

## Second-Order Step Response LabVIEW GUI Assignment

These exercises may be used with the second-order Step Response LabVIEW GUI.

1. With the default values of mass, damping, and stiffness, what is the force input to the system to achieve the unit step?
2. Change the stiffness. Now what is the force input required to obtain a unit step? If you do not understand how to calculate the force input, refer to the note at the bottom of the GUI or the second-order step response tutorial.
3. If the initial displacement and velocity remain set to zero, how can you see that this is a step response, based only on the response plot?
4. Give the system a combination of step input, and initial displacement and velocity, and observe the effect on the response.

If you have not already done the Free Response LabVIEW GUI Assignment, complete the following questions:

5. 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?
6. 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?
7. 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.
8. 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.
9. Adjust the parameters until the critical damping is approximately 30 lbf-s/in. How does each of the parameters affect the critical damping?