CBCS SCHEME - Make-Up Exam

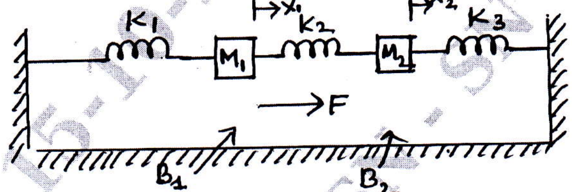
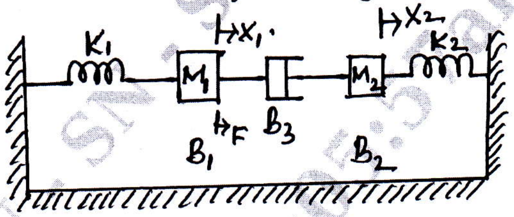
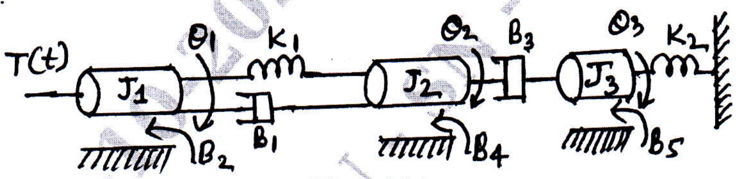
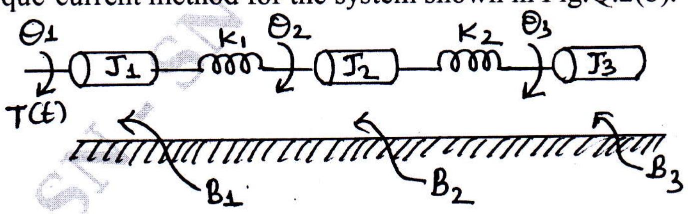
USN | | | | | | | | | | |

BEC403

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. List any four differences between Open Loop Control system and Closed Loop Control system.	4	L2	CO1
	b.	For the physical system shown in Fig.Q.1(b) draw its mechanical model and obtain equivalent electrical system using Force-voltage method.  Fig.Q.1(b)	8	L3	CO1
	c.	For the mechanical system shown in Fig.Q.1(c) draw its mechanical model and obtain its equivalent electrical system using Force-current method.  Fig.Q.1(c)	8	L3	CO1
		OR			
Q.2	a.	For the mechanical system shown in Fig.Q.2(a) write the differential equations and obtain its equivalent electrical system using Torque-voltage method.  Fig.Q.2(a)	7	L3	CO1
	b.	Draw the mechanical model and obtain the equivalent electrical network using Torque-current method for the system shown in Fig.Q.2(b).  Fig.Q.2(b)	8	L3	CO1

	c.	With the help of neat diagrams and necessary equations, explain the basic elements of translational motion.	5	L2	CO1

Module – 2

Q.3	a.	Find $\frac{C(S)}{R(S)}$ using Mason's gain formula for the graph shown in Fig.Q.3(a).	6	L3	CO1

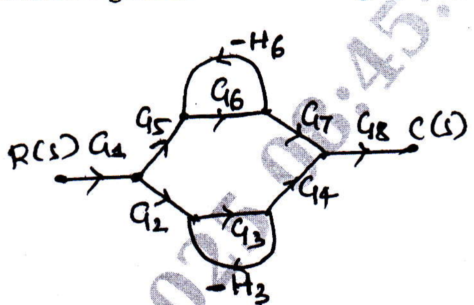


Fig.Q.3(a)

	b.	Find $\frac{C(S)}{R(S)}$ using block diagram reduction technique for the block diagram shown in Fig.Q.3(b).	6	L3	CO1

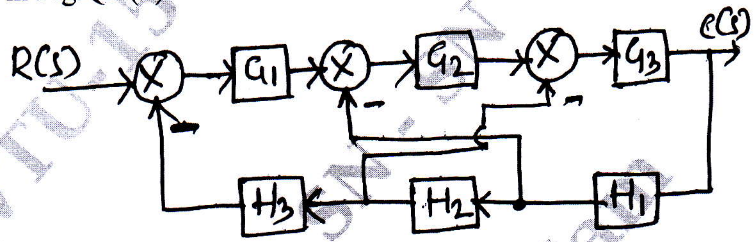


Fig.Q.3(b)

	c.	Obtain the expression for C_1 and C_2 for the multiple input multiple output system shown in Fig.Q.3(c).	8	L3	CO1

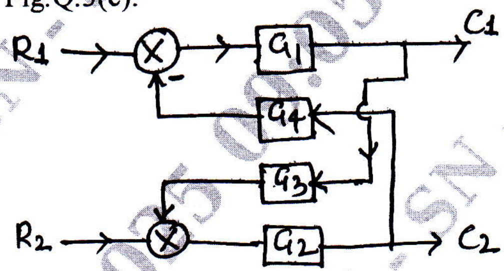


Fig.Q.3(c)

OR

Q.4	a.	Obtain $\frac{C(S)}{R(S)}$ using block diagram reduction rules for the Fig.Q.4(a).	8	L3	CO1

