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CBCS SCHEME

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18MT34

Third Semester B.E./B.Tech. Degree Examination, June/July 2025
Control Systems

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Distinguish between open loop and closed loop control system. Describe two example for each. **(10 Marks)**

b. For the mechanical system shown in Fig. Q1 (b). Find the transfer function $\frac{X_1(s)}{F(s)}$. **(10 Marks)**

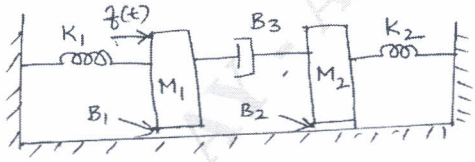

Fig. Q1 (b)

OR

2 a. Refer Fig. Q2(a), draw the mechanical network. Draw the electrical network based on torque-current anology. Give all the relevant performance equations. **(10 Marks)**

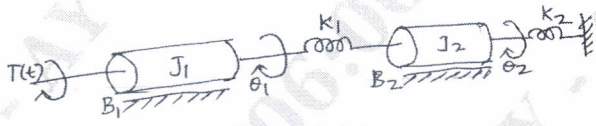

Fig. Q2 (a)

b. Reduce the block diagram to its simple form and hence obtain $\frac{C(s)}{R(s)}$. Refer Fig. Q2 (b). **(10 Marks)**

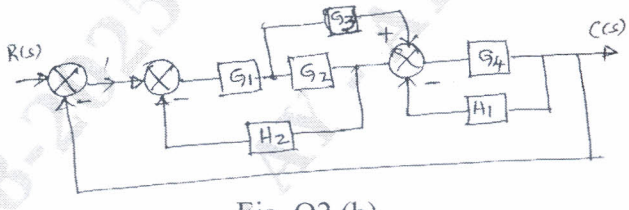

Fig. Q2 (b)

Module-2

3 a. Find C(S)/R(S) by Mason's gain formula, for the signal flow graph shown in Fig Q3(a).

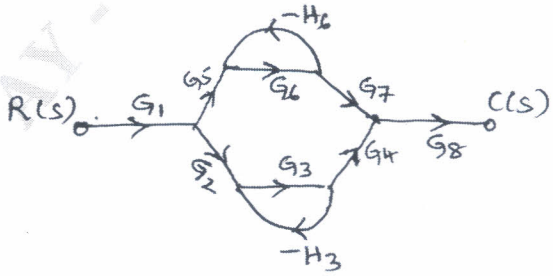

Fig Q3(a) **(10 Marks)**

b. Derive an expression of unit response of a second order system for underdamped case. **(10 Marks)**

OR

4 a. Define any five time response specifications of under damped second order system. Draw necessary response output graph. **(08 Marks)**

b. The open loop transfer function of a unity feedback control system is given by $G(s) = \frac{K}{S(ST+1)}$.

i) By chart factor the amplifier gain 'K' should be multiplied so that damping ratio is increased from 0.2 to 0.8.

ii) By what factor the time constant T should be multiplied so that the damping ratio is reduced from 0.6 to 0.3. **(12 Marks)**

Module-3

5 a. What is stability analysis? State R-H criterion statement and explain. **(07 Marks)**

b. Examine the stability of the system, having C.E $S^5 + 2S^4 + 3S^3 + 6S^2 + 2S + 1 = 0$. **(07 Marks)**

c. For an unity feedback system, the system is conditionally stable and oscillates with a frequency of 61 rad s^{-1}. Find R and K_{mar}. $G(s) = \frac{9}{s^3 + Rs^2 + 3ks}$ **(06 Marks)**

OR

6 a. Define Bandwidth and derive an expression for bandwidth of a standard second order system. **(10 Marks)**

b. The OLTE of an unity FBCS, is $G(s) = \frac{k}{s(s+a)}$,

i) Find the value of 'k' and 'a' so that M_r = resonant, peak = 1.04 and W_r = resonant, frequency = 11.55 rad s^{-1}.

ii) For the values of 'k' and 'a' found in part (i), calculate the settling time and bandwidth of the system. **(10 Marks)**

Module-4

7 a. Explain the method of calculation the breakaway points and centroid. **(06 Marks)**

b. Sketch the complete root locus of system having, $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$. **(14 Marks)**

OR

8 a. Explain the concept of gain margin and phase margin, and how these values help in studying relative stability. **(06 Marks)**

b. For a unity feedback system $G(s) = \frac{800(s+2)}{s^2(s+10)(s+40)}$, sketch the bode plot and comment on stability. **(14 Marks)**

Module-5

9 a. List the advantages of state variable analysis. **(04 Marks)**

b. Define state, state variables, state space and state trajectory. **(08 Marks)**

c. Obtain the transfer function : If $\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix}$ $y = \begin{bmatrix} 1 & 2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \end{bmatrix}$. **(08 Marks)**

OR

10 a. List the properties of state transition matrix and write the transfer function of a state space model in general. **(08 Marks)**

b. Obtain the state transition matrix for $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$. **(12 Marks)**