CBCS SCHEME

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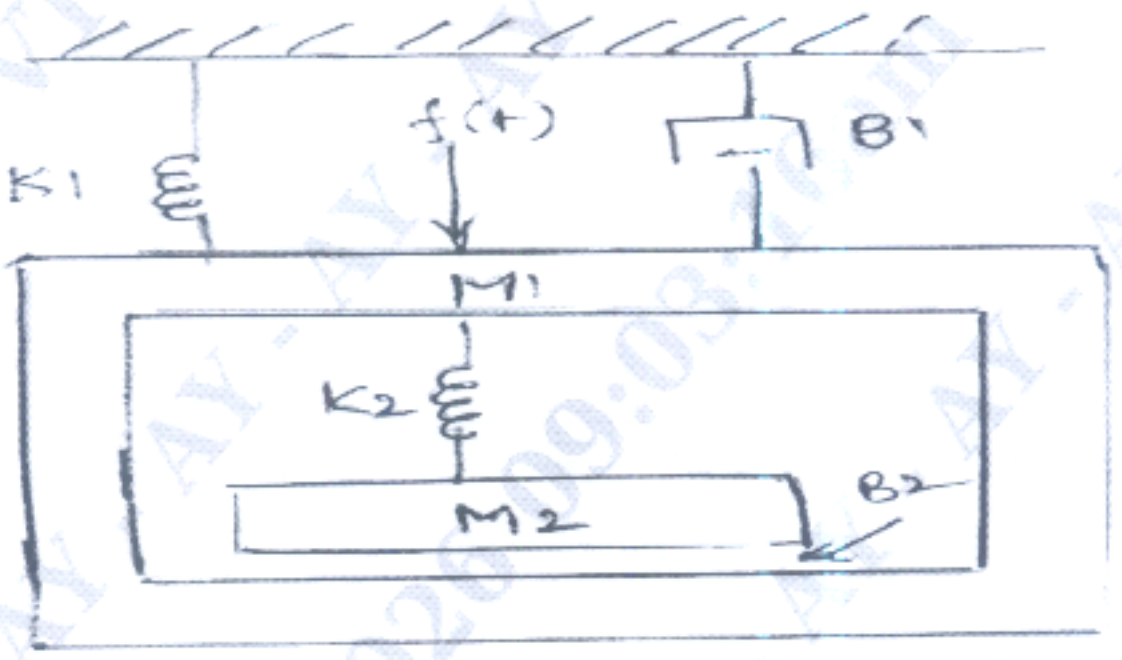
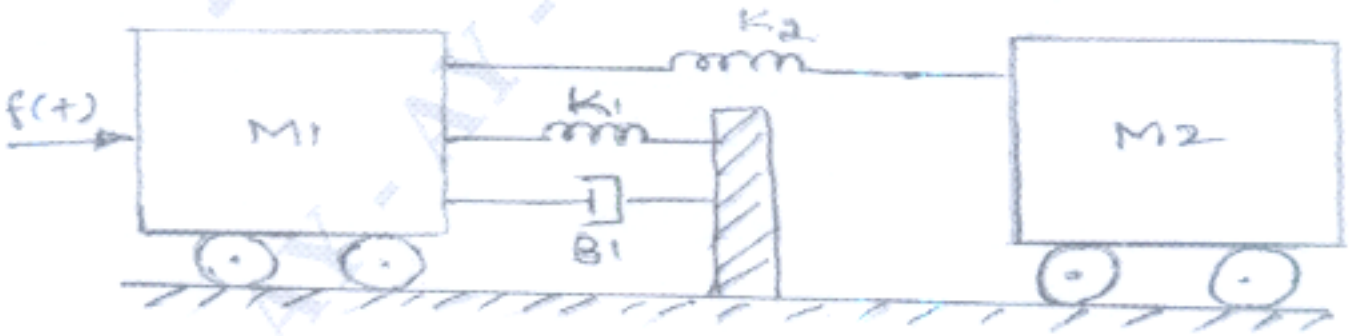
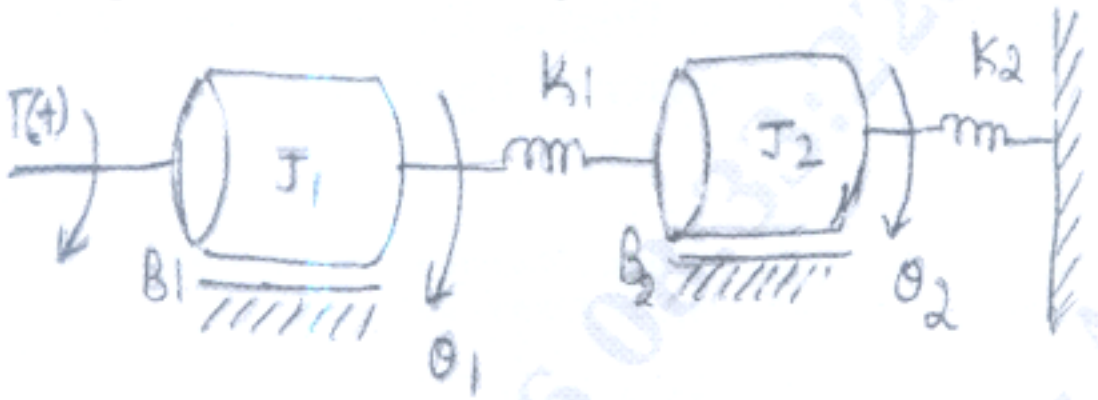
BEC403

