytics Track
Select 3 of the following courses (9 credits)

MIST.6070  Electronic Business
MKTG.6010  Customers and Markets
MKTG.6300  Market Research
MKTG.6410  Marketing Analytics

Finance Analytics Track
Select 3 of the following courses (9 credits)

POMS.6210  Advanced Statistics for Business
FINA.6010  Corporate Finance
FINA.6110  Financial Statements Analysis
FINA.6210  Security Analysis and Portfolio Management

The Manning School of Business Website (http://www.uml.edu/msb/) has more information on the Master of Science in Business Analytics.
MGMT.5010 Organizational Behavior (Formerly MGMT/66.501) - Credits: 2
Introduces students to management and organizational behavior. Its general purpose is to study and understand the behavior of individuals and groups in organizations. It is directed toward behavioral action components and emphasizes the close relationship between the study of organizational behavior and the practice of management. Pre-requisites: MBA or Certificate Programs, or Permission of MBA Director.

MGMT.5040 Curricular Practical Training (Formerly MGMT/66.504) - Credits: 1
An internship, practicum or other type of employment that is either required by the student’s academic program or an experience for which a student receives academic credit. To be eligible the student must be in legal F-1 status and have been enrolled full-time for one academic year. CPT work experience must be in the student’s field of study and contain a curricular component. Contact the Manning School of Business Graduate Programs office for additional details.

MGMT.5110 Global Enterprise and Competition (Formerly MGMT/66.511) - Credits: 2
To be taken as last course in foundation core. Is an integrated investigation of global competitive issues to help students understand the processes of organization and technological innovation which permit businesses to achieve competitive advantages in a global environment. This course also deals with the nature and techniques of industry analysis necessary to the formulation of effective global strategy for the firm.

MGMT.5750 Business Fundamentals for Scientists and Engineers (Formerly PSM 575) - Credits: 3
Is designed for science and other non-business professionals seeking to excel as managers. This course will introduce core business principles. Starting with managing ourselves, and others, we will move through the functional business disciplines. There will be weekly, theme-based case studies and related articles that will provide ample opportunity to work individually and in teams. The goal of this course is to build your knowledge of business principles and develop the analytic and practical skills necessary to contribute in decision-making and operations.

MGMT.6010 Managing Organizational Change (Formerly MGMT/66.601) - Credits: 3
Examines how business enterprises are designed, managed and changed to operate efficiently and perform effectively within their competitive environments. It critically examines organizations that vary in terms of such characteristics as size, complexity, goals, and technology as they operate under different circumstances and at various stages of their life cycles. The role and impact of individual managers receive particular attention.

MGMT.6070 Independent Study in MIS (Formerly MGMT 607) - Credits: 3
MGMT.6100 Managerial Leadership - Credits: 3
This course examines leadership theory and research with an emphasis on preparing students for the leadership challenges they face in their professional careers. Topic covered include: the difference between management and leadership; the role of experience; effective use of power and influence; leader traits and characteristics; and the situational factors leaders must assess in facilitating group effectiveness and teambuilding. Students will have the opportunity throughout the course to develop specific leadership skills and practice these skills through exercises, applied reading and class projects.

MGMT.6150 International Business - Credits: 3
This course addresses the issues involved in doing business overseas, and how it differs form purely domestic business. It surveys the changing international business landscape, focusing on the opportunities and challenges that company decision makers face in the global marketplace, and the factors that influence their decision to internationalize. Special attention is given to the broad concept of globalization - of markets and production - multinational enterprises include: governments, central banks, financial markets, regional and multilateral institutions (e.g., World Band, IMF, WTO), and the role of individuals who shape the international environment.

MGMT.6250 Negotiations (Formerly MGMT/66.625) - Credits: 3
Pre-Requisite: MBA Foundation Core.

MGMT.6301 Management Consulting - Credits: 3
Management Consulting is a global industry with over 4200 billion in annual revenue. This course provides students with an in-depth conceptual and practical understanding of the consulting industry; how consulting firms are organized; project proposal writing; project life cycles; management of the consultant-client relationship; and consulting processes and tools relevant to the management and organizational issues many companies often face and that consultants often address. Upon completion of the course students will have a sufficient understanding of the consulting profession to explore this field as a potential career option.

MGMT.6400 Building and Managing Teams
One critical determinant of success in an on-going corporate venture or launch of a new product, service or company is the performance of teams. This course examines the key roles of leader and follower in the development of project teams in both start startups and existing companies. It will address issues relating to team composition, team member capabilities, and team dynamics as teams develop and change over time. Emphasis is placed on acquiring the interpersonal, communication and collaboration skills necessary for effective team performance.

MGMT.6450 Advanced Professional Communication
(Formerly MGMT/66.645) - Credits: 3

Workforce analytics is the use of empirical data to improve the management of an organization’s human resources. The goal is for students to develop analytical literacy that will enable them to understand and apply fundamental analytic techniques, engage knowledgeably with data scientists in the application of more complex forms of analysis, interpret the analytical reporting of others with greater sophistication, and apply empirical evidence to employee-related decisions. The course emphasizes the link between workforce analytics and strategic decision making at all levels of leadership that will guide strategic performance management, talent development, and optimal investment in human capital. It is thus a high value leadership tool central to the achievement of organizational goals.

