CBCS SCHEME

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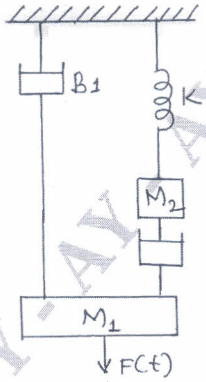
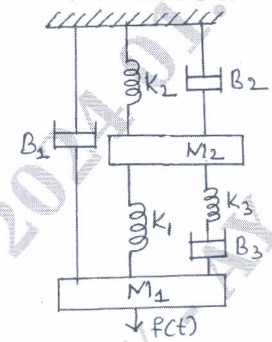
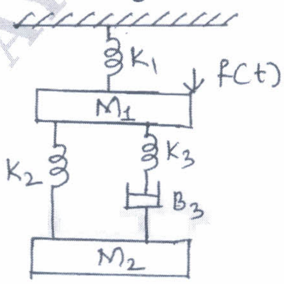
BEC403

Fourth Semester B.E./B.Tech. Degree Examination, June/July 2024
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. Write down any four differences between Open Loop Control System and Closed Loop Control System.	4	L2	CO1
	b.	For the mechanical system shown in Fig. Q1(b), obtain the equivalent electrical system using Force – Voltage method. Fig. Q1(b) 	8	L2	CO1
	c.	For the mechanical system, shown in Fig. Q1(c), obtain the equivalent electrical system using Force – Current method. Fig. Q1(c) 	8	L2	CO1
		OR			
Q.2	a.	For the mechanical system shown in Fig. Q2(a), obtain the equivalent electrical system using Force – Voltage method. Fig. Q2(a) 	7	L2	CO1

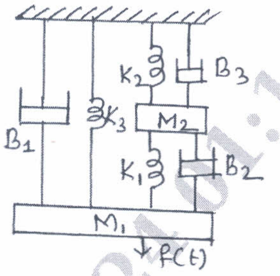
<table>
<tr><td></td><td>b.</td><td>For the mechanical system shown in Fig. Q2(b), obtain the equivalent electrical system using Force – Voltage method.


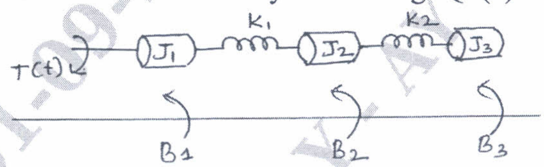
Fig. Q2(b)</td><td>7</td><td>L2</td><td>CO1</td></tr>
<tr><td></td><td>c.</td><td>Draw the electrical network based on torque – current analogy and write performance equation for the mechanical system of Fig. Q2(c).


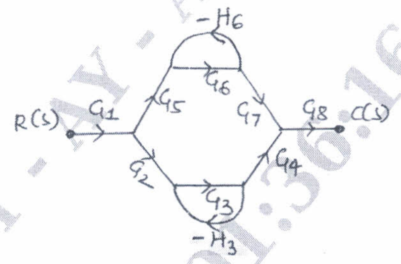
Fig. Q2(c)</td><td>6</td><td>L2</td><td>CO1</td></tr>
<tr><td colspan="6" align="center">Module – 2</td></tr>
<tr><td>Q.3</td><td>a.</td><td>Find $\frac{C(s)}{R(s)}$ by Mason's gain formula for Fig. Q3(a).


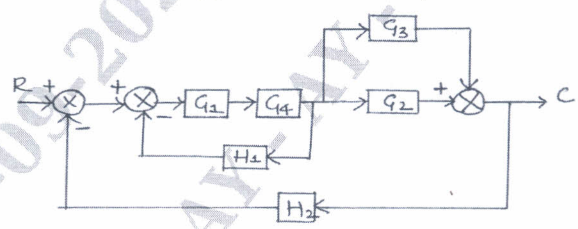
Fig. Q3(a)</td><td>6</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Determine the transfer function $\frac{C(s)}{R(s)}$ of the system shown in Fig. Q3(b).


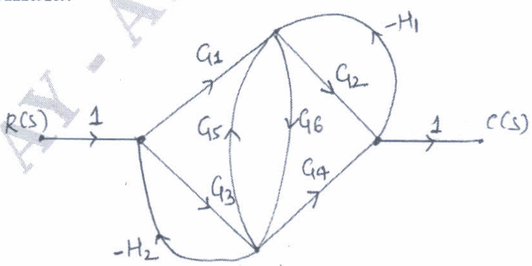
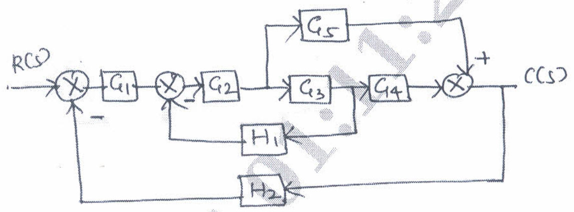
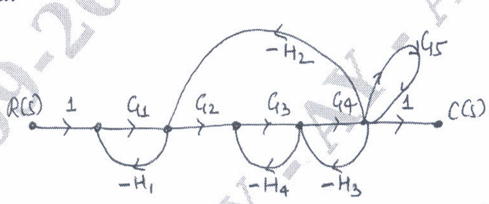
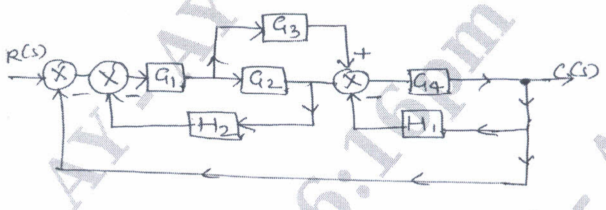
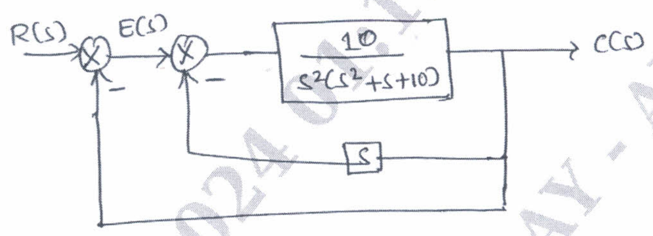
Fig. Q3(b)</td><td>6</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>For the single flow graph of Fig. Q3(c), find the transfer function using Mason's gain formula.


