U.S.N.										

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

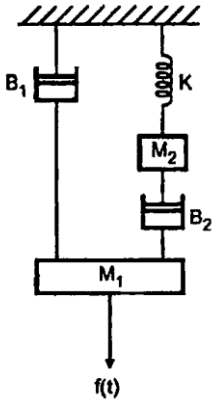
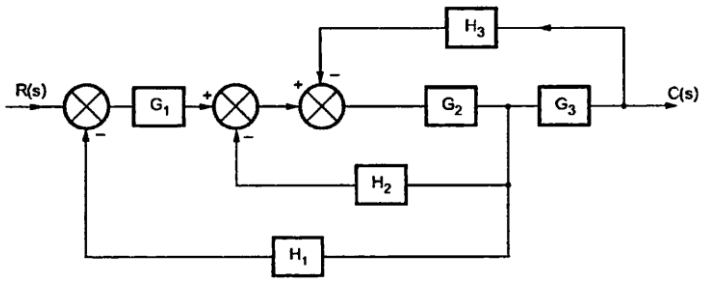
Autonomous Institute Affiliated to VTU

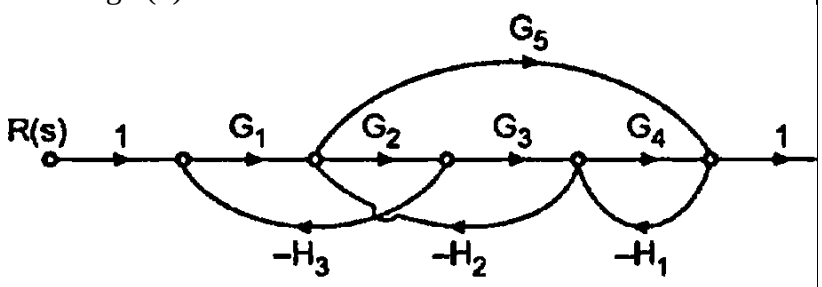
September / October 2023 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: ES CLUSTER (EEE/ECE/EIE/ETE) **Duration: 3 hrs.**
Course Code: 22ES4ESCST **Max Marks: 100**
Course: Control Systems **Date: 22.09.2023**

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)		Draw the equivalent mechanical system if the system shown in fig.1(a) Write the set of equilibrium equation. Obtain F-V and F-I analogous circuits.  fig.1(a)	*CO3*	*PO2*	**08**
	b)		Explain (i) lead compensator (ii) lag compensator.	*CO1*	-	**08**
	c)		Distinguish between open loop and closed loop control system.	*CO1*	-	**04**
			OR			
2	a)		Obtain the transfer function C(s)/R(s) for the block diagram shown in in fig.2.(a) using block diagram reduction technique.  fig.2. (a)	*CO2*	*PO1*	**10**

		b)	Obtain C(s)/R(s) using Mason's Gain Formula of the system shown in fig.2(b)  fig.2.(a)	*CO3*	*PO2*	**10**
			UNIT - II			
	3	a)	Derive the expressions for peak time and rise time in term of ω_n and ζ for a second order control system.	*CO2*	*PO1*	**10**
		b)	A unity feedback system is characterized by open-loop transfer function G(s)=$\frac{K}{s(s+10)}$ Find the value of K so that the system will have a damping ratio of 0.5. For this value of K determine the settling time, peak overshoot and time to peak overshoot for unit step input.	*CO3*	*PO2*	**10**
			UNIT - III			
	4	a)	Define the following of Root Locus plot with a suitable example. i) Asymptote ii) Centroid iii) Breakaway points iv) Angle of Departure.	*CO1*	-	**08**
		b)	Sketch the root locus diagram of a control system having G(s)H(s)= $\frac{K}{s(s+3)(s^2+3s+3)}$	*CO3*	*PO2*	**12**
			UNIT - IV			
	5	a)	Sketch Bode plot for the transfer function G(s)= $\frac{Ks^2}{(1+0.2s)(1+0.02s)}$ Determine the value of K for the gain cross-over frequency to be 5 rad/sec.	*CO3*	*PO2*	**14**
		b)	Explain procedure for Nyquist plot and state Nyquist stability criterion.	*CO1*	-	**06**
			OR			
	6	a)	Construct Nyquist plot and comment on stability for a unity feedback control system G(s)=$\frac{40}{(s+4)(s^2+2s+2)}$	*CO3*	*PO2*	**10**
		b)	Explain the following: i) Gain cross-over frequency. ii) Phase cross-over frequency. iii) Gain Margin. iv) Phase Margin. v) stability of the control system based on the relation between gain margin and phase margin	*CO1*	-	**10**

			UNIT - V			
	7	a)	Obtain the state space representation in phase variable form for the system represented by $\frac{d^4y}{dt^4} + 20\frac{d^3y}{dt^3} + 45\frac{d^2y}{dt^2} + 18\frac{dy}{dt} + 100y = 10\frac{d^2u}{dt^2} + 5\frac{du}{dt} + 100u$ with y as output and u as input	*CO2*	*PO1*	**08**
		b)	Obtain the state model for the given transfer function of a system $\frac{Y(s)}{R(s)} = \frac{(s+2)(s+3)}{s(s+1)(s^2+9s+20)}$	*CO2*	*PO1*	**08**
		c)	Define the following (i) State (ii) State variables (iii) State space (iv) State vector	*CO1*	-	**04**

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