

# A Design Study Approach to Classical Control

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## Homework D.f

For the mass-spring-damper system, do the following:

- (a) For the mass-spring-damper system, you are to design a lead controller using root-locus methods to place the closed-loop poles of the system in regions corresponding to a rise time of less than 2.2 seconds and damping ratio greater than 0.7. Your lead controller should be of the form

$$D_{\text{lead}}(s) = K \left( \frac{s/z_{\text{lead}} + 1}{s/p_{\text{lead}} + 1} \right).$$

Plot the root-locus of the compensated system with the closed-loop pole locations plotted. Use this lead controller to control your Simulink model. Plot the response of the system.

- (b) Add lag compensation to your lead controller to reduce the steady-state error to a unit step input to be less than 5 percent. Plot the root locus for your system with lead-lag compensation showing the location of your closed-loop poles. Plot the step response of your system in Simulink. Your compensator should be of this form

$$D_{\text{lead-lag}}(s) = K \left( \frac{s/z_{\text{lead}} + 1}{s/p_{\text{lead}} + 1} \right) \left( \frac{s/z_{\text{lag}} + 1}{s/p_{\text{lag}} + 1} \right).$$