MGMT.6500 Workforce Analytics - Credits: 3

An introduction to the primary human resource functions-job design, recruitment, selection, training, managing workforce diversity, employee development, performance appraisal, compensation and benefits, with an emphasis on how these functions are affected by Equal Employment Opportunity requirements. 3 credits

MGMT.6520 Human Resources Management
(Formerly MGMT/66.652) - Credits: 3

This reading and discussion course for advanced MBA students explores the new skill and performance requirements imposed on middle managers by globalization and technology. Particular attention is given to emerging organizational forms that expand the emphasis on such things as individual free agency, the creation and synthesis of innovations, internal entrepreneurship, influence without authority and the coordination of activities over remote work sites.

MGMT.6550 Mid-Management Skills for the New Business Environment (Formerly MGMT/66.655) - Credits: 3

Reviews strategies for positioning a firm within its competitive environment. Fundamental concepts in strategic management; role of the CEO, levels and components of strategy, competitive analysis, and formulation and implementation of strategy are explored. Pre-Requisite: MBA Advanced Core.

MGMT.6770 Independent Study: Management
(Formerly MGMT/66.677) - Credits: 3

Prerequisite: MBA Foundation Core and 66.601, or permission of MBA Coordinator

MGMT.6880 Current Topics in Management
(Formerly MGMT/66.688) - Credits: 3

Topics of current interest in Management. Subject matter to be announced in advance. For a current semester course title, please log onto ISIS, the Inter-Campus Student Information System. Please see "notes" for the class to see the full description for individual topics.

MGMT.6910 Strategy Formation and Implementation
(Formerly MGMT/66.691) - Credits: 3

MGMT.7150 Managing Quality In Comp Or (Formerly MGMT/66.715) - Credits: 3

MGMT.7300 Research Design I (Formerly MGMT/66.730) - Credits: 3

Seminar will address study design, including but not limited to methods, hypothesis development and testing, reliability, and validity.

MGMT.7330 Research Design Methods II (Formerly MGMT/66.733) - Credits: 3

Expanding beyond Research Design Methods I Student will begin the design of a research project which considers the range of research methodologies and the implications of their use.

MGMT.7400 Leadership Theory & Principles
(Formerly MGMT/66.740) - Credits: 3

This course will help students develop a strong understanding of the theoretical lineage of leadership, from great man theory and trait theory up until more recent dynamic leadership theories. In addition to an understanding of the historical theoretical development, students will also gain an appreciation of current knowledge concerning leadership.

MGMT.7410 Leadership & Decision Making
This course will examine the manner and nature in which leaders make decisions, specifically decisions as it relates to the larger organization. The course will draw from a diverse spectrum of organizational theories, such as economics, behavioral economics, and psychology. Additionally, we will examine the manner which heuristics, bias and perception influence otherwise rationale decisions. The course will also examine decision making dynamics within the confines of senior leadership teams.

**MGMT.7420 Leadership & Change Management**
(Formerly MGMT/66.742) - Credits: 3

The course will focus on research that examines leaders within the context of organizations that are undergoing significant change and restructuring initiatives. Specific attention will be paid to the moderating role of leadership on change and organizational outcome. Numerous research streams will be examined including but not limited to leaders ability to interpret shifts in the environment, leaders role in various phases of the change process, the role of leaders in addressing culture within change efforts, and leaders’ ability to manage continuous change and strategic renewal.

**MGMT.7430 Leadership & Ethics**
(Formerly MGMT/66.743) - Credits: 3

This course will focus on ethics as it pertains to organizational leaders. Theoretical principles underlying business ethics, specifically as it related to organizational leaders will be addressed, such as the role leaders play in establishing ethics within the organization, the manner in which ethics impacts top management team decision making, and ethical culture.

**MGMT.7440 Independent Study**
(Formerly MGMT/66.744) - Credits: 3

Students will be expected to establish a relationship with a faculty member and develop and submit a paper to a top academic conference within their first two years.

**MGMT.7450 Seminar in Organization Theory**
(Formerly MGMT/66.745) - Credits: 3

This course focuses on the theories that explain the manner in which organizations form, behave, thrive, and decline. The course will draw from the contemporary literature in organization theory. Specific attention will paid to the major school of thought including but not limited too classical management theory, bureaucracy, behavioral decision theory, contingency theory, resource dependence theory, population ecology theory, organizational economic theory, institutional theory, and network theory.

**MGMT.7460 Seminar in Organizational Behavior**
(Formerly MGMT/66.746) - Credits: 3

The doctoral seminar in organizational behavior focuses on theoretical perspectives that explain individual behavior and social processes in organizational settings. The course will draw on literature at the micro and meso levels of analysis. It will provide a broad exposure to the major research domains of this discipline such as motivation, organizational justice, decision making, leadership, power, and organizational change. Emphasis will be placed on critical evaluation of existing paradigms and emerging trends.

