CBCS SCHEME

USN

21MT734

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Control System 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 peak overshoot for second order control system. **(12 Marks)**

b. Explain PI and PD controllers. **(08 Marks)**

OR

2 a. Explain the transient response specification of second order control system. **(08 Marks)**

b. A negative feedback system has the following transfer function $G(s) = \dfrac{9}{s(s+2)}$; $H(s) = 1$.
Determine natural frequency, damping ratio, damping frequency, damping factor, rise time and peak overshoot, peak time, 5% settling time. Assume unit step input. **(12 Marks)**

Module-2

3 a. Determine stability using Hurwitz criteria for $F(s) = s^3 + s^2 + s^1 + 4 = 0$. **(10 Marks)**

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

OR

4 a. Using R-H 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. A step of '2' is applied to a unity feedback system. Determine value of 'A' and 'K'. Damping ratio $\varepsilon = 0.6$, damping frequency $\omega_d = 8$ rad/sec. what is the peak value of the response. Refer Fig.Q4(b).

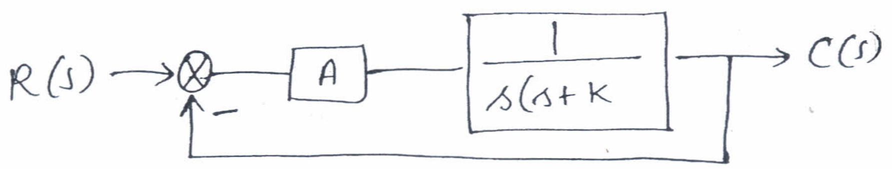

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Draw the root locus for closed loop system and comment on stability.

$$G(s)H(s) = \frac{k}{s(s+5)(s+10)}.$$ **(10 Marks)**

b. Sketch the root locus for the system :

$$G(s)H(s) = \frac{k}{s(s+1)(s+2)(s+3)}.$$

(10 Marks)

OR

6 a. Reduce the imaginary part of complex poles such that the distance of s = 0 and –3 from s = –1.5

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

b. Plot the root locus for K = 0 to ∞. A feedback control system has open loop transfer function: $G(s)H(s) = \frac{k}{s(s+4)(s^2+4s+20)}$. **(10 Marks)**

Module-4

7 a. Explain frequency response specification. **(10 Marks)**

b. Derive bandwidth for second order control system. **(10 Marks)**

OR

8 a. Sketch the bode plot for the system having,

$$G(s)H(s) = \frac{20}{s(1+0.1s)}.$$ **(10 Marks)**

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

Module-5

9 a. Obtain the state model for the system given by differential equation :

$$\frac{d^3y}{dt^3} + \frac{6d^2y}{dt^2} + \frac{11dy}{dt} + 6y = 5u_1 + 10u_2.$$ **(10 Marks)**

b. 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 homogeneous equation assume initial state vector,

$$X_0 = \begin{bmatrix} 1 \\ 0 \end{bmatrix}.$$ **(10 Marks)**

OR

10 a. Derive transfer function form state model. **(10 Marks)**

b. Obtain the state model for the electrical circuits. Choose the state variables as : $i_1(t)$, $i_2(t)$ and $V_c(t)$. Refer Fig.Q10(b).

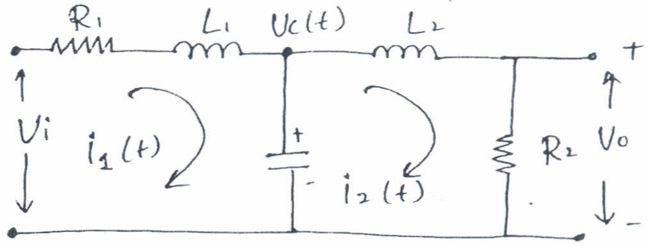

Fig.Q10(b) **(10 Marks)**

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