Final Assessment Test (FAT) - July/August 2023

Programme	**B.Tech.**	Semester	**Fall Inter Semester 22-23**
Course Title	**CONTROL SYSTEMS**	Course Code	**BECE302L**
Faculty Name	**Prof. Sunil Kumar Pradhan**	Slot	**C1+TC1**
		Class Nbr	**CH2022325500122**
Time	**3 Hours**	Max. Marks	**100**

For Bode plot, use semi-log graph sheet. For Polar plot and Nyquist plot you can use Normal graph sheet or polar graph sheet. For root locus use normal graph sheet only.

Part A (5 X 8 Marks)
Answer all questions

01. Discuss the effect of feedback on time constant and sensitivity of a control system. [8]

02. A second order control system is represented by the transfer function given below. [8]

$$\frac{Q(s)}{T(s)} = \frac{1}{Js^2+Fs+K}$$

Where Q(s) is the proportional output and T(s) is the input torque. A step input 10 Newton-meter is applied to the system and the test results are maximum overshoot(M_p) = 6%, peak time(t_p) = 1 second, and the steady state error of the output is 0.5 radian. Determine the value of J, K, and F.

03. The open loop transfer function with unity feedback system is given by [8]

$$G(s)= \frac{108}{s^2(s+4)(s^2+3s+12)}$$

Find the static error coefficients and steady state error of the system when subjected to an input given by $r(t) = 2+5t+ 2t^2$.

04. A unity feedback system has a loop transfer function G(s) = (s+2)/(s+1)(s-1). Use Nyquist criteria to determine the system stability. [8]

05. Explain different types of compensation with block diagrams. Discuss the effects and limitations of the phase-lead network. [8]

Part B (4 X 15 Marks)
Answer all questions

06. Let's consider a block diagram which is shown in the Figure 1.Obtain the equivalent signal flow graph and determine the transfer function by using Mason's gain formula. [15]

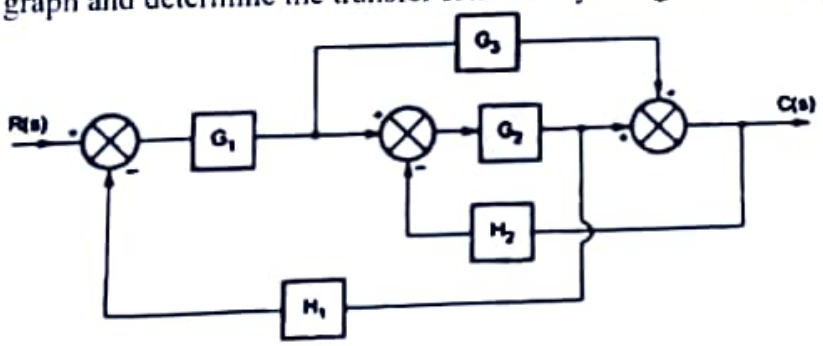

Figure 1

07. A unity feedback system has an open-loop transfer function which is represented below. Sketch the root locus and comment on the stability of the system. [15]

$$G(s)H(s) = \frac{K}{s(s+2)(s+4)}$$

08. Draw the Bode-plot for the transfer function as represented below. Find the gain margin, phase margin, gain cross-over frequency and phase cross over frequency. [15]

$$G(s)H(s) = \frac{4000(s+0.05)(s+4)}{s(s+1)(s+10)}$$

09. Find the state transition matrix $\phi(t)$ and the characteristic equation of A. [15]

$$A=\begin{bmatrix} -3 & 0 \\ 0 & -3 \end{bmatrix}$$

A system is described by the following equations.

$$\dot{X}(t)=\begin{bmatrix} -1 & 1 \\ 0 & -2 \end{bmatrix} x(t) + \begin{bmatrix} 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix} u(t) \quad \text{and} \quad y(t) = \begin{bmatrix} 1 & 2 \\ 1 & 0 \\ 1 & 1 \end{bmatrix} x(t)$$

Find the transfer function of the system.

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