CBCS SCHEME

USN | | | | | | | | | | |

15MT34

Third Semester B.E. Degree Examination, June/July 2023
Control Systems

Time: 3 hrs. Max. Marks: 80

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. Define control systems. Distinguish between open loop and closed loop control systems. **(08 Marks)**

b. In the circuit below Fig.1(b). Determine the transfer function $E_0(S)/E_i(S)$.

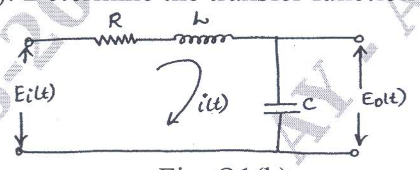
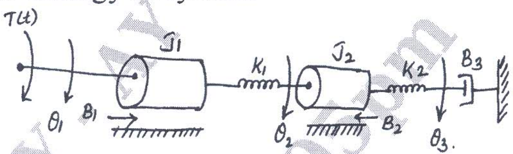


Fig. Q1(b) **(08 Marks)**

OR

2 a. Write the differential equations for the mechanical rotational system shown in Fig.Q2(a). Obtain the torque-current analogy of system. **(08 Marks)**

Fig. Q2(a)



b. Reduce the block diagram shown in Fig.Q2(b) to its simple form and hence obtain C(s)/R(s).

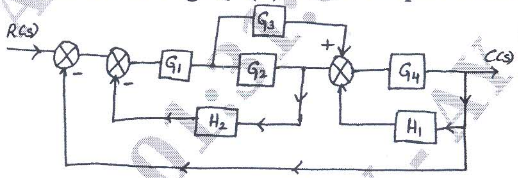


Fig. Q2(b) **(08 Marks)**

Module-2

3 a. State and explain the Mason gain formula. **(08 Marks)**

b. Find the transfer function $\frac{C(s)}{R(s)}$ using signal flow graph.

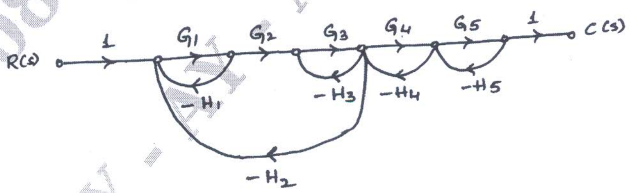


Fig. Q3(b) **(08 Marks)**

OR

4 a. A system is given by differential equation, $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 8y = 8x$ where y = output and x = input. Determine all time domain specifications for unit step input. **(08 Marks)**

b. Consider unity feedback control system whose open loop transfer function is given by $G(s) = \frac{0.4s+1}{s(s+0.6)}$. Calculate rise time, peak overshoot, peak time and settling time. **(08 Marks)**

Module-3

5 a. Using Routh criteria determine the stability of the following :

i) $s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$.

ii) $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$. **(08 Marks)**

b. Sketch the complete root locus of system having $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$. Comment on stability. **(08 Marks)**

OR

6 a. State and explain Routh Hurwitz criterion of stability. **(08 Marks)**

b. $S^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$. Find the number of roots of this equation with positive real part, zero real part and negative real part. **(08 Marks)**

Module-4

7 a. A system of third order shows resonance peak of 2 and resonance frequency of 3 rad/sec. Determine the transfer function of equivalent second order system and hence find T_r, T_p, T_s and % overshoot. **(08 Marks)**

b. For a particular unity feedback, $G(s) = \frac{242(s+5)}{s(s+1)(s^2+5s+121)}$. Sketch the bode plot. Find ω_{gc} and ω_{pc}. G.M, P.M. **(08 Marks)**

OR

8 a. Consider type2 system with transfer function $G(s)H(s) = \frac{1}{s^2(1+T_s)}$. Obtain its polar plot. **(08 Marks)**

b. For a certain control system $G(s)H(s) = \frac{k}{s(s+2)(s+10)}$. Sketch the Nyquist plot and hence calculate the range of values of k for stability. **(08 Marks)**

Module-5

9 a. Define : i) State ii) State Vector iii) State Space iv) State Variable. **(08 Marks)**

b. Derive the transfer function for state model. **(08 Marks)**

OR

10 a. Determine the transfer function matrix for MIMO system given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 3 \\ -2 & -5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} u_1 \\ u_2 \end{bmatrix} \; ; \quad \begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 2 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(08 Marks)

b. Obtain the time response of the following system.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(t)$$

Where u(t) is the unit step occurring at t = 0 and $x^T(0) = [1 \;\; 0]$. **(08 Marks)**

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