CBCS SCHEME

USN

BEE602

Sixth Semester B.E/B.Tech. Degree Examination, Dec.2025/Jan.2026
Control System

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
1	a.	Define control system. Explain open loop and closed loop control system with the help of neat block diagram.	6	L2	CO1
	b.	For the mechanical system shown in Fig.Q1(b). Write the differential equations governing the behavior of mechanical system and obtain force-current analogous electrical system. Fig.Q1(b)	8	L2	CO1
	c.	For the electrical network shown in Fig.Q1(c). Obtain transfer function $\frac{V_0(s)}{Vi(s)}$. Fig.Q1(c)	6	L2	CO1
		OR			
2	a.	Define the transfer function and derive transfer function of an armature controlled DC motor and construct the block diagram of DC motor.	8	L2	CO1
	b.	For the mechanical system shown in Fig.Q2(b). Obtain analogous electrical circuit based on force-voltage analogy. Fig.Q2(b)	6	L2	CO1
	c.	Draw the analogous electrical circuit for the mechanical system shown in Fig.Q2(c) base on torque–voltage. Fig.Q2(c)	6	L2	CO1

		Module – 2			
3	a.	Define the following terms : i) Source node ii) Sink node iii) Forward path iv) Forward path gain v) Loop vi) Self loop.	6	L1	CO2
	b.	Obtain the closed loop transfer function : $\frac{C(s)}{R(s)}$ using block diagram reduction technique and also verify the result by signal flow graph method for Fig.Q3(b). Fig. Q3(b)	14	L3	CO2
		OR			
4	a.	Draw the block diagram of electrical circuit shown in Fig.Q4(a) and evaluate transfer function $E_0(s)/E_i(s)$ using block diagram reduction techniques. $R_1 = 100\ K\Omega$, $R_2 = 1\ M\Omega$, $C_1 = 10\ \mu F$, $C_2 = 1\ \mu F$. Fig.Q4(a)	10	L3	CO2
	b.	Apply the mason's gain formula to the signal flow graph shown in Fig.Q4(b) to find the transfer function $\frac{X_6}{X_1}$. Fig.Q4(b)	10	L3	CO2
		Module – 3			
5	a.	Define and derive the expression for rise time (t_r), peak time (t_p) for a under-damped second order system excited by a step input.	8	L2	CO3
	b.	The loop transfer function of a feed back control system is given by $G(s)H(s) = \frac{100}{s^2(s+4)(s+12)}$. Determine the steady state error constants and steady state error for the input $r(z) = 2z^2 + 5z + 10$.	6	L3	CO3
	c.	Determine the stability of the system represented by following characteristics equation : $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$.	6	L3	CO3

		OR			
6	a.	Explain the necessary and sufficient condition for a system to be stable according the RH criteria.	4	L1	CO3
	b.	A unity feedback control system is characteristized by the open loop transfer function : $G(s) = \frac{K(s+13)}{s(s+5)(s+7)}$ using RH criterion, calculate the range of K for the system to be stable and frequency of oscillations.	8	L3	CO3
	c.	A unity feedback control system is characterized by an open loop transfer function $G(s) = \frac{k}{s(s+10)}$. Determine K value for damping ratio of 0.5 and for the value of K find t_p, M_p, t_s for 2% tolerance.	8	L3	CO3
		Module – 4			
7	a.	Draw the complete root locus plot for the system $G(s)H(s) = \frac{k}{s(s+2)(s+4)}$. Find the range of K, so that damping ratio of the closed loop system is 0.5.	10	L4	CO4
	b.	A unity feedback control system has $G(s) = \frac{80}{s(s+20)(s+10)}$. Draw the bode plot, determine GM, PM W_{gc} and W_{pc} comment on stability.	10	L4	CO4
		OR			
8	a.	The open loop transfer function of a control system is given by : $G(s)H(s) = \frac{k}{s(s+6)(s^2+4s+13)}$ Determine : i) Break point ii) Angle of departure.	8	L4	CO4
	b.	Define the following terms of second order system. i) Resonant peak M_r ii) Resonant frequency W_r.	4	L2	CO4
	c.	Determine the open loop transfer function of a system where approximate plot is shown in Fig.Q8(c). Fig.Q8(c)	8	L4	CO4
		Module – 5			
9	a.	What is controller? Explain the effect of P, I, D PI, PD and PID controller on second order system.	10	L	CO
	b.	Obtain the transfer function of the system described by $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u,\ x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}\ y = [1\ 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$.	10	L3	CO5
		OR			
10	a.	Explain the effect of lag and lead compensator.	10	L2	CO5
	b.	Obtain state transition matrix for the state model where A value is given by $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$.	10	L3	CO5

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