**MGMT.7470 Leadership Theory and Concepts**
(Formerly MGMT/66.747) - Credits: 3

This doctoral seminar will provide an in-depth review of the theoretical and conceptual frameworks that characterize organizational leadership research, and provide an overview of the empirical research stemming from these frameworks. Students will develop a critical understanding of the literature and an ability to engage in the scholarly discourse surrounding leadership. The course will also help students develop their ideas regarding their own contribution to the field.

**MGMT.7510 Public & Business Policy Practicum**
(Formerly MGMT/66.751) - Credits: 3

Examines the larger context of technology, specifically the role that government policy plays in stimulating technology industry clusters. The course will focus on public policy, public economics, and drivers for government support Specific attention will be paid to research that examines national and regional competitiveness, as it related to role of state and federal government. The class will address comparative policies with other developing economics, such as China and India. Significant emphasis will be placed of the competitiveness of the U.S. technology industries, such as pharmaceuticals, information technology, etc. Students will be expected to put forth original research that addresses current public and business policy concerns, such as whether or not the United States is in decline? Such introspection is not only meant to be provocative, but relevant to the current discussion going on in business policy and public policy circles.

**MGMT.7600 International Business Research**
(Formerly MGMT/66.760) - Credits: 3

The aim of the doctoral seminar is to help students develop an advanced understanding of the evolution of international business theories and the present state of international business literature. It introduces a variety of economic and management
theories as well as their relevance and application in the field of international business, including models of international trade, product cycle model, competitive advantage model, eclectic paradigm, etc... The course also discusses selected research topics on international trade, international production, and multinational enterprise practices with emphasis on theoretic contributions to international business study.

MGMT.7610 International Management Research (Formerly MGMT/66.761) - Credits: 3

This seminar provides an in-depth review of the evolution of the multinational enterprise and the theoretical and empirical literature on international management research. It introduces multiple theoretical lenses through which multinational enterprise management practices can be studied, including international economics, organizational behavior, strategic management, organizational theory, and public policy. The topics include culture, global corporate strategy, cross-cultural communication and negotiation, corporate governance and organizational form cross-nationally and international human resource management issues. It emphasizes on developing a critical understanding of theory, concept development, research design and research results within the field of international management.

MGMT.7620 International Business Research Methods (Formerly MGMT/66.762) - Credits: 3

The course is designed to provide students with an overview of methodologies (specifically multivariate data analysis) used in international business research. In the process, students will also tackle methods in international business research and what it takes to write a high-impact international business article.

MGMT.7820 Business Policy & Strategy (Formerly MGMT/66.782) - Credits: 3

This course will focus on the various schools of thought for explaining firm performance variance, specifically industry structure, competitive advantage, and competitive position.

MGMT.7840 Country/regional Studies Seminar (Formerly MGMT/66.784) - Credits: 3

This class would primarily be an onsite placement in a country/region worked out between the student and their advising committee. Prior to the onsite placement, student would go through an in-depth review of issues related to the overseas placement: economic, technical, financial, management, political, legal, organizational formalities and issues. Of particular importance would be a demonstration of language skills necessary to work successfully in the specific area of the world.

MGMT.7960 Doctoral Dissertation (Formerly MGMT 796) - Credits: 1-9

Doctoral dissertation research.

MGMT.7970 Managerial Research Seminar (Formerly MGMT 797) - Credits: 0

This course will involve mandatory attendance at on-going monthly presentations by invited scholars from local, national, and international universities. The goal of the course is to enhance PhD student appreciation for, and familiarity with, high quality research in various business-related disciplines.
ENTR.5650 Technological Entrepreneurship (Formerly ENTR 565) - Credits: 3
This course is designed to help master's level students, often from fields outside of business, understand how technological and social innovations lead to new businesses and how those are created, funded, governed, and grown.

ENTR.5910 Independent Study (Formerly ENTR 591) - Credits: 1

ENTR.6100 Global Entrepreneurship and Innovation I (Formerly ENTR /64.610) - Credits: 3
The Course is offered as a 2-week intensive experiential learning of Global Entrepreneurship and Innovation. It is designed to help students to understand the importance of entrepreneurship and innovation in today's global economy and to cultivate an entrepreneurial mind-set among the students in the UMass Lowell. Students will work in interdisciplinary, multi-cultural environments exploring problem solving techniques, opportunities identification, business concept development and venture planning using standard business model framework and bringing ideas to reality.

ENTR.6110 Global Entrepreneurship and Innovation II (Formerly ENTR /64.611) - Credits: 3
The Course is offered as a 2-week intensive experiential learning of Global Entrepreneurship and Innovation. It is designed to help students to understand the importance of entrepreneurship and innovation in today's global economy and to cultivate an entrepreneurial mind-set among the students in the UMass Lowell. Students will work in interdisciplinary, multi-cultural environments exploring problem solving techniques, opportunities identification, business concept development & Venture planning using standard business model framework and bringing ideas to reality.

