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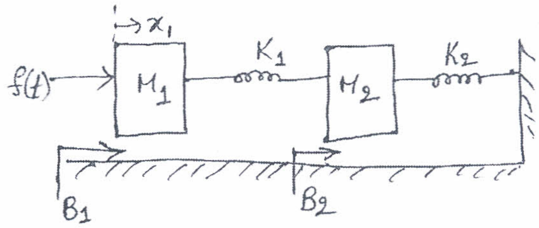
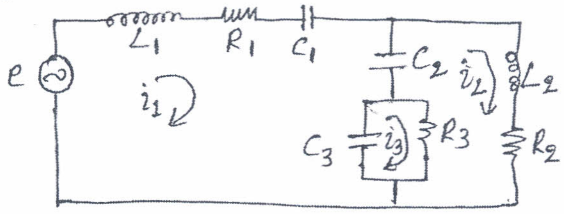
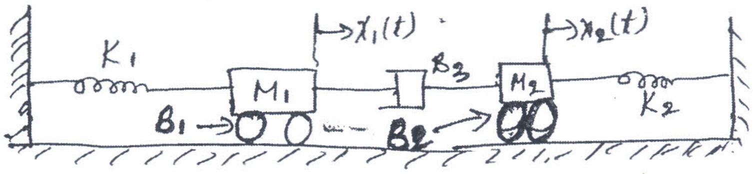
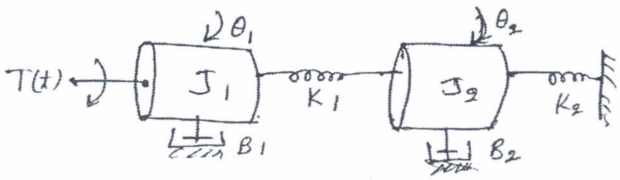
Fourth Semester B.E./B.Tech. Degree Examination, June/July 2025

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.	Define control system with examples. Compare closed loop and open loop control systems.	06	L1 L2 L3	CO1
	b.	For the mechanical system shown in Fig.Q1(b), write the mechanical network, equilibrium equations and obtain the electrical network based on F-V analogy.  Fig.Q1(b)	08	L1 L2 L3	CO1
	c.	The force-voltage analogy of a mechanical system is shown in Fig.Q1(c). Obtain its analogous mechanical network.  Fig.Q1(c)	06	L1 L2 L3	CO1
		OR			
Q.2	a.	Explain the effect of feedback on control systems.	06	L1 L2 L3	CO1
	b.	Find the force-voltage analogous electrical network for the given mechanical system shown in Fig.Q2(b).  Fig.Q2(b)	06	L1 L2 L3	CO1
	c.	Derive the differential equation governing the mechanical rotational system shown in Fig.Q2(c). Draw the equivalent voltage and current analogy circuits.  Fig.Q2(c)	08	L1 L2 L3	CO1

Module – 2

Q.3 a. Determine the transfer function C(S)/R(S) for the system shown in Fig.Q3(a), using block diagram reduction technique. — 10 — L1 L2 L3 — CO2

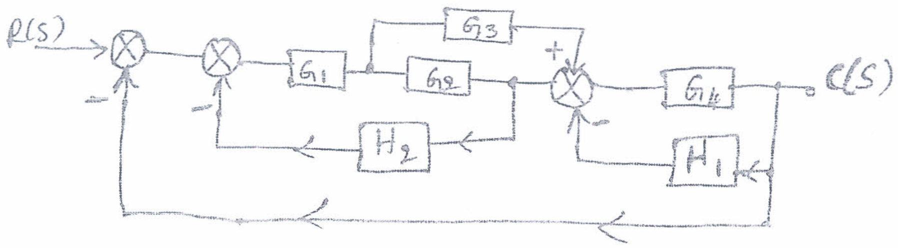


Fig.Q3(a)

b. Determine the overall transfer function using Mason's gain formula for the signal flow graph shown in Fig.Q3(b). — 10 — L1 L2 L3 — CO2

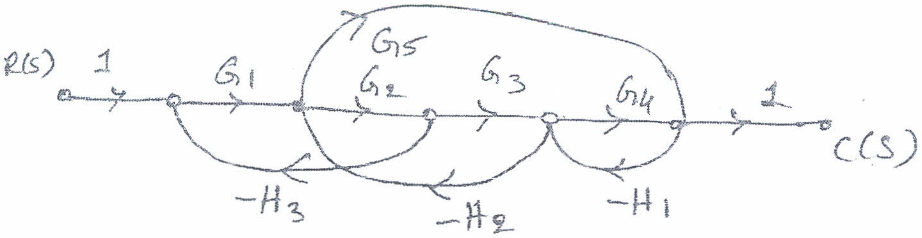


Fig.Q3(b)

OR

Q.4 a. Find the transfer function by reducing the block diagram shown in Fig.Q4(a). — 10 — L1 L2 L3 — CO3

