U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester : VI**

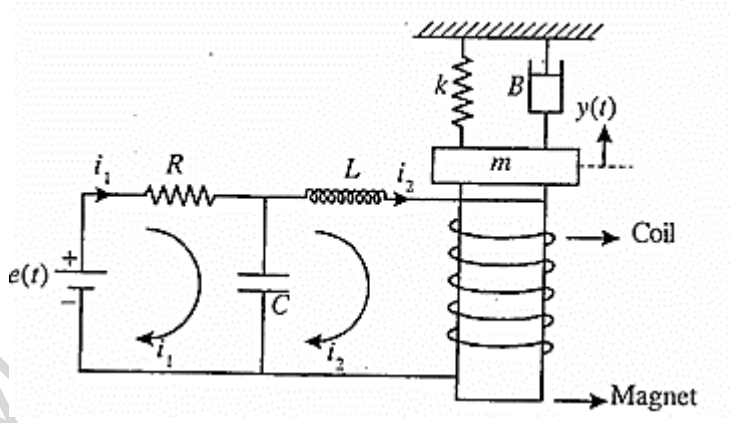
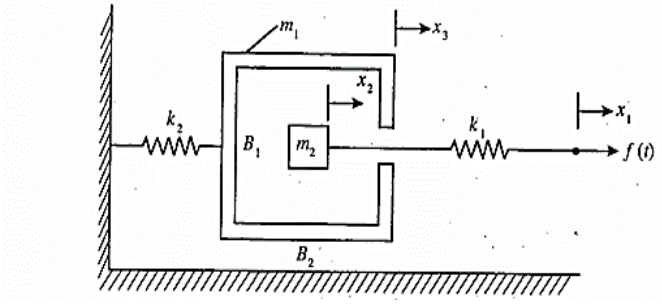
Branch: Mechanical Engineering **Duration: 3 hrs.**

Course Code: 22ME6PCCOE **Max Marks: 100**

Course: Control Engineering

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		Discuss the requirements of a good control system.	CO1	PO1	**06**
	b)		For the electromechanical system shown in Fig. 1, find the transfer function Y(s)/E(s). The coil has a back emf of $e_b = K_b$ (dy/dt) and the coil current produces a force of $F=k_m i$ on the mass m.  Fig. 1	CO2	PO2	**14**
			OR			
2	a)		 Fig. 2	CO2	PO2	**08**

			For the mechanical system shown in Fig. 2, draw the equivalent mechanical network and obtain differential equations of equilibrium.			
		b)	Derive the expression for Transfer Function of field-controlled DC motor.	*CO2*	*PO1*	**08**
		c)	List out the differences between Open loop and Closed loop control systems.	*CO1*	*PO1*	**04**
			UNIT - II			
	3	a)	Derive an expression for the first order response for unit step input.	*CO3*	*PO1*	**10**
		b)	The open loop transfer function of a unity feedback system is given by $G(S) = \frac{10(S+2)}{S^2(S+1)}$ Find (a) Position, velocity and acceleration error constants (b) Steady state error when the input is $R(S) = \frac{3}{S} - \frac{2}{S^2} + \frac{1}{3\,S^3}$	*CO3*	*PO2*	**10**
			OR			
	4	a)	Applying Routh-Hurwitz criterion, find the range of k for stability of a system with open loop transfer function $$GH(S) = \frac{K}{S(S+4)(S^2+2S+2)}$$ Also determine the stability of the system when k=12	*CO4*	*PO2*	**10**
		b)	A unity feedback system has the open loop transfer function $G(S) = \frac{25}{S(S+5)}$ Determine the following for a unit step input (a) Maximum Overshoot (b) Peak time (c) Rise time (d) Settling time	*CO3*	*PO2*	**10**
			UNIT - III			
	5		Draw the root locus and find the range of k for a un ity feedback system with tranfer function $$G(S) = \frac{K(S+6)}{S(S+1)(S+2)}$$	*CO4*	*PO2*	**20**
			OR			
	6		Construct the Root Locus for a unity feedback system with $G(S) = \frac{K(S+1)}{S^2(S+3)(S+5)}$ and find the range of k for system stability.	*CO4*	*PO2*	**20**
			UNIT - IV			
	7		Draw the Bode plot and determine gain margin, phase margin, gain cross over frequency and phase cross over frequency for a system having open loop transfer function	*CO4*	*PO2*	**20**

			GH(S) = $\frac{80}{S\,(S+2)(S+20)}$			
			OR			
	8		Draw the Bode plot and determine the value of k for which the system is marginally stable, the transfer function of the unity feedback system being GH(S) = $\frac{k}{S\,(S+4)(S+10)}$	*CO4*	*PO2*	**20**
			UNIT - V			
	9	a)	Investigate the stability of a system with open loop transfer function Sketch the Nyquist plot of G(S)H(S) = $\frac{K}{(S+1)(S+2)(S+3)}$ Find the range of K.	*CO4*	*PO2*	**12**
		b)	Draw Polar plot for transfer function G(S) = $\frac{12}{S^2(S+1)(S+2)}$	*CO4*	*PO1*	**08**
			OR			
	10	a)	Using Nyquist stability criterion, determine the value of k for the stability of system with open loop transfer function G(S) = $\frac{k\,(S+3)}{S(S-1)}$	*CO4*	*PO2*	**12**
		b)	Draw Polar plot for transfer function G(S) = $\frac{12}{S(S+1)(S+2)}$	*CO4*	*PO1*	**08**

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