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Control System

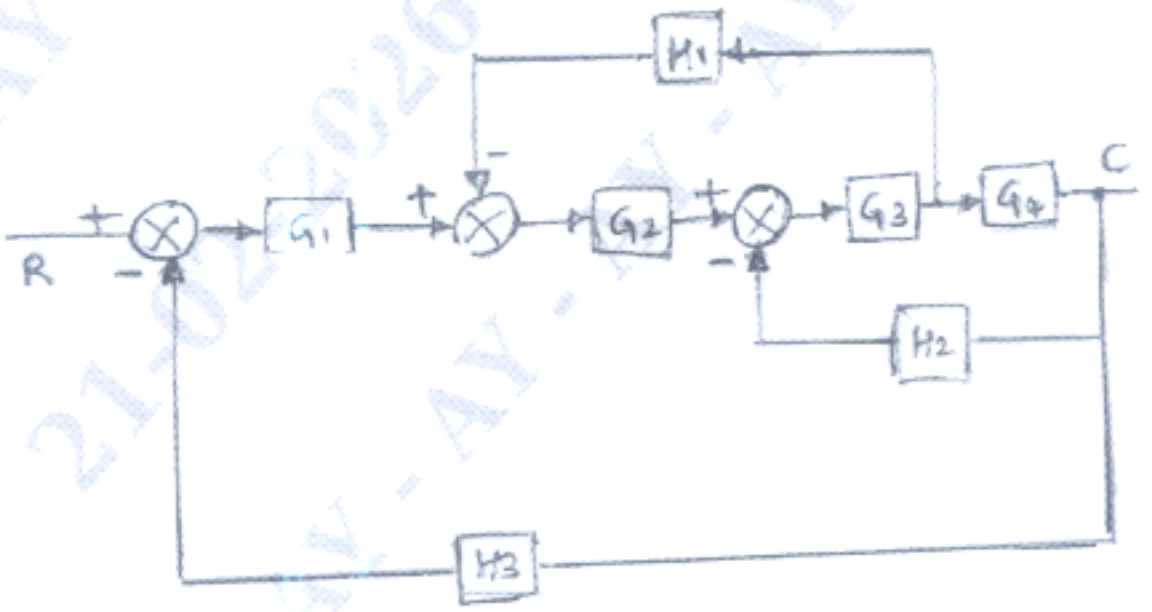
Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

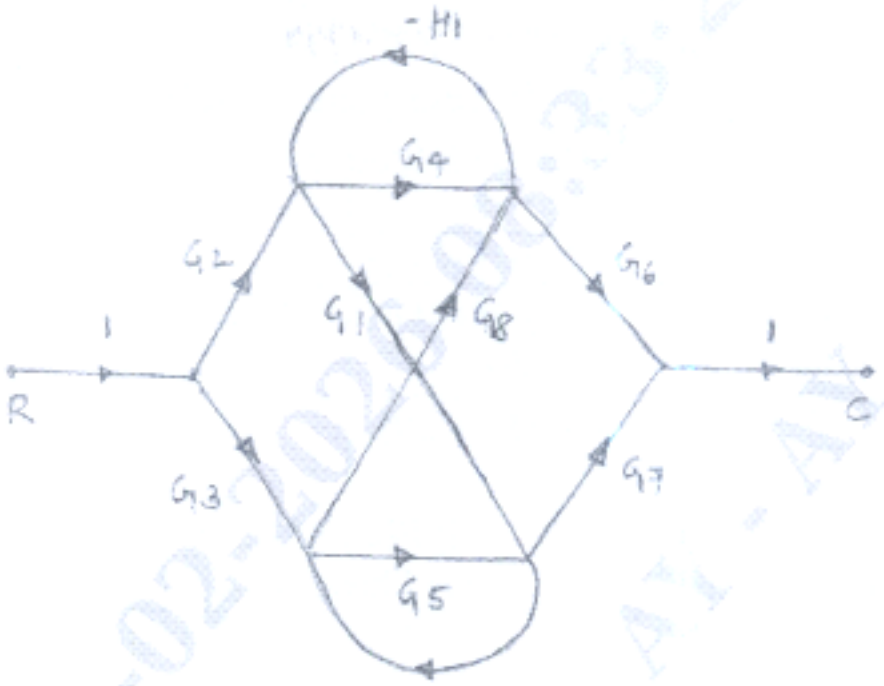
		Module – 1	M	L	C
Q.1	a.	Define Control System. Compare open loop and closed loop system.	05	L1	CO1
	b.	Explain closed loop control system with an example.	05	L1	CO1
	c.	For mechanical system shown in Fig. Q. 1 (c). i) Draw mechanical network ii) Write differential equations iii) Draw electrical network by F – V analogy.  Fig. Q.1 (c)	10	L2	CO1
		OR			
Q.2	a.	For the mechanical system shown in Fig. Q 2 (a). i) Draw mechanical network ii) Draw the analogous electrical circuit in which force is analogous to current.  Fig. Q 2 (a)	10	L2	CO1

