Course: Digital Control (CSE416)

Date: 12/12/2020 **Midterm Exam 1** **Total:** 30 marks **Time:** 1 hour

Attempt the following questions:

Question (1): (10 marks)

Assume that a controller is required to be implemented on a microprocessor and the controller continuous transfer function is defined as:

$$C(s) = \frac{2s+1}{s+\alpha},$$ whereas α is a tuning parameter.

1. Obtain the discrete transfer function of the controller $C(z)$ using backward Euler emulation technique for a generic sampling time T. *(4 marks)*
2. What is the range of the tuning parameter α to produce a stable discrete transfer function for the controller using backward Euler emulation $C(z)$? *(3 marks)*
3. Write a code layout to implement the controller using backward Euler emulation. *(3 marks)*

Question (2): (10 marks)

Consider the cruise control systems in Figure 1. The input the traction force u, the output is the cruising speed v, b is the damping ratio, and M is the car mass.

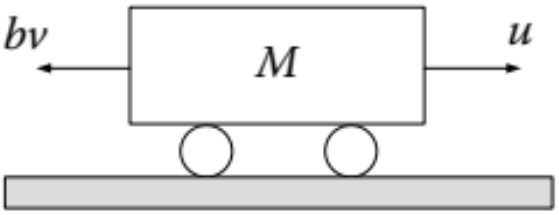

Figure 1

1. Obtain the continuous transfer function model of the system $\frac{V(s)}{U(s)}$. *(5 marks)*
2. Discretize the continuous transfer function to obtain $\frac{V(z)}{U(z)}$ using the zero-order hold. *(5 marks)*

Question (3): (10 marks)

Consider the following closed-loop digital control system in Figure 2.

1. Draw the Bode diagram assume that $T = 0.1\ sec$. *(8 marks)*
2. For what range of radial frequencies does this plot hold? *(2 marks)*

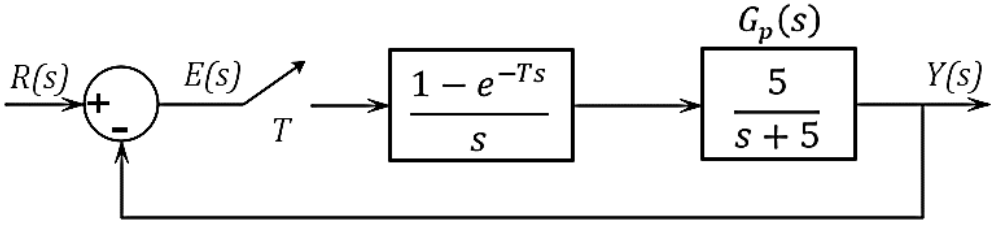

Figure 2