CBCS SCHEME

USN

21MT734

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025

Control Systems and Engineering

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. Derive time response for first order control system. **(10 Marks)**

b. Derive peak time (T_p) for second order control system. **(10 Marks)**

OR

2 a. Explain PI and PID controllers. **(10 Marks)**

b. A unit feedback system is characterized by open loop transfer function $G(s) = \frac{K}{s(s+10)}$.

Determine gain K, such that system has a damping ratio 0.5 for this value of K. Determine settling time, peak overshoot, rise time for unit step input. **(10 Marks)**

Module-2

3 a. Determine stability using Hurwitz criteria $s^3 + 8s^2 + 14s + 24 = 0$ **(06 Marks)**

b. Determine stability for the characteristic equation $s^6 + s^5 + 5s^4 + 3s^3 + 2s^2 - 4s - 8 = 0$ **(14 Marks)**

OR

4 a. Using RH criteria, determine stability of the system having characteristic equation: $s^6 + 2s^5 + 5s^4 + 8s^3 + 8s^2 + 8s + 4 = 0$ **(10 Marks)**

b. For a system with characteristic equation $F(s) = s^6 + 3s^5 + 4s^4 + 6s^3 + 5s^2 + 3s + 2 = 0$ examine stability. **(10 Marks)**

Module-3

5 a. Sketch the complete root locus for

$$G(s)H(s) = \frac{K}{s(s+3)(s^2+3s+3)}$$ **(10 Marks)**

b. Draw the root locus for closed loop system $G(s)H(s) = \frac{K}{s(s+5)(s+10)}$; comment on stability. **(10 Marks)**

OR

6 a. Sketch the complete root locus for the system $G(s)H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$ **(10 Marks)**

b. A feedback control system has open loop transfer function $G(s)H(s) = \frac{K}{s(s+4)(s^2+4s+20)}$.

Plot the root locus for K = 0 to ∞. Indicate all the points. **(10 Marks)**

Module-4

7 a. Derive resonant peak (Mr) and resonant frequency (Wr) for second order control system. **(10 Marks)**

b. Explain the frequency response/domain specification. **(10 Marks)**

OR

8 a. A system of third order shows resonance peak of 2 and resonance frequency 3 rad/sec. Determine the transfer function of equivalent second order system, hence find T_r, T_p, T_s and % overshoot, time of oscillation and number of oscillation before settling. **(10 Marks)**

b. Sketch the bode plot for the system having $G(s)H(s) = \dfrac{20}{s(1+0.1s)}$ **(10 Marks)**

Module-5

9 a. Construct the state model using phase variables if the system is described by the differential equation

$$\frac{d^3y(t)}{dt^3} + 4\frac{d^2y(t)}{dt^2} + 7\frac{dy(t)}{dt} + 2y(t) = 5u(t)$$ **(10 Marks)**

b. Find the transfer function of the system having state model

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u \quad \text{and} \quad y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$$ **(10 Marks)**

OR

10 a. Linear time invariant system is characterized by the homogeneous state equation.

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Compute the solution of homogenous equation assume the initial state sector $X_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$ **(10 Marks)**

b. Derive transfer function from state model. **(10 Marks)**

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