ENTR.6350 Financing Innovation and Technology Ventures (Formerly ENTR /64.635) - Credits: 3
This course focuses on strategies for financing innovation and new technology ventures both within a firm and on a stand-alone basis. Topics covered will include: different types of business organizations; different sources of funding including internal sources and external sources such as angel investors, venture capitalists, etc.; short-term and long-term financial planning and forecasting; business valuation; term sheet negotiation and exit strategies including mergers and acquisitions and IPOs. Each aspect of the course will be covered within the context of a business plan and venture lifecycle.

ENTR.6400 New Venture Creation (Formerly ENTR/64.640) - Credits: 3
This course is designed for students who are interested in entrepreneurship. The focus is on entrepreneurship as generic activity. It explores the opportunities and challenges face by individuals who seek to start a new ventures and the probable career development paths that are available. For those who may be interested in starting or running a new business, the course will provide an essential foundation for this process, identify the skills and resources required, and explore the opportunities available to the young entrepreneur.

ENTR.6450 New Product Development (Formerly 66.630) - Credits: 3
This course will enable students to understand the complexities involved in new innovation and technology-based product development. Through examples and exercises, students will be exposed to such topics as creative problem solving, customers/suppliers/partners involvements and inputs processes, integration among all functions, building and managing cross functional teams, rapid prototyping and development, creating a learning organization and measurements.

ENTR.6500 Innovation and Emerging Technology (Formerly ENTR /64.650) - Credits: 3
This course examines technological innovation and its relationship to value-creation and business strategy. Emphasis is placed on emerging scientific and technical innovations and the opportunities and challenges they present to both existing businesses and new venture entrepreneurs. The overall goal of this course is to help you to understand, appreciate and learn to manage the technology innovation process. Students examine innovation strategies, planning models, evaluation models, licensing and the commercialization process required to launch new businesses around innovative products and technologies.

ENTR.6550 Corporate Entrepreneurship (Formerly ENTR /64.655) - Credits: 3
This course focuses on entrepreneurship in established companies. Corporate Entrepreneurship (CE) is a process by which companies adopt a conscious strategy to encourage creativity, innovation, outside-the-box thinking, experimentation and risk taking. As a result, companies promoting and implementing CE strive for competitive advantages in rapidly changing global markets. The course will cover components of CE, developing & implementing CE strategies and managing CE.
ENTR.6700 Global Entrepreneurship (Formerly ENTR /64.670) - Credits: 3

This course discusses state of global entrepreneurship and the opportunities for it. It will cover different forms of global entrepreneurship, influences of macro forces and factors for global entrepreneurs consideration. The course will offer a structured approach to thinking and creating entrepreneurship beyond domestic markets and operations. It will present entrepreneurship framework, case studies, group projects and connections with global entrepreneurs to understand real-life global entrepreneurship.

ENTR.6800 Capstone I - New Venture Planning (Formerly ENTR /64.680) - Credits: 3

Capstone I-New Venture Planning (64.680) and Capstone II-New venture Implementation (64.681) focus on technology commercialization, business planning and initial incubation of an early-stage business by project teams, and the development of an investment proposal to launch a new business. In Capstone I students will be exploring, identifying and analyzing the path "from Idea to Market" for technology and research projects. They will evaluate selected technology and research projects for commercial applications and explore different options available to productize and introduce these projects to market. Where appropriate, teams will complete a new venture business plan and launch a new business (Capstone II). These two courses together will comprise the M.S.I.T.E program Capstone experience and will require students to actually develop these commercialization projects. Each student team will be assigned to a faculty member(s) who will instruct and guide them throughout this process. Capstone II may only be taken by students in the M.S.I.T.E. program.

ENTR.6880 Current Topics in Entrepreneurship (Formerly ENTR /64.688) - Credits: 3

This course is designed for an entrepreneur or an intrapreneur that focuses on key marketing concepts, methods, and strategic issues relevant for start-up and early-stage entrepreneurs and new ventures within an established company. It will give students a broad and deep understanding of such topics; Entrepreneurship and marketing; Marketing Opportunities; Market Development; Distribution strategy; pricing Strategy; Customer Relationship Strategy; Communication Strategy; and Effective use of Social Media. Start-up entrepreneurs and intrapreneurs face the challenge of matching large resources of established companies and thus have to utilize different ("entrepreneurial") marketing methods to succeed.

ENTR.6990 Independent Study (Formerly ENTR /64.699) - Credits: 3

ENTR.7400 Seminar in Entrepreneurship Research (Formerly ENTR /64.740) - Credits: 3

This is a full-semester seminar devoted to the diverse field of entrepreneurship. During the semester, we will cover seminal articles as well as contemporary topics and debates. Our emphasis is on reading and discussing academic articles from various perspectives on entrepreneurship. Students are expected to actively participate and contribute to class discussions as well as prepare a research proposal.

ENTR.7410 Corporate Entrepreneurship (Formerly ENTR /64.741) - Credits: 3

The course investigates the extant literature on innovation within the confines of an established organization. Corporate entrepreneurship is concerned with firm level entrepreneurship, specifically the notion of strategic renewal. Specific attention will be paid to underlying theoretical constructs associated with innovation, such as risk, culture, top management disposition, as well as their affect on organizational performance.