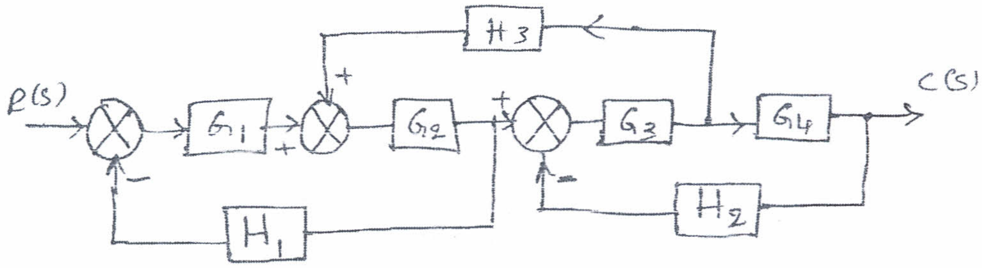


Fig.Q4(a)

b. Find the transfer function by using Mason's gain formula for the signal flow graph shown in Fig.Q4(b). — 10 — L1 L2 L3 — CO2

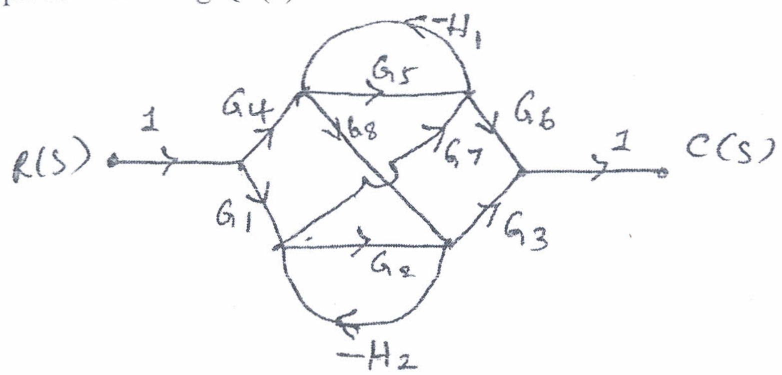
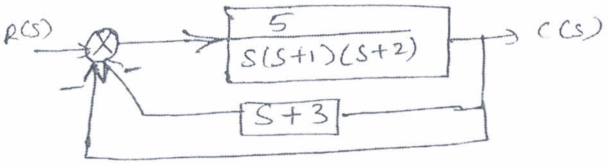


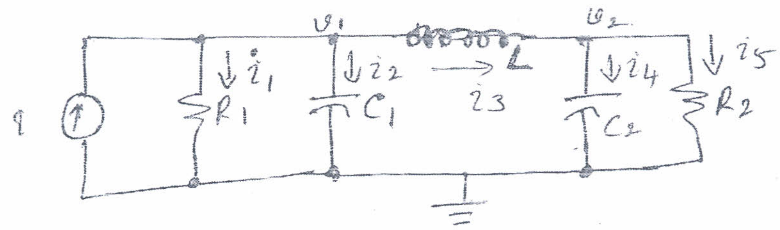
Fig.Q4(b)

		Module – 3			
Q.5	a.	For the system shown in Fig.Q5(a), find the (i) System type (ii) Static error constants K_p , K_v, K_a (iii) the steady state error for an input $r(t) = 3 + 2t$.  Fig.Q5(a)	08	L1 L2 L3	CO3
	b.	Find the step response c(t) for the system described by $\frac{C(s)}{R(s)} = \frac{4}{s+4}$ Also find time constant, rise time and settling time.	05	L1 L2 L3	CO3
	c.	Derive the equation steady state error of simple closed loop system.	07	L1 L2 L3	CO3
		OR			
Q.6	a.	Given a unity feedback system with $G(s) = \frac{20(1+s)}{s^2(2+s)(4+s)}$ (i) What is the type of system? (ii) Find static error coefficients. (iii) Find steady error if the input is $r(t) = 40 + 2t + 5t^2$	06	L1 L2 L3	CO3
	b.	Write the general block diagram of the following and explain : (i) PD type of controller (ii) PI type of controller	06	L1 L2 L3	CO3
	c.	Derive the response of an under damped second order system for unit step input.	08	L1 L2 L3	CO3
		Module – 4			
Q.7	a.	Mention limitations of Routh's criterion.	04	L1 L2 L3	CO4
	b.	Determine the range of K for which the system is stable such that a unity feedback system has $G(s) = \frac{K(s+13)}{s(s+3)(s+7)}$ using RH criterion. Also find closed loop, poles more negative than – 1.	08	L1 L2 L3	CO4
	c.	Check the stability of the given characteristic equation using Routh's method. $s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$	08	L1 L2 L3	CO4
		OR			
Q.8	a.	Sketch the complete Root locus of system having $G(s)\,H(s) = \frac{K}{s(s+5)(s+10)}$	08	L1 L2 L3	CO4
	b.	Sketch the complete Root locus of system having $G(s)\,H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$	12	L1 L2 L3	CO4

Module – 5

Q.9	a.	Draw the Bode plot for the open loop transfer function of a system is $$G(s) = \frac{K(1+0.2s)(1+0.025s)}{s^3(1+0.001s)(1+0.005s)}$$ Determine that the system is conditionally stable. Find the range of K for which the system is stable.	10	L1 L2 L3	CO5
	b.	The transfer function of a system is $$G(s)\,H(s) = \frac{K}{s(s+2)(s+10)}$$ Sketch the Nyquist plot and hence calculate the range of values of K for stability.	10	L1 L2 L3	CO5

OR

Q.10	a.	Obtain the state model of the network shown in Fig.Q10(a) assuming $R_1 = R_2 = 1\ \Omega$, $C_1 = C_2 = 1F$, and $L = 1H$.  Fig.Q10(a)	10	L1 L2 L3	CO5
	b.	Obtain the state transition matrix for the state model whose A matrix is given by $$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$$	10	L1 L2 L3	CO5

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