Experiment 10

Objective: To verify the effect of input waveform, loop gain, and system type upon steady-state errors.

Software requirement: MATLAB, Simulink, and the Control System Toolbox.

Prelab:

1. What system types will yield zero steady-state error for step inputs?
2. What system types will yield zero steady-state error for ramp inputs?
3. What system types will yield infinite steady-state error for ramp inputs?
4. What system types will yield zero steady-state error for parabolic inputs?
5. What system types will yield infinite steady-state error for parabolic inputs?
6. For the negative feedback system of Figure 1, where

   $G(s) = \dfrac{k(s+6)}{(s+4)(s+7)(s+9)(s+12)}$ and H(s)=1, calculate the steady state error in terms of k for the following inputs: *5u(t), 5tu(t) and 5t²u(t)*

7. Repeat step 6 for $G(s) = \dfrac{k(s+6)(s+8)}{s(s+4)(s+7)(s+9)(s+12)}$ and H(s) =1.

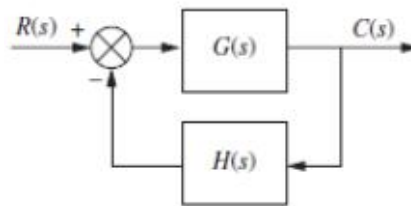8. Repeat step 6 for $G(s) = \dfrac{k(s+1)(s+6)(s+8)}{s^2(s+4)(s+7)(s+9)(s+12)}$ and H(s) =1.

Figure 1: Closed Loop System

Lab

1. Using Simulink set up the negative feedback system of step 6 of Prelab. Plot on one graph the error signal of the system for an input of *5u(t)* and K = 50; 500; 1000, and 5000. Repeat for inputs of *5tu(t)* and *5t²u(t)*. Take your plots and compare the expected steady-state errors to those calculated in the Prelab. Explain the reasons for any discrepancies.

2. Using Simulink set up the negative feedback system of step 7 of Prelab. Plot on one graph the error signal of the system for an input of *5u(t)* and K = 50; 500; 1000, and 5000. Repeat for inputs of *5tu(t)* and *5t²u(t)*. Take your plots and compare the expected

steady-state errors to those calculated in the Prelab. Explain the reasons for any discrepancies.

3. Using Simulink set up the negative feedback system of step 8 of Prelab. Plot on one graph the error signal of the system for an input of *5u(t)* and K = 200; 400; 800, and 1000. Repeat for inputs of *5tu(t)* and $5t^2u(t)$. Take your plots and compare the expected steady-state errors to those calculated in the Prelab. Explain the reasons for any discrepancies.