ENTR.7420 Seminar in Corporate Entrepreneurship (Formerly ENTR /64.742) - Credits: 3

In this course, students will become familiar with and develop an in-depth understanding of the concepts, models, and paradigms that collectively form the foundation for corporate entrepreneurship. The purpose is to develop a keen awareness of major gaps that exist in the literature. Students will develop
the ability to critically integrate findings from the literature and strengthen the skills needed to conduct original research in the related areas.

ENTR.7430 Seminar in Innovation and New Product Development (Formerly ENTR /64.743) - Credits: 3

This seminar is on the progress of the scholarly research on innovation and new product development. Topics include: types, drivers, and outcomes of innovation; new product development processes, how innovations and new products can help an organization develop a sustainable competitive advantage.

ENTR.7440 Current Topics in Innovation and Entrepreneurship (Formerly ENTR /64.744) - Credits: 3

This course examines current topics facing entrepreneurs and companies in strategic marketing of their innovative products and services. The specific issues covered include customers risk and value perceptions, buyer-seller relations, customer lifetime value, international

ENTR.7960 Doctoral Dissertation (Formerly ENTR /64.796) - Credits: 1-9

Doctoral dissertation research.

ENTR.7970 Managerial Research Seminar (Formerly ENTR /64.797) - Credits: 0

The course will involve an on-going monthly presentation from across scholarly disciplines. Speakers will be drawn from local, national, and international universities. Attendance will be mandatory; PhD students should gain an appreciation for high level scholarship and corporate governance research.

ENTR.9010 Research Seminar: Industrial Competition (Formerly ENTR /64.901) - Credits: 3

MKTG.5010 Marketing Fundamentals (Formerly MKTG 501,62.501) - Credits: 2

Describes how marketing strategies and plans of a competitive enterprise are formulated, implemented, and adjusted over time. Behavioral and quantitative aspects are covered, as well as analysis of the environmental forces affecting marketing decisions. Pre-requisites: MBA or Certificate Programs, or Permission of MBA Director.

MKTG.5450 Professional and Scientific Communication (Formerly PSM 545) - Credits: 3

This course will help you improve your professional communication. A science professional who can communicate quickly, clearly and effectively will be most successful in the workplace. In this course, you will gain a fuller understanding of the communication process, and will practice the application of effective communication skills. You will develop both written and oral communication within the context of your professional area. Students will prepare and present a variety of short to moderate length presentations and written assignments. These assignments simulate those encountered in the "real-world" including persuasive presentations, oral and written reports, media interviews, memoranda, and crisis situations. This class will also display the impact of newer technologies such as e-mail and presentational software and the opportunities they present and constraints they place on effective communication. Supplemental course reading and materials included as appropriate.

MKTG.6010 Customers and Markets (Formerly MKTG 601/62.601) - Credits: 3

Prerequisite: Student must be matriculated and have finished foundation core. Pursues the development of comprehensive and integrated marketing plans using industry/competitor analysis, market value chains, and forecasting. An emphasis is given to business-to-business marketing situations which require an in-depth analysis of the firms’ complex organizational behavior and evolving buyer-seller relationship.

MKTG.6150 Sustainable Marketing (Formerly MKTG 615/62.615) - Credits: 3

MKTG.6200 Sales Management (Formerly MKTG.620) - Credits: 3

This course offers students the opportunity to understand how sales management is conducted in small entrepreneurial organizations and large established enterprises. Topics include aligning the sales function with overall organizational objectives, integrating sales into the value delivery process, recruiting a talented sales team and meeting enterprise goals through target setting, compensation schemes, effective use of sales automation systems, and the importance of the Internet and other emerging technologies in the sales discipline. The course will explore the range of sales skills from the consultative selling of complex deals to transactional account management, as well as structural options such as product specialization, customer segment focus and territory alignment.

MKTG.6250 Digital Marketing (Formerly MKTG 625/62.625) - Credits: 3

This course combines a strategic view of digital marketing and
its challenges and opportunities with a tactical approach whereby through case studies, interactive sessions, class exercises, and client projects, students learn about the latest research and best practices in the industry. Topics to be covered include digital marketing strategy, digital marketing and business model innovation, social media marketing, search engine optimization, mobile marketing, video marketing, web analytics and measurement, legal and security issues, and multichannel integration. Students will leave the course with a working knowledge of the tools and processes for creating, managing, and executing digital marketing plans.

MKTG.6300 Market Research (Formerly 62.630) - Credits: 3

In this course students will learn and apply various marketing research techniques that will enable them to make soundly based decisions about new products or services in either an existing firm or new venture. Some of the topics covered include: assessing customer needs, estimating market demand, deciding the features of a proposed product/service and the price that would be most attractive in its target market. The course will provide students with an overview of key marketing concepts, and understanding of the statistical methodology behind market research techniques and practical application of these techniques through cases and projects.