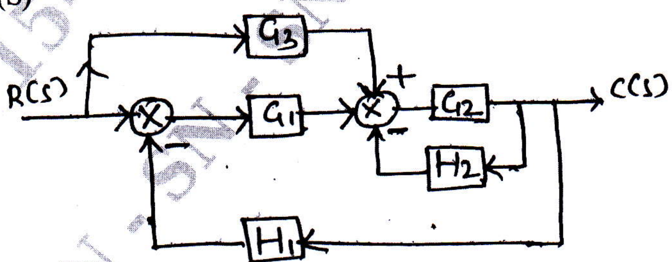
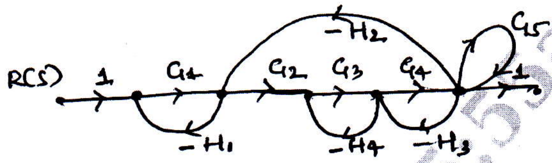
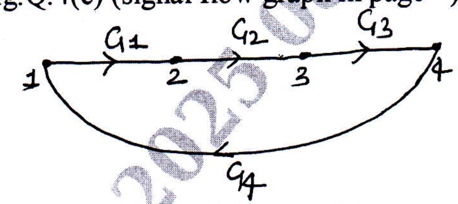
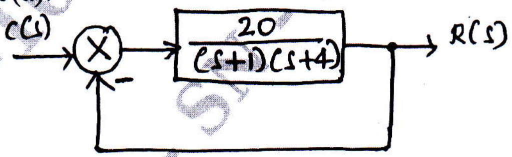


Fig.Q.4(a)

	b.	Find $\frac{C(S)}{R(S)}$ for the signal flow graph using Masons gain formula.  Fig.Q.4(b)	7	L3	CO1
	c.	Write MATLAB code to find the transfer function of the signal flow graph shown below in Fig.Q.4(c) (signal flow graph in page >).  This signal flow graph is Fig.Q.4(c)	5	L3	CO1
		Module – 3			
Q.5	a.	With the help of waveforms, mathematical expressions and Laplace transform explain the standard test inputs.	8	L2	CO2
	b.	A unit step input is applied to the unity feedback system for which open loop transfer function $G(S) = \frac{16}{S(S+8)}$. Find : i) Its closed TF ii) Natural frequency of oscillations 'ω_n' iii) Damping ratio 'ξ' iv) Damped frequency of oscillations 'ω_d'	6	L3	CO2
	c.	For a unity feedback system $G(S) = \frac{10}{S(S+1)}$. Find: i) Static error coefficients ii) Steady state error for unit step unit ramp and unit parabolic input iii) e_{ss} for $r(t) = 1 + t + t^2/2$	6	L3	CO2
		OR			
Q.6	a.	Obtain the closed loop transfer function damping ratio, natural frequency and expression for the output response if subjected to unit step input. Shown in Fig.Q.6(a).  Fig.Q.6(a)	8	L3	CO2
	b.	A system has 30% overshoot and settling time of 5 seconds for an unit step input. Determine : i) Transfer function ii) Peak time (t_p) iii) Output response	8	L3	CO2

	c.	Write a MATLAB code to plot the response of a second order system for unit step input by considering $w_n = 5$ and damping ratio 'ξ' of 0.2.	4	L3	CO2
		Module – 4			
Q.7	a.	Explain the Hurwitz criteria. What are the draw backs of Hurwitz criteria?	4	L2	CO2
	b.	$S^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$. Find the number of roots of this equation with positive real part, negative real part and zero real part.	8	L3	CO2
	c.	State angle condition and magnitude condition in case of root locus. Consider the system with $G(S)H(S) = \dfrac{K}{S(S+4)}$. Test a point $s = -2 + j5$ for its existence on root locus. Also find corresponding K.	8	L3	CO3
		OR			
Q.8	a.	Write the procedure for constructing root locus.	8	L2	CO3
	b.	Sketch the complete root locus of system having $G(S)H(S) = \dfrac{K}{S(S+1)(S+2)(S+3)}$	12	L3	CO3
		Module – 5			
Q.9	a.	For a certain control system $G(S)H(S) = \dfrac{K}{S(S+2)(S+10)}$ Sketch the Nyquist plot and hence calculate range of values of 'K' for stability.	10	L3	CO4
	b.	Draw the bode plot for a system having $G(S) = \dfrac{K(1+0.2S)(1+0.025S)}{S^3(1+0.001S)(1+0.005S)}$. Show that the system is conditionally stable. Find range of 'K' for which the system is stable. (Unity feedback).	10	L3	CO4
		OR			
Q.10	a.	Construct the state model using phase variables for a system described as $\dfrac{d^3y(t)}{dt^3} + \dfrac{4d^2y(t)}{dt^2} + \dfrac{7dy(t)}{dt} + 2y(t) = 5u(t)$	6	L3	CO5
	b.	Find the state transition matrix for $A = \begin{bmatrix} 0 & -1 \\ +2 & -3 \end{bmatrix}$	8	L3	CO5
	c.	Explain the properties of state transition matrix.	6	L2	CO5

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