Fig. Q3(c)</td><td>8</td><td>L3</td><td>CO3</td></tr>
</table>

		OR			
Q.4	**a.**	Reduce the block diagram to its canonical form and obtain C(s)/R(s) of the system of Fig. Q4(a).  Fig. Q4(a)	6	L3	CO3
	b.	Obtain the transfer function of the single flow graph shown in Fig. Q4(b), using Mason's gain formula.  Fig. Q4(b)	6	L3	CO3
	c.	Reduce the block diagram of Fig. Q4(c) to its simple form and obtain C(s)/R(s).  Fig. Q4(c)	8	L3	CO3
		Module – 3			
Q.5	**a.**	With the help of graphical representation and mathematical expression, explain the following test signals : i) Step signal ii) Ramp signal iii) Impulse signal iv) Parabolic signal.	8	L3	CO2
	b.	Find Kp , Kv , Ka and steady state error for a system with Open loop transfer function $G(s)\,H(s) = \dfrac{10(s+2)(s+3)}{s(s+1)(s+4)(s+5)}$, where $r(t) = 3 + t + t^2$.	6	L3	CO2
	c.	The Open loop transfer function of a servo system with unity feedback is given as $G(s) = \dfrac{10}{s(0.1s+1)}$. Find out static error constants and obtain steady state error when an input $r(t) = A_0 + A_1 t + \dfrac{A_2}{2} t^2$ is applied.	6	L3	CO2
		OR			
Q.6	**a.**	For a unity feedback control system with $G(s) = \dfrac{64}{s(s+9.6)}$, write the output response to a unit step input. Determine 1) The response at t = 0.1 set 2) Maximum value of response and the time at which it occurs. 3) Settling time.	10	L2	CO3

	b.	For the system shown in Fig. Q6(b), 1) Identify the type of C(s) / E(s) 2) Find values of Kp , Kv , Ka. 3) If r(t) = 10u(t), find steady state value of the output.  Fig. Q6(b)	10	L2	CO3
		Module – 4			
Q.7	a.	Find the number of roots with positive real part, zero real part and negative real part for a system $s^6 + 4s^5 + 3s^4 - 16s^2 - 64s - 48 = 0$.	6	L2	CO4
	b.	For a unity feedback system , $G(s) = \frac{K}{s(1+0.4s)(1+0.25s)}$, find range of values of K, Marginal value of K and frequency of sustained oscillations.	6	L2	CO4
	c.	Explain the angle condition in Root locus. Test the following points using angle condition for the system $G(s)\,H(s) = \frac{K}{s(s+2)(s+4)}$. i) s = - 0.75 ii) s = -1 + j4.	8	L2	CO4
		OR			
Q.8	a.	Sketch the complete root locus and comment on the stability of the system $G(s)\,H(s) = \frac{K}{s(s+1)(s+2)(s+3)}$.	12	L2	CO4
	b.	Sketch the Bode plot for the transfer fl. Find value of 'K' for W_{gc} = 5 rad/sec. $G(s) = \frac{K s^2}{(1+0.2s)(1+0.02s)}$	8	L2	CO4
		Module – 5			
Q.9	a.	For a certain control system $G(s)\,H(s) = \frac{K}{s(s+2)(s+10)}$, sketch the Nyquist plot and hence calculate the range values of K for stability.	10	L2	CO5
	b.	Explain the Lag compensator and Lead compensator with the help of a circuit diagram.	10	L2	CO5
		OR			

Q.10	**a.**	Construct the state model using phase variables if the system is described by the differential equation $\frac{d^3y(t)}{dt^3}+4\frac{d^2y(t)}{dt^2}+7\frac{dy(t)}{dt}+2y(t)=5u(t)$. Also draw the state diagram.	**6**	**L2**	**CO5**
	b.	The transfer function of a control system is $\frac{Y(s)}{U(s)}=\frac{s^2+3s+4}{s^3+2s^2+3s+2}$. Obtain the State model using signal flow graph.	**7**	**L2**	**CO5**
	c.	Find the state transition matrix for $A=\begin{bmatrix} 0 & -1 \\ +2 & -3 \end{bmatrix}$	**7**	**L1**	**CO5**

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