MKTG.6700 International Marketing (Formerly MKTG 670/62.670) - Credits: 3

This course gives students a comprehensive view of marketing planning activity related to foreign markets. It is aimed at developing your understanding of the various dimensions in a business enterprise that are influenced by marketing. Marketing is a leading, integrated activity that influences the enterprise as a whole. Understanding of key trends in the global context and how they might affect a firm’s marketing activity is fundamental for all employees, particularly marketers, executive management and the leadership team including the CEO, and managers at all levels in various functions of the company. This course provides a comprehensive introduction to this fascinating subject in business management.

MKTG.6770 Independent Study: Marketing (Formerly MKTG 677/62.677) - Credits: 3

Pre-Requisite: MBA Foundation Core and 62.601 or permission of MBA Coordinator.

MKTG.6880 Current Topics in Marketing (Formerly MKTG 688/62.688) - Credits: 3

Topics of current interest in Marketing. Subject matter to be announced in advance. For a current semester course title, please log on to ISIS, the Inter-Campus Student Information System.

MKTG.7400 International Marketing Research (Formerly MKTG 740/62.740) - Credits: 3

The doctoral seminar is designed to expose students to the cutting-edge research in marketing models and discuss the relevance and implications of these marketing theories in a global business environment. It covers various research topics including pricing, new product development, marketing, brand management, and consumer behavior in a cross-national setting, with emphasis on developing a critical understanding of theory, concept development, research design, and research results within the field of international marketing.
MIST.6010 Management Information Systems  
(Formerly 63.601, MIST 601) - Credits: 3

Examines computer technologies, database management, and data communications as vehicle to improve and/or restructure business processes and decision making effectiveness to create competitive advantage.

MIST.6030 Database Management  
(Formerly 63.730: Advanced Data Management, MIST 603) - Credits: 3

This course provides students with in dept knowledge for modeling, designing, implementing, and managing database systems for operational and decision support purposes. Topics covered include relational database model, entity-relationship modeling, normalization, SQL language, data warehousing, data quality and integration, data and database administration, and object-oriented database.

MIST.6060 Business Intelligence and Data Mining  
(Formerly MIST 606) - Credits: 3

This Course introduces the concepts and technologies of business intelligence and data mining. The course studies how data-oriented business intelligence techniques can be used by organizations to gain competitive advantages, as well as how to design and develop these techniques. Topics include classification, clustering, association analysis, prediction, and text and web mining. Data-mining related ethical issues will also be discussed.

MIST.6070 Electronic Business  
(Formerly 63.630: E-business, MIST 607) - Credits: 3

This course provides a foundation on digital commerce and e-business for MBA students. It will cover both technological and managerial aspects of managing e-business operations in either a traditional or pure "dot.com" organization. Issues covered include interactive marketing and market-spaces, agent-based commerce and intelligent markets, electronic shopping carts, user interface issues, EDI transaction via Extranets, database interfaces, personalization and targeted communications, security, encryption, and payment systems, privacy and intellectual property.

MIST.6080 Enterprise System Management  
(Formerly 63.640, MIST 608) - Credits: 3

This course, an MBA elective, will focus on Enterprise Resource Planning (ERP) systems that integrate information spanning the functional boundaries within an organization. ERP systems include like SAP/R3, PeopleSoft, Oracle, and Customer Relationship Management (CRM) like Seibel, Tariva, etc. The goals of the course are to help students understand ERP systems and their underlying components and technologies, the implications of implementing ERP in organizations. Course will cover management and technical issues during the pre-implementation, installation, and post-installation stages of the ERP and/or CRM software in organizations. This course will cover topics such as: ES planning, business process re-engineering, selection of ES software and vendors, role of outside consultants, budgeting and resource planning, systems conversion, testing, user training, stabilization, role of top management, IT staff, consultants, design teams, and employee, and other topics.

MIST.6090 Independent Study in MIST - Credits: 3

Independent Study in MIST

MIST.6100 Information Technology Infrastructure  
(Formerly 63.610, MIST 610) - Credits: 3

This course examines in detail, the two major technologies for establishing the Information Technology (IT) architecture &Infrastructure in an organization. Topics include Multi-user Database environments, review of IT architectures, the migration of legacy systems, network (WAN, LAN) design, deployment, and management, and role of the Internet, Extranet, and Intranet.

MIST.6140 Social and Economic Networks  
(Formerly 63.745: Electronic Commerce, MIST 614) - Credits: 3

This course provides a foundation on digital commerce and e-business for PhD program. It will cover both theory and practice of e-commerce (B2C), e-business (B2B) and emerging e-business technologies such as Web 2.0 and social networking, all with an organizational perspective. Various theoretical models will be analyzed on topics such as e-strategy, interactive/e-marketing and supply-chain, agent-based commerce and intelligent markets, shopping carts and payment systems, user interface design, EDI transactions and Extranets, personalization and privacy security, encryption, and intellectual property. Students will be assessed through research paper and exams.

MIST.6150 Data Engineering for Business Analytics  
(Formerly 63.760 Enterprise Information Systems, MIST 615) - Credits: 3

This course will focus on Enterprise Systems such as Enterprise Resource Planning (ERP) systems and customer relationship Management (CRM) that integrate information spanning the functional boundaries (cross-functional) within an organization and link them with customers. This course will analyze theory
and practice of implementing enterprise systems and their underlying components and technologies, their implications organization change and business processes. Students will be assessed through research paper and exams.

