CBCS SCHEME

USN | | | | | | | | | |

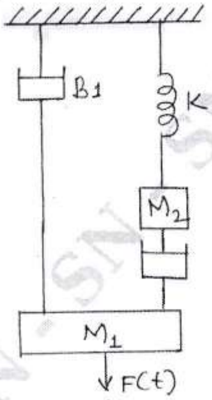
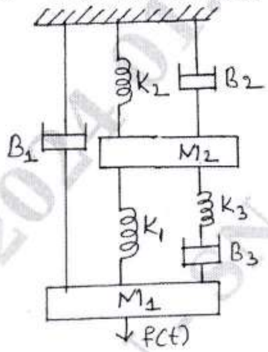
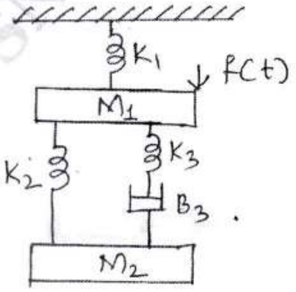
BEC403

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

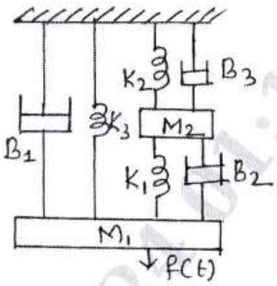
<table>
<tr><td></td><td>b.</td><td>For the mechanical system shown in Fig. Q2(b), obtain the equivalent electrical system using Force – Voltage method.


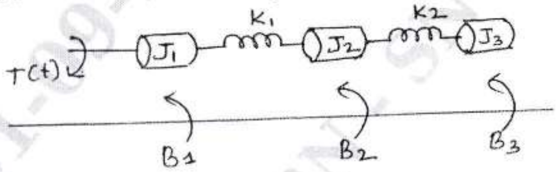
Fig. Q2(b)</td><td>7</td><td>L2</td><td>CO1</td></tr>
<tr><td></td><td>c.</td><td>Draw the electrical network based on torque – current analogy and write performance equation for the mechanical system of Fig. Q2(c).


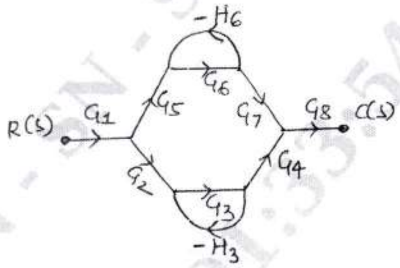
Fig. Q2(c)</td><td>6</td><td>L2</td><td>CO1</td></tr>
<tr><td colspan="6">Module – 2</td></tr>
<tr><td>Q.3</td><td>a.</td><td>Find $\frac{C(s)}{R(s)}$ by Mason's gain formula for Fig. Q3(a).


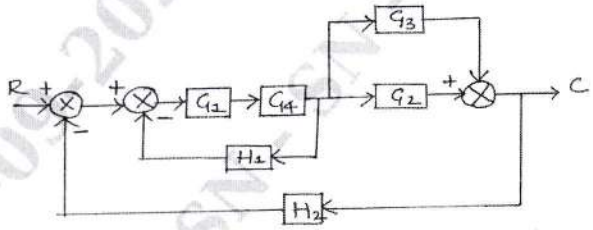
Fig. Q3(a)</td><td>6</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Determine the transfer function $\frac{C(s)}{R(s)}$ of the system shown in Fig. Q3(b).


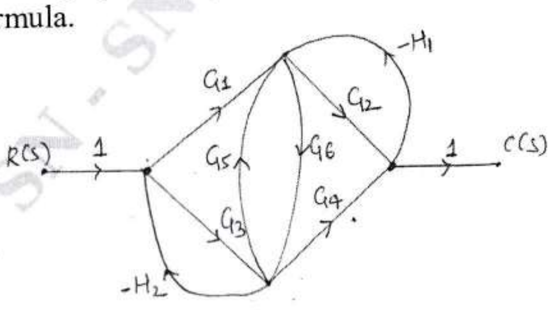
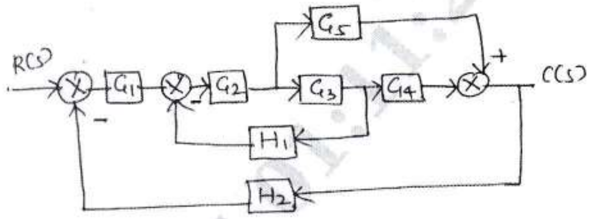
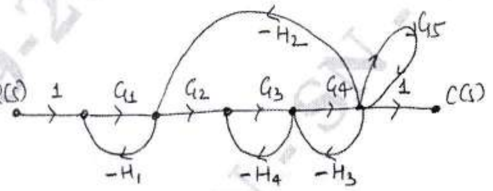
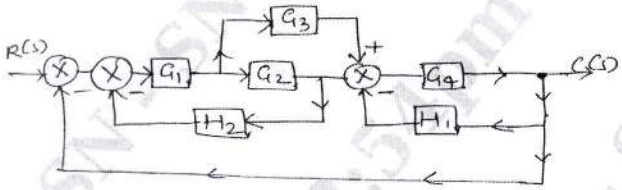
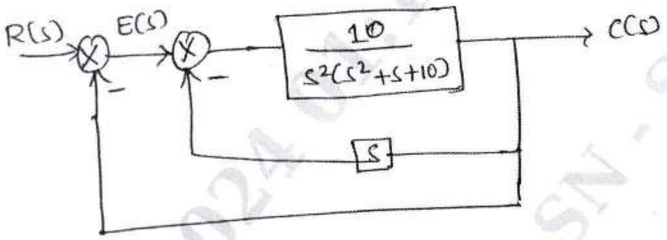
Fig. Q3(b)</td><td>6</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>For the single flow graph of Fig. Q3(c), find the transfer function using Mason's gain formula.


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 , $G(s) = \dfrac{K}{s(1+0.4s)(1+0.25s)}$, 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 $G(s)\,H(s) = \dfrac{K}{s(s+2)(s+4)}$. 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 $G(s)\,H(s) = \dfrac{K}{s(s+1)(s+2)(s+3)}$.	12	L2	CO4
	b.	Sketch the Bode plot for the transfer fl. Find value of 'K' for W_{gc} = 5 rad/sec. $G(s) = \dfrac{K s^2}{(1+0.2s)(1+0.02s)}$	8	L2	CO4
		Module – 5			
Q.9	a.	For a certain control system $G(s)\,H(s) = \dfrac{K}{s(s+2)(s+10)}$, 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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