

**University of Massachusetts Lowell  
College of Arts and Sciences  
Department of Physics and Applied Physics**

**Graduate Program in  
Radiological Health Physics**

Student Information for  
Doctor of Philosophy Degree  
Applied Physics Concentration  
**Radiological Sciences Option**

August, 2010

Dr. Robert Giles  
Chairperson  
Department of Physics  
and Applied Physics  
Olney Science Center 136  
Tel. (978) 934-3780  
Robert\_Giles@uml.edu

Dr. Clayton S. French  
Coordinator  
Radiological Sciences Program  
Pinanski Energy Center 209  
Tel. (978) 934-3286  
Fax: (978) 934-1054  
Clayton\_French@uml.edu

**Ph.D. Physics/Radiological Sciences Option  
(Department of Physics and Applied Physics)**

**Program Coordinator**

Clayton S. French, Professor of Radiological Sciences, B.S., Lowell Technological Institute; M.S. and Ph.D., University of Lowell (C.H.P.).

**Physics/Radiological Sciences Faculty**

Erno Sajo, Professor of Radiological Sciences; B.S., M.S., Technical University of Budapest, Hungary; Ph.D. University of Lowell.

Mark A. Tries, Associate Professor of Radiological Sciences; B.S., University of Lowell; M.S. and Ph.D., University of Massachusetts Lowell.

David C. Medich, Adjunct Professor of Radiological Sciences and Director of Radiation Safety, B.S., Union College; M.S. State University of New York at Buffalo, Ph.D., University of Massachusetts Lowell.

George E. Chabot, Professor Emeritus of Radiological Sciences; A.B., Harvard University; M.S., Harvard School of Public Health; Ph.D., University of Lowell (C.H.P.).

Kenneth W. Skrable, Professor Emeritus of Radiological Sciences; B.S., Moravian College; M.S., Vanderbilt University; Ph.D., Rutgers - The State University (C.H.P.).

**Physics Faculty**

Partha Chowdhury, Professor, Physics; Ph.D., SUNY Stony Brook  
James J. Egan; Chairperson and Professor, Physics; Ph.D., University of Kentucky  
Robert Giles; Professor, Physics; Ph.D., University of Massachusetts Lowell  
William Goodhue; Professor, Physics; Ph.D., University of Massachusetts Lowell  
Gunter H.r. Kegel; Professor, Physics; Ph.D., Massachusetts Institute of Technology  
Jayant Kumar, Professor, Physics; Ph.D., Rutgers - The State University  
Roger McLeod, ; Professor, Physics; M.S., Lowell Technological Institute  
Arthur Mittler; Professor, Physics; Ph.D., University of Kentucky  
David J. Pullen; Professor, Physics; D. Phil., Oxford University (England)  
Walter A. Schier; Professor, Physics; Ph.D., University of Notre Dame  
Kunnat J. Sebastian; Professor, Physics; Ph.D., University of Maryland  
Richard W. Stimets; Professor, Physics; Ph.D., Mass. Institute of Technology

## **Doctor of Philosophy Degree Program**

The Applied Physics Concentration is designed to expand the scope of the Ph.D. Program in Physics to encompass an option in Radiological Sciences. It is intended to develop advanced professional and academic competence in practical, applied, technological health physics and medical physics and to provide professional training for students whose previous specialization need not necessarily have been in the field of physics, but could have involved engineering, other science, or mathematical disciplines. This program is particularly well suited for those seeking to pursue careers in research, education or public service.

For physics majors, the acquisition of the doctoral degree would normally require about four years beyond the bachelor's degree, or a minimum of two years beyond the master's degree; for non-physics majors, an additional year of study would customarily be entailed.

### **Course Requirements**

At least 60 credit hours are required for the Ph.D. Of these, at least 15 and at most 24 may be for Thesis Research, 98-701/702, (excluding any credits accepted for 98-701/702 courses in partial fulfillment of the Master's Degree requirements), and at least 30 graduate course credits (with a grade of B or higher), plus at most 3 credits for departmental graduate colloquia and seminars, in addition to 6 credits for the successful completion of Advanced Project Research I/II, 98-751/752. A student possessing a Master's Degree for research may apply to have the M.S. thesis or project report accepted in substitution for two semesters of Advanced Project Research I/II, 98-751/752 by making an oral presentation of the M.S. research to a faculty committee.

### **General Required Courses**

Demonstration of competency in the following undergraduate-level physics core courses, or their equivalents, is required (in addition to a comprehensive knowledge of introductory general physics):

95-514	Classical Mechanics
95-535/6	Quantum Mechanics I/II
95-553/4	Electricity and Magnetism I/II

These, or their equivalents, would normally be taken (for graduate credit in the case of non-physics majors), when needed, during the first four semesters of the graduate program.

### **Comprehensive Examination**

A comprehensive examination based primarily upon these undergraduate courses will be administered, with the aim of establishing the student's needs in proceeding to graduate-level instruction. Part III of this examination (Modern Physics - Quantum Mechanics) shall consist of a Comprehensive Examination in Radiological Sciences and Protection.

## En Route Master of Science Degree

Ph.D. candidates who have passed the Ph.D. comprehensive examination and who have completed all of the courses required for the M.S. degree in Radiological Sciences and Protection will be awarded the master's degree en route, with no research requirement.

### Graduate Level Courses

The required graduate courses comprise:

95.536 Intro Quantum Mechanics II	(3-0)3
95.606 Mathematical Methods of Physics II	(4-0)4
95.561/662 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.

