International Islamic University Chittagong
Department of Electrical and Electronic Engineering

Final Examination, Autumn-2018
Course Code: **EEE 4701**
Time: **2 hours 30 minutes**

Program: **B.Sc. Engg. (EEE)**
Course Title: **Control System I.**
Full Marks: 50

Part A

[Answer any ***two*** questions from the followings; Figures in the right margin indicate full marks.]

Q1 Since the transfer function is a representation of a system from input to output, the system's step response can lead to a representation even though the inner construction is not known. **Figure 1** shows the laboratory result of a system step response.

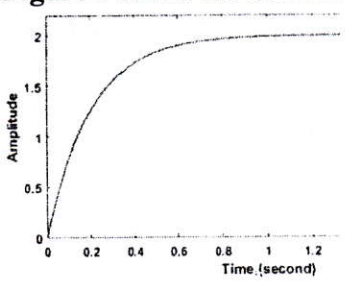


Figure 1: System step response.

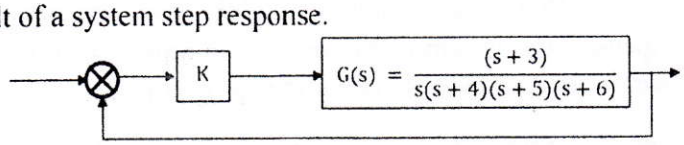


Figure 2: A system for gain design

1(a). Determine the transfer function of the system. **04**

1(b). Express the second order general transfer function by means of natural frequency and damping ratio. **03**

1(c). Classify the system based on the values of damping ratio. **03**

Q2 Control systems analysis and design focus on three specifications: (1) transient response, (2) stability, and (3) steady-state errors. A system in **Figure 2** is subject to determine steady-state error and gain design.

2(a). Define steady-state error. What are the standard test inputs? **02**

2(b). Evaluate the steady-state error of the system for standard inputs. **04**

2(c). Determine the gain, K, for the steady-state error of 10%. **04**

3(a). Define poles & zeros of a system. **02**

3(b). A system has a transfer function, **03**

$$G(S) = \frac{50}{s + 50}$$

Find the time constant, T_c, settling time, T_s, and rise time, T_r.

3(c). If $V_i(t)$ is a step voltage in the network shown in **Figure 3**, find the value of the resistor such that a 30% overshoot in voltage will be seen across the capacitor if C= 20^{-6}F and L=2 H. **05**

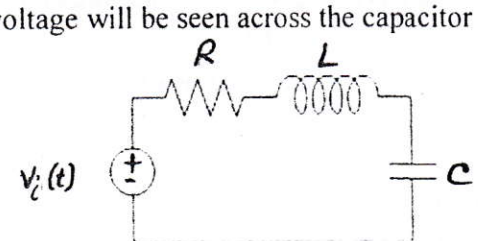


Figure 3: A typical system

Part B

[Answer any ***three*** questions from the followings; figures in the right margin indicate full marks.]

Q4 An uncompensated system is shown in **Figure 4**.

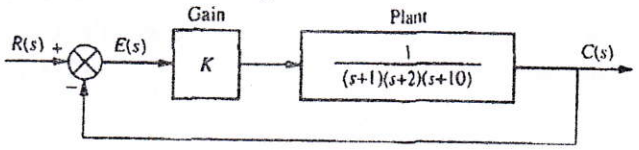


Figure 4: An uncompensated system

4(a). What kind of compensation improves the following? **03**

(i) Steady-state error

(ii) Transient response

(iii) Both steady-state error and transient response

4(b). Compensate the system of **Figure 4** to improve the steady-state error by a factor of 20 if the system is operating with a damping ratio of 0.174. **07**

5(a). Define root locus. What is the control system problem addressed by the root locus? **04**

5(b). For the , **06**

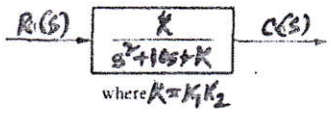


Figure 5: Closed loop transfer function.

(a) Determine the poles for the gain (K) values in-between 0-50 with an interval of 5.

(b) Draw the poles in the complex plane.

(c) Sketch the root locus for the system.