	b.	For the mechanical system shown in Fig. Q 2(b) : i) Draw the mechanical network ii) Draw the electrical network based on torque – current analogy and write performance equations for mechanical system.  Fig. Q. 2 (b)	10	L2	CO1

Module – 2

Q.3	a.	Solve using the Mason gain formula for the given signal flow graph shown in Fig. Q. 3 (a).  Fig. Q. 3 (a)	10	L2	CO1
	b.	The system block diagram is shown in Fig. Q 3 (b). Find C (s) /R(s).  Fig. Q 3 (b)	10	L2	CO1

OR

Q.4	**a.**	Find C(s) / R(s) by using Masons gain formula shown in Fig. Q4 (a).  Fig. Q. 4 (a)	**10**	**L2**	**CO1**
	b.	Write the six rules of reducing block diagram.	**06**	**L1**	**CO1**
	c.	Define Mason's gain formula in signal flow graph.	**04**	**L1**	**CO1**
		Module – 3			
Q.5	**a.**	Starting from the output equation c (t) derive expressions for : i) Peak time (t_p) ii) Peak overshoot (m_p) of an under damped second order system subjected to unit step input.	**10**	**L2**	**CO2**
	b.	A unity feedback system is characterized by open loop transfer function $G(s) = \frac{K}{s(s+10)}$. Determine the value of K so that the system will have the damping ratio of 0.5 of this value of K. Determine the settling time. Peak overshoot and rise time for a unit step input.	**10**	**L3**	**CO2**
		OR			
Q.6	**a.**	Derive an expression for C(t) of an underdamped second order system for unit step input.	**08**	**L2**	**CO2**
	b.	Explain the following test signals with the help of graph and mathematical expression . i) step signal ii) Ramp Signal iii) Parabolic signal	**06**	**L1**	**CO2**
	c.	What are static error coefficients ? Derive the formula for each. How they are related to the steady state error.	**06**	**L2**	**CO2**
		Module – 4			
Q.7	**a.**	The characteristic equation of a feedback control system is $S^3 + 3KS^2 + (K+2)S + 4 = 0$. Determine the range of K for which the system is stable.	**10**	**L3**	**CO3**
	b.	Draw root locus diagram for a system having $G(s).H(s) = \frac{K}{s(s+1)(s+3))}$	**10**	**L3**	**CO3**

		OR			
Q.8	**a.**	Explain the construction rules of root locus.	**10**	**L2**	**CO3**
	b.	The open loop transfer function of unity feedback system is given by $G(s) = \frac{K}{s(s+3)(s^2+s+1).}$ Determine the values of K that will cause sustained oscillations in the closed loop system. Also find the oscillation frequency.	**10**	**L3**	**CO3**
		Module – 5			
Q.9	**a.**	Construct the Bode plot for a unity feedback system whose open loop transfer function is given by $G(s) = \frac{80}{s(s+2)(s+20)}$ From the Bode plot determine: i) Gain Margin ii) Phase Margin iii) Gain cross over frequency iv) Phase cross over frequency	**10**	**L3**	**CO4**
	b.	For a control system $G(s).H(s) = \frac{K}{s(s+2)(s+10)}$ Sketch the Nyquist plot and hence calculate range of K for stability.	**10**	**L3**	**CO4**
		OR			
Q.10	**a.**	Construct Bode plot for a unity feedback system with $G(s) = \frac{10(s+10)}{s(s+2)(s+5)}$ From the Bode plot find i) Gain Margin ii) Phase Margin Also comment on stability.	**10**	**L3**	**CO4**
	b.	Explain the terms : i) State ii) State variable iii) State vector iv) State space	**04**	**L1**	**CO5**
	c.	Find the state transition matrix for $A = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix}$	**06**	**L3**	**CO5**

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