UNH

University of New Hampshire
Department of Mechanical Engineering
ME 670

Systems Modeling, Simulation, and Control

Problem Set No. 5

NOTE: This assignment is to be done individually. Any papers which show signs of collaborative efforts will be dealt with appropriately.

Problem 1 Create a working M-file in MATLAB to simulate the mass-spring-damper system in Ogata B-3-13(a). Assume that θ_i is a unit step input, $\theta_0(0) = -1$, and $\dot{\theta}_0(0) = 0$. Choose appropriate values for J, b, and k to simulate the response for $\theta_0(t)$ for each of the following cases:

1. undamped system
2. critically damped system
3. overdamped system
4. underdamped system

For each case, plot the response of $\theta_0(t)$ from time 0 to until the system reaches steady state (or repeats itself). On each plot, be sure to state the values of your choice of J, b, and k values. You should submit a print out of your M-file and all four *labeled* plots.

Problem 2 Use SIMULINK to confirm the validity of your step responses obtained in Problem 1. For each case, plot the response of $\theta_0(t)$ from time 0 to until the system reaches steady state (or repeats itself). On each plot, be sure to state the values of your choice of J, b, and k values. You should submit a print out of your SIMULINK model and all four *labeled* plots

Problem 3 Using the numerical methods technique discussed in class and a time step of $\Delta t = 0.01$, write an M-file that will numerically integrate your differential equation (in state space form) so as to obtain the same underdamped step response of Problem 1 and Problem 2. (Note that your final time should be greater than your settling time t_s.) You should submit a print out of your M-file and *labeled* plot.

Problem 4 Ogata B-5-1

Problem 5 Ogata B-5-3

Problem 6 Ogata B-5-5

Problem 7 Ogata B-5-6

Problem 8 Ogata B-5-7