6(a). Given the unity feedback system of **Figure 6**, find the poles a **05**

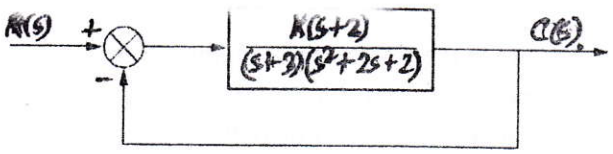


Figure 6

6(b). Obtain the bode plot of the system given by the transfer function **05**

$$G(S) = \frac{4}{s^2 + s + 4}$$

7(a). Write down the characteristics of lag and lead compensation **03**

7(b). What are the rules to be considered for drawing root l **03**

7(c). Given a unity feedback system that has the forw transfer function **04**

$$G(s) = \frac{K(s+2)}{(s^2 - 4s + 13)}$$

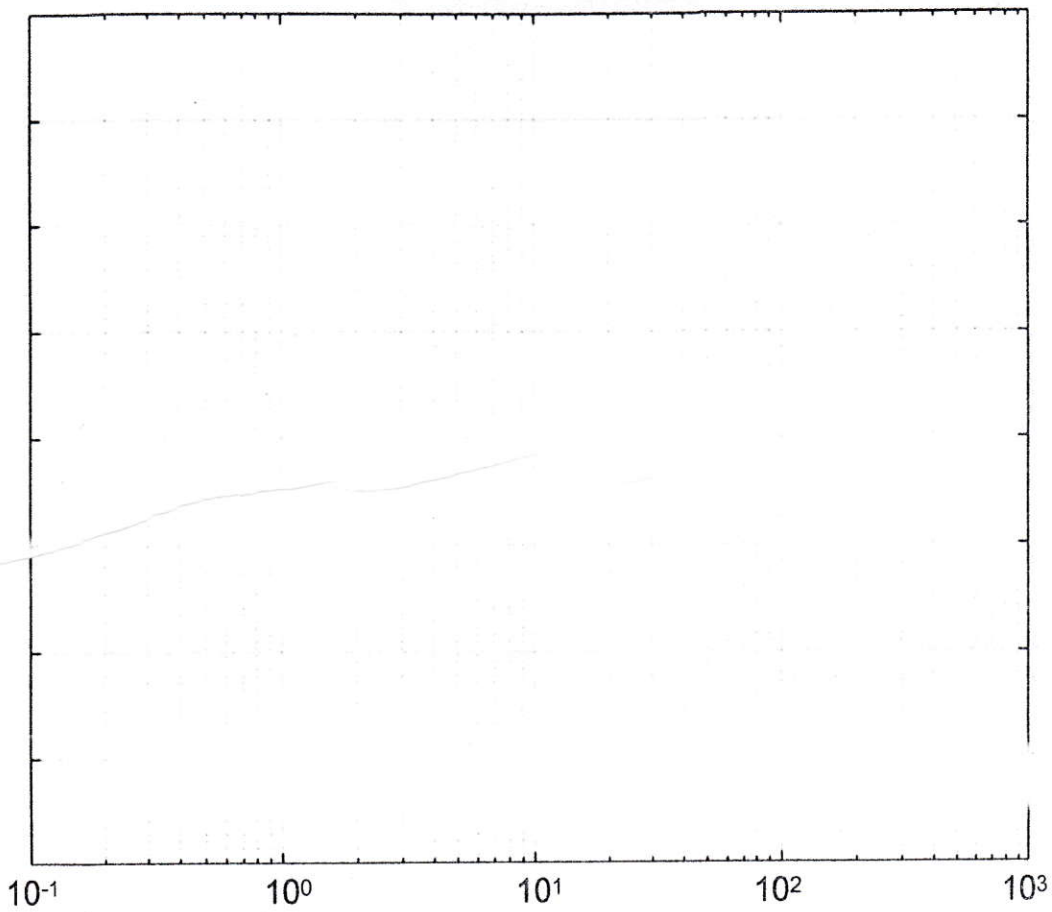
do the following:

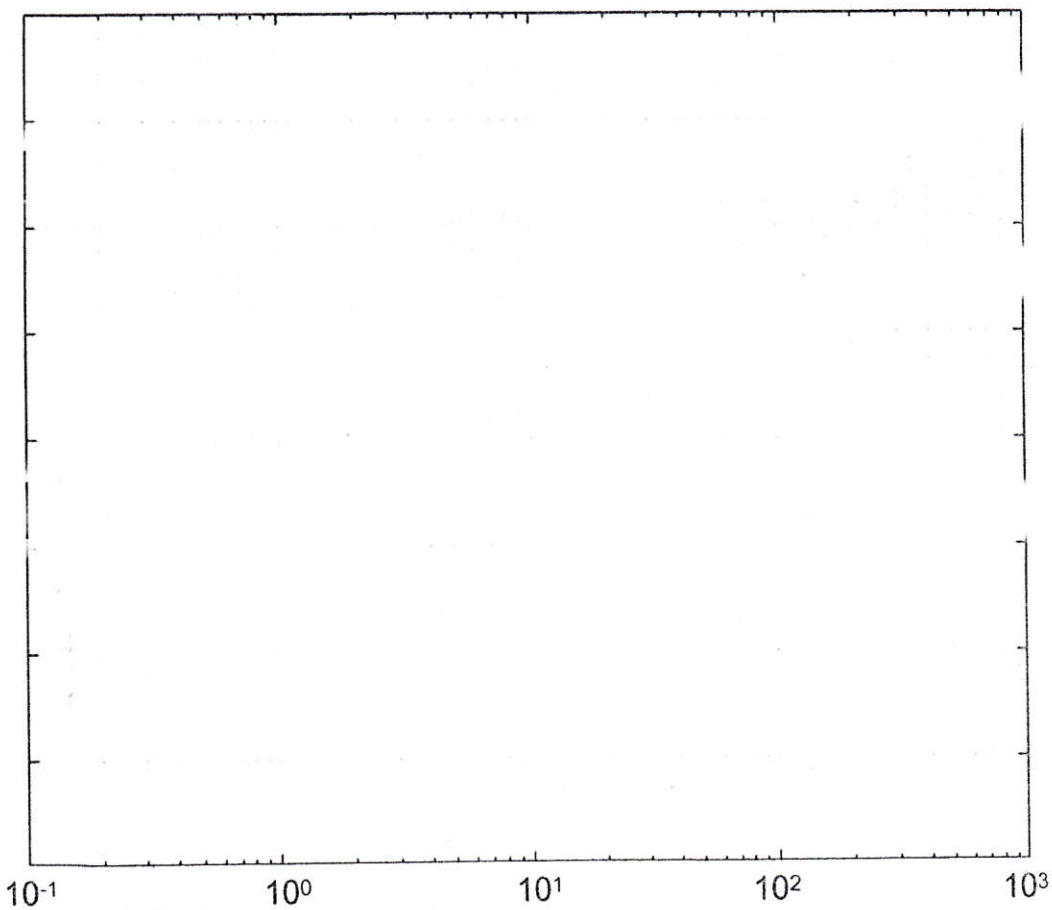
(i) Sketch the root locus.

(ii) Find the imaginary axis crossing.

(iii) Find the gain, K, at the imaginary axis crossing.

(iv) Find the break-in point.





Semi Loglog graph for EEE4701