

## Free Response LabVIEW GUI Assignment

The following exercises can be used with the Free Response LabVIEW GUI to better understand its capabilities and the concepts which it illustrates.

1. Give the system some initial displacement. Could you determine the initial displacement from the plot alone, if you didn't already know what it was?
2. Re-set the initial displacement to zero, and give the system an initial velocity. How does the time response differ from that for the system with an initial displacement? Do either of the other plots differ?
3. Give the system some combination of an initial displacement and initial velocity, and observe the time response.
4. Set two parameters (mass, damping, or stiffness) and adjust the third to observe the effects on the three plots
3. Set the mass to 5. Adjust damping and/or stiffness to achieve a natural frequency of 3 rad/sec (note that you are given the natural frequency in Hz, not rad/sec) and an approximate maximum frequency response magnitude of  $10^{-1}$ . Notice the pole locations on the root locus plot and the damping ratio.
4. Set damping to 20. Adjust the mass and/or stiffness to get two real roots as indicated by the root locus plot. Which parameter had a greater effect? What is the critical damping, and how does this relate to the current damping of the system?
5. Repeat the above exercise and adjust the mass and/or stiffness to get two repeated roots as indicated by the root locus plot. How do you know that they are indeed two repeated roots?
6. Set the stiffness to 30. Adjust the mass and/or damping to achieve a natural frequency of 1 Hz. Were you able to do this? Adjust the stiffness until the natural frequency is 1 Hz.
7. Set the mass to 5 and the stiffness to 100. Look at the frequency response plot and observe the shape and location of the peak at the natural frequency. Now change the damping, observe the change in the natural frequency and damped natural frequency, and compare to the frequency response.
8. Adjust the parameters until the critical damping is approximately 30 lbf-s/in. How does each of the parameters affect the critical damping?