MIST.6160 Advanced Data Mining (Formerly 63.798: Independent Study in Management Information, MIST 616) - Credits: 3

MIST.6170 Information Privacy and Security (Formerly 63.770, MIST 617) - Credits: 3

This course examines information privacy and security from various perspectives. The course provides students with in-depth understanding of the privacy and security issues due to advances in information technology, as well as related legal, organizational, social and economic implications and consequences. The course also explores approaches to analyze, design and implement the privacy and security components/functions of information systems.

MIST.6350 Project Management (Formerly MIST/MGMT 635) - Credits: 3

This course will focus on managing innovation and technology projects and the critical role that a project manager plays in successful execution. Topics included in the course are: project planning, deliverables, managing quality, change management, documentation, communication, risks management, project team and human resource management approaches and creating and managing expectations.

MIST.6450 Information Technology Project Management (Formerly 63.620, MIST 645) - Credits: 3

Application and integration of the project management body of knowledge (PMBOK) areas to managing information technology (IT) projects. Focuses on project management tools and techniques for defining and managing the project’s goal, scope, schedule, and budget. Other topics include quality management, risk management, change management, and knowledge management as they are related to IT projects.

MIST.6490 Business Analytics Capstone Project - Credits: 3

Consists of a practicum including the development and delivery of big-data analysis for supporting business decision making in organizations. In this culminating project, students draw on the breadth and depth of the curriculum to address an industry-supplied problem in small teams. The capstone project will involve application of industry accepted methodologies and analytical tools to solve real-world problems in R&D marketing, supply chain, healthcare, finance and/or other disciplines.

MIST.6880 Current Topics in Management Information Systems (Formerly 63.688, MIST 688) - Credits: 3

Selected topics having current and future impact in the field of MIS. Subject matter to be announced in advance.

MIST.7060 Data Analytics (Formerly 63.706, MIST 706) - Credits: 3

This course introduces the concepts and technologies of data analytics and data mining for transforming data into insight and business intelligence. The course studies how data-driven analytics technologies can be used by organizations to gain competitive advantages, and how to design and develop these technologies. Topics include data integration, data transformation, prediction, classification, clustering, association, text mining, optimization, model and performance evaluation, and data-mining related privacy and ethical issues.

MIST.7070 Electronic Commerce (Formerly 63.707, MIST 707) - Credits: 3

This course provides a foundation on digital commerce and e-business research for PhD. students. It will cover both technological and managerial aspects of managing e-business operations in either a pure (Dot.Com) organization or traditional organization (bricks-and-click). Issues covered include interactive marketing and market-spaces, agent-based commerce and intelligent markets, electronic shopping carts, user interface issues, EDI transaction via Extranets, database interfaces, personalization and targeted communications, security, encryption, and payment systems, privacy and intellectual property. Students will be conducting literature review in each of these key e-business areas and identify potential future research directions.

MIST.7080 Enterprise Systems (Formerly 63.708, MIST 708) - Credits: 3

The course will focus on implementation issues with Enterprise Systems (also called Enterprise Resource planning -- ERP) which integrate the informational and functional boundaries within organization. The goals of the course are to help students understand the underlying ERP components and technologies, change management, and process integration in organization. Conceptual models will be analyzed on topics such as business process management, customer relationship management, supply chain management, privacy and security, and outsourcing issues as related to the implementation of
enterprise systems. Students will be assessed through case analysis, exams, and research paper proposals.

**MIST.7090 Independent Study in Management Information Systems** (Formerly 63.709, MIST 709) - Credits: 1-3

An opportunity for the student to carry out individualized study relating to the field of Management Information Systems under the supervision of a member of the faculty. Prerequisites: MBA Foundation Core and Permission of MBA Coordinator.

**MIST.7370 Multivariate Statistical Methods** (Formerly 63.737, MIST 737) - Credits: 3

This course introduces statistical methods and techniques for multivariate data analysis. The course studies basic ideas underlying multivariate statistical methods and covers various applications of multivariate statistical analysis. The course discusses the design of a multivariate study, the choice of a multivariate method, the procedure of multivariate statistical analysis, and the interpretation of the analysis results. Topics include multivariate normal distribution, multivariate analysis of variance and covariance (MANOVA and MACOVA), principal components, factor analysis, structure equation modeling, canonical correlation, discriminant analysis, and cluster analysis.

**MIST.7450 Information Technology Project Management** (Formerly 63.780, MIST 745) - Credits: 3

This course covers the concepts, practices, processes, tools, techniques and resources used by information system (IS) project managers. The entire project life cycle will be covered from project initiation to project termination. The course will closely apply the framework of the Project Management Body of Knowledge (PMBoK) to carry out IT projects. The course will focus on how to manage the scope, schedule, budget and change of projects, with research emphasis on information systems and information technology projects.