98.541 Radiochemistry	(3-0) 3
98.543 Radiochemistry Lab	(1-0) 1
98.575 Certification Preparation in Radiological Sciences	(3-0) 3
98.581 Mathematical Methods of Radiological Sciences	(3-0) 3
98.582 Numerical Methods of Radiological Sciences	(3-0) 3
98.565 Physics of Radiation Oncology	(3-0) 3
92.548 mathematics of Signal Processing	(3-0) 3
92.549 Mathematics of Tomography	(3-0) 3
98.585 MCNP for Radiological Sciences	(3-0) 3
98.596 Medical Physics	(3-0) 3
98.670-98.693 Various Health or Medical Physics Internships	(1/2/3-0)

### Colloquia and Seminars

Attendance at departmental colloquia or seminars, 95-601/602, and graduate seminars, 98-711/712, each carrying 1 credit per semester, is obligatory in each semester of graduate enrollment. Of the credits so obtained for seminar enrollment, at most 3 credits may be used toward satisfying the graduate credit requirement.

### Language Requirement

There is no foreign language requirement.

## **Doctoral Research Admission Examination**

Ph.D. candidates in the Radiological Sciences & Protection concentration are required to take an oral Doctoral Research Admission Examination after they have satisfactorily completed two semesters (6 credits) of an Advanced Research Project, such as: 98-751/752 Advanced Project in Radiological Sciences I/II (0-10) (0-10) 6 or its equivalent, entailing the writing of a comprehensive research report at the conclusion of each of the two semesters in the form of a detailed term paper.

Customarily, non-physics majors would engage in such a research project, which need not necessarily be in the same field as that to be pursued for the Ph.D. thesis research, under the direction of a member of the graduate faculty in their particular concentration, during the fifth and sixth semesters of their graduate program, immediately after satisfactory completion of the Comprehensive Examination. The Doctoral Research Admission Examination will concentrate on the material involved in the 751/752 Advanced Research Project and the two research reports (or alternatively, in the case of students who have completed their M.S. degree requirements, on the research and Master's dissertation in their respective field), together with coverage of any topics in satisfactorily completed (with a grade of B or higher) graduate-level courses that the student has taken to date. Upon passing the oral Doctoral Research Admission Examination, the student is eligible to proceed to Ph.D. research, i.e., to submit a Doctoral Research Proposal to the respective Graduate Committee(s), and, if approved, register for: 98-701/702 Graduate Research in Radiological Sciences 3, 6, or 9 cr/sem or equivalent. A Ph.D. thesis proposal must be approved at least one year prior to the completion of the Ph.D. degree. Of the credits so obtained for 701/702 Thesis Research, a total of at least 15 and at most 24 credits can be counted toward the required graduate credits.

## **Thesis Requirements**

A thesis proposal must be submitted, according to the procedures in the catalog in the description of the Master of Science Program. A student may not register for 98-701, Graduate Research, until he has passed the Ph.D. qualifying examination and his thesis proposal is approved. However, he may begin research sooner, and register for 95-711 Special Problems. The thesis is to be based on original research performed under the supervision of a member of the graduate faculty holding an earned Ph.D. degree, and written to conform to the requirements of the Graduate School. Four legible copies of a typewritten original must be submitted to the Department. Following this, the student must pass an oral examination conducted by his thesis committee, based on, but not necessarily limited to, his thesis. A student may do a thesis under the supervision of someone outside the Department holding an earned Ph.D. only with the consent of the Physics Department and with a member of the Physics Department as co-supervisor (overseer) of the thesis research.

## Typical Schedule in the Radiological Sciences Option

In conformance with the above requirements, a typical schedule has been drawn up for the option. This may be varied in particular circumstances, and is intended purely for general guidance in compiling a general course of studies for the first six semesters of enrollment in the graduate program.

Semester I		Semester II	
98.501 Rad Safety & Control I	(4)	98.502 Rad Safety & Control II	(4)
98.533 Ext. Radiation Dosimetry	(3)	98.534 Int. Radiation Dosimetry	(3)
98.541 Radiochemistry	(3)	98.562 Radiation Biology	(3)
95.601 Physics Colloquia	(1)	98.602 Physics Colloquia	(1)
98.711 Seminar in Rad Sci	(1)	98.712 Seminar in Rad Sci	(1)
Total	(12)	Total	(12)
Semester III		Semester IV	
95.535 Quantum Mechanics I	(3)	95.536 Quantum Mechanics II	(4)
95.553 Electricity & Mag I	(3)	95.554 Electricity & Mag II	(3)
95.601 Physics Colloquia	(1)	98.602 Physics Colloquia	(1)
98.701 Grad Research in Rad Sci	(3)	95.514 Classical Mechanics	(4)
98.711 Seminar in Rad Sci	(1)	98.712 Seminar in Rad Sci	(1)
Total	(11)	Total	(13)
Comprehensive Examination			
Semester V		Semester VI	
95.605 Math Methods of Physics	(3)	95.606 Math Methods of Physics	(3)
95.561 Nuclear Physics I	(3)	95.562 Nuclear Physics II	(3)
98.701 Grad Research in Rad Sci	(3)	98.702 Grad Research in Rad Sci	(3)
95.601 Physics Colloquia	(1)	98.602 Physics Colloquia	(1)
98.711 Seminar in Rad Sci	(1)	98.712 Seminar in Rad Sci	(1)
98.514 Advanced Ext Rad Dosim	(3)	98.516 Advanced Int Rad Dosim	(3)
Total	(14)	Total	(14)

## Doctoral Research Admission Examination

NOTE: It is assumed that the requirements for the Master of Science degree in Radiological Sciences & Protection will be completed sometime during the above sequence. All Ph.D. students are required to take Mathematical Methods of Physics I & II, 75.605/75.606.