CBCS SCHEME

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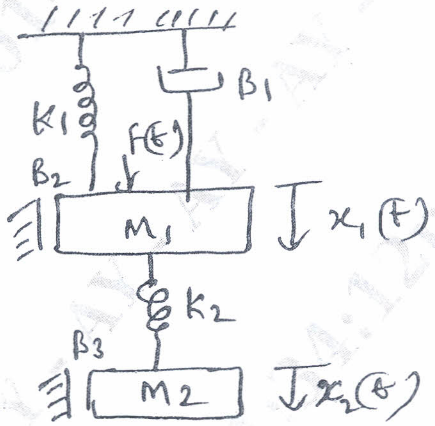
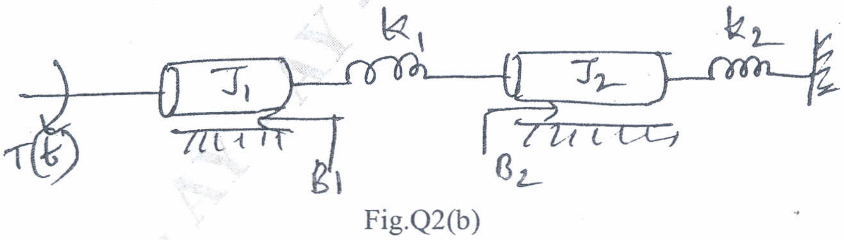
BEE602

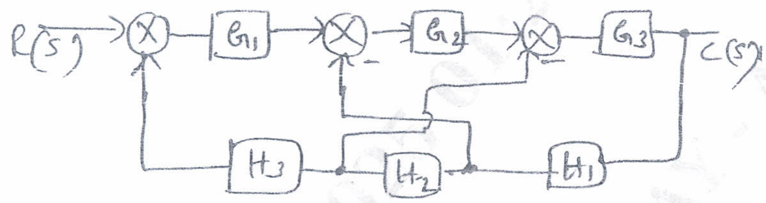
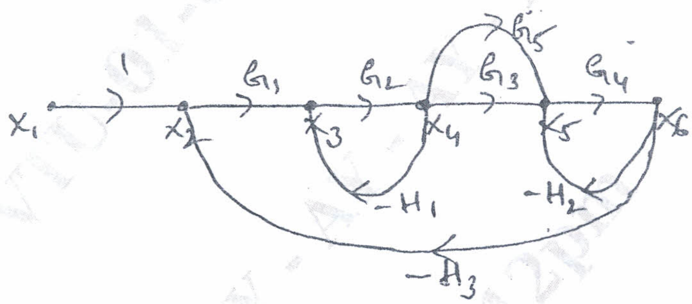
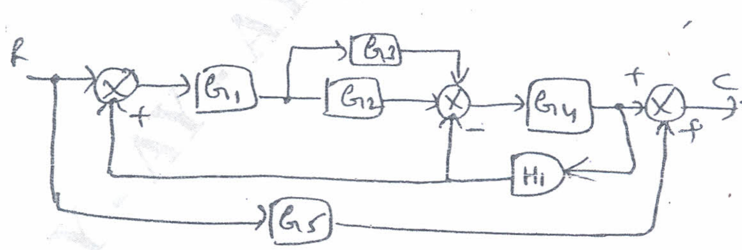
Sixth Semester B.E./B.Tech. Degree Examination, June/July 2025
Control Systems

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**
Q.1	**a.**	Construct mathematical model for the mechanical system shown in Fig.Q1(a). Draw electrical equivalent network based on force voltage analogy and force current analogy.  Fig.Q1(a)	12	L3	CO1
	b.	Derive the transfer function of armature controlled DC motor.	8	L4	CO1
		OR			
Q.2	**a.**	Distinguish between open loop and closed loop systems with examples.	8	L2	CO1
	b.	For the mechanical translation system as shown is Fig.Q2(b). Draw the electrical network based on torque current and torque voltage analogy. Write its performance equations.  Fig.Q2(b)	12	L3	CO1

Module – 2

Q.3	a.	Obtain $\frac{C(s)}{R(s)}$ using block diagram reduction rule.  Fig.Q3(a)	8	L3	C2O
	b.	Determine transfer function $X_6(s)/X_1(s)$ using Mason's gain formula for the signal flow graph shown in Fig.Q3(b).  Fig.Q3(b)	8	L4	CO2
	c.	Define : i) Source and sink node ii) Loop and forward path.	4	L2	CO2
		OR			
Q.4	a.	Explain Mason's gain formula indicating each term.	4	L1	CO2
	b.	Illustrate how to perform the following connection with block diagram reduction technique. i) Shifting summing point after a block ii) Shifting take off point ahead of a block iii) Blocks in parallel.	6	L3	CO2
	c.	Determine the transfer function $\frac{C(s)}{R(s)}$ of a system shown in Fig.Q4(c).  Fig.Q4(c)	10	L2	CO2

		Module – 3			
Q.5	a.	Derive an expression for rise time and peak-time for a second order system excited by a step input (under dumped case).	8	L4	CO3
	b.	Check the stability of the given characteristic equation using R – H criterion. $S^5 + 6s^4 + 3x^3 + 2s^2 + s + 1 = 0$.	6	L3	CO3
	c.	A second order system is given by $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 6s + 25}$, find rise time, peak time, peak overshoot and settling time for 2% tolerance.	6	L3	CO3
		OR			
Q.6	a.	Explain the difficulties encountered while assessing the R – H criteria and how do you eliminate these difficulties with examples.	8	L1	CO3
	b.	A unity feedback control system has $G(s) = \frac{K(s+4)}{s(s+1)(s+2)}$ using R-H criterion. Find the range of K for which system to be stable and also determine the frequency of oscillations.	8	L3	CO3
	c.	Obtain an expression for time response of the first order system subjected to unit step input.	4	L4	CO3
		Module – 4			
Q.7	a.	Explain the terms given below with respect to root locus : i) Break away point ii) Asymptotes iii) Intersection of root locus branches with J^{ω} axis.	6	L2	CO4
	b.	A unity feedback system the open loop transfer function is given by : $G(s) = \frac{K}{s(s+2)(s^2+6s+25)}$ i) Sketch the root locus for $0 \le K \le \infty$ ii) At what value of ' K' the system becomes stable iii) At this point of instability determine the frequency of oscillation of system.	14	L3	CO3
		OR			
Q.8	a.	A unity FBCS with $G(s) = \frac{80}{s(s+2)(s+20)}$. Find gain and phase margin using bode plot.	12	L2	CO4
	b.	Derive an expression for resonant peak and resonant frequency for a second order system.	8	L4	CO4

		Module – 5			
Q.9	**a.**	Explain PID controller and discuss the effect on the behavior of the system.	**10**	**L1**	**CO5**
	b.	Explain the step by step design procedure of lead compensation network.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Mention the properties of state transition matrix. Given that : $A_1 = \begin{bmatrix} \sigma & 0 \\ 0 & \sigma \end{bmatrix}$; $A_2 = \begin{bmatrix} 0 & \omega \\ -\omega & 0 \end{bmatrix}$; $A = \begin{bmatrix} \sigma & \omega \\ -\omega & \sigma \end{bmatrix}$ Compute e^{AT}.	**10**	**L2**	**CO5**
	b.	Explain the concept of state. Define : i) State variable ii) State vector iii) State space iv) State trajectory.	**10**	**L2**	**CO5**

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