**MIST.7500 Seminar in Information Systems Research** (Formerly 63.750, MIST 750) - Credits: 3

This course focuses on the contemporary topics in information systems research. The materials discussed in this course will be selected from leading IS research publications. Subject areas may be organizational, social, or technological in nature. Research methodologies may be empirical, computational or economics oriented. This course will normally be taught by multiple faculty members jointly.

**MIST.7880 Current Topics in Management Information Systems** (Formerly MIST 788) - Credits: 3

This course addresses one or more topics having current or future impact on the research fields of Information Systems. Topics can change at each course offering. Typically, the course will focus on emerging research streams in Management Information Systems, exploring new techniques and research methodologies used in the literature that yield high-impact research results.

**MIST.7900 Doctoral Dissertation** (Formerly MIST 790) - Credits: 1-9

Doctoral dissertation research.

**MIST.7970 Managerial Research Seminar** (Formerly MIST 797) - Credits: 1

The course will involve an on-going monthly presentation from across scholarly disciplines. Speakers will be drawn from local, national, and international universities. Attendance will be mandatory; PhD students should gain an appreciation for high level scholarship and corporate governance research.

**POMS.5010 Operations Fundamentals** (Formerly 63.501/POMS 501) - Credits: 2

Provides students with an introduction to operations management and operations analysis. The latter furnishes the student with a set of quantitative tools which are useful in designing and operating the former. These techniques are also generally applicable to other functional areas/courses within the MBA Program. Prerequisites: MBA or Certificate Programs, or Permission of MBA Director.

**POMS.5CO-OP Curricular Practical Training** - Credits: 0-1

Curricular Practical Training

**POMS.6010 Operations Management** (Formerly 63.671/POMS 601) - Credits: 3

Examines the strategic and tactical operations processes of manufacturing and service firms that foster global competitiveness. This course focuses on traditional and newer approaches including just-in-time, total quality management, MRP, flexible manufacturing systems, and capacity and management that lead to an integrated operations strategy. Cost reductions, flexibility, and market responsiveness are also
considered.

POMS.6020 Global Supply Chain Management (Formerly POMS 602) - Credits: 3

Supply chain management has become a crucial factor in the success of many leading organizations, including for-profit and not-for-profit companies, government agencies, and humanitarian relief efforts. This course will start with principles and concepts of supply chain management, tracing the flows of materials, funds, and information required to develop and deliver products and services around the globe. Topics covered include sourcing, logistics, demand planning, and inventory management, along with the use of quality tools and lean methodologies to improve supply chain operations and develop supplier relationships. This course will also discuss the challenges, key issues, and trends in global supply chain management, such as sustainability, disruptions, security, and innovation.

POMS.6030 Service Management (Formerly 63.673/POMS 603) - Credits: 3
POMS.6040 Managerial Quality Control (Formerly 63.690/POMS 604) - Credits: 3
POMS.6120 Statistics for Predictive Analytics - Credits: 3

This course introduces statistical methods and techniques for predictive analytics. This is part of the business-analytics umbrella of courses. The main focus of this course is on regression, a powerful and widely used predictive method. Topics covered include simple linear regression, multiple regression, variable selection, model diagnostics, and systems of regression equations. The course also covers classification techniques using statistical methods such as linear discriminant function and logistic regression. Spreadsheet software, such as MS Excel, and statistical software, such as SAS and R, will be heavily utilized.

POMS.6210 Advanced Statistics for Business Analytics - Credits: 3

This course covers two domains: time series analysis and multivariate statistics. Topics in the time series part include models for time series forecasting such as exponential smoothing, trend projections, forecasting with trend and seasonal components, Box-Jenkins methods, spectral analysis, AR, MA, ARMA, ARIMA, and SARIMA models. Topics in the multivariate statistics part cover T-squared statistic, multivariate analysis of variance (MANOVA), canonical correlation, principal components, factor analysis, discriminant analysis, path analysis, causal analytics, and structural equation modeling. Various software technologies such as R, SAS, Matlab, and IBM SPSS Modeler will be utilized. Permission of MSBA Program Coordinator or course instructor.

POMS.6220 Decision Analytics - Credits: 3

This course covers the three main facets of business analytics: descriptive, predictive, and prescriptive analytics. Students will gain the knowledge of managerial decision-making (commonly referred to as data analytics, decision support systems-DSS, data mining). Some of the business analytic topics covered include neural networks, decision trees, support vector machines, k-means, association rule mining, Analytical Hierarchy Process, Data Envelopment Analysis, expert systems, optimization, and simulation.

POMS.6240 Analytical Decision Making Tools - Credits: 3

This course covers principles and techniques of applied mathematical modeling for managerial decision making. Emphasis is on the methods of prescriptive analytics, including optimization models, decision analysis, simulation modeling, and risk analysis. Problems studied will include applications in finance, health care, marketing, operations, and management. Cases studies will be used extensively to demonstrate the practical use of models to improve managerial decision making. In addition to developing and applying models, emphasis will be placed on explaining the models and interpreting their results.

POMS.7090 Independent Study: Operations Management (Formerly 63.779/POMS 709) - Credits: 3

Pre-requisites: MBA Foundation Core and Permission of MBA Coordinator