U.S.N.										

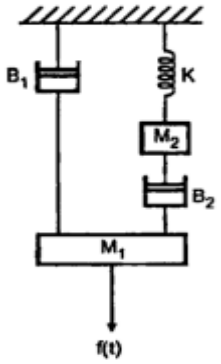
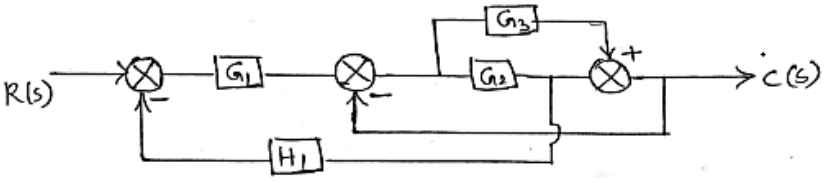
B.M.S. College of Engineering, Bengaluru-560019

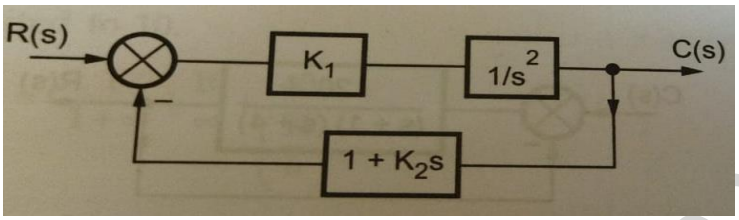
Autonomous Institute Affiliated to VTU

July / August 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: ES Cluster **Duration: 3 hrs.**
Course Code: 19ES4ESCST **Max Marks: 100**
Course: Control Systems

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

		UNIT - I	CO	PO	Marks
1	a)	Define open loop and closed loop control system with example. What are the merits and demerits of Closed Loop control systems?	CO1	PO8, 9	**10**
	b)	Draw the equivalent mechanical system if the system shown in fig.1 Write the set of equilibrium equation. Obtain F-V and F-I analogous circuits.  Fig(1)	CO1	PO8, 9	**10**
		OR			
2	a)	For the system represented by the following equations, find the transfer function $\boldsymbol{X}(\boldsymbol{s})/\boldsymbol{U}(\boldsymbol{s})$ by the signal flow graph technique. $x(t) = x_1(t) + \boldsymbol{\alpha}_0 u(t)$ $\boldsymbol{dx_1/dt} = -\boldsymbol{\alpha}_1 x_1(t) + x_2(t) + \boldsymbol{\alpha}_2 u(t)$ $\boldsymbol{dx_2/dt} = -\boldsymbol{\alpha}_2 x_1(t) + \boldsymbol{\alpha}_1 u(t)$	CO1	PO8, 9	**08**
	b)	Describe any two block diagram reduction rules with necessary diagrams.	CO1	PO8, 9	**04**
	c)	Obtain C(s)/R(s) ratio for the block diagram shown in in fig.2. using block diagram reduction technique.  Fig(2)	CO1	PO8, 9	**08**

			UNIT - II			
	3	a)	Define the time domain specifications of a second order system injected with a unit step input with diagram.	*CO2*	*PO8, 9*	**04**
		b)	A unity feedback system has G(s)= $K/\ (s+2)(s+4)(s^2+6s+25)$ using R-H criterion, find the range of K for stability, marginal value of K and frequency of sustained oscillations.	*CO2*	*PO8, 9*	**08**
		c)	For a control system shown in fig 3, find the value of K_1 and K_2 so that M_p=25% and T_p=4 Sec. Assume unit step input.  Fig(3)	*CO2*	*PO8, 9*	**08**
			UNIT - III			
	4	a)	Check the stability of the given characteristic equation using Routh's method $s^6 + 2s^5 + 8s^4+12s^3+20s^2+16s+16= 0$.	*CO3*	*PO8, 9*	**10**
		b)	Sketch the root locus diagram of a control system having G(s)H(s)= $K/s(s+4)(s^2+4s+20)$ Comment on stability.	*CO3*	*PO8, 9*	**10**
			UNIT - IV			
	5	a)	Define the frequency response specifications.	*CO4*	*PO8, 9*	**08**
		b)	Sketch Bode plot for the transfer function G(s)= Ks^2 /(1+0.2s)(1+0.02s) Determine the value of K for the gain cross-over frequency to be 5 rad/sec.	*CO4*	*PO8, 9*	**12**
			OR			
	6	a)	A negative feedback system is characterized by an open loop transfer function is G(s)H(s) = $\mathbf{1}/\boldsymbol{s}(\mathbf{1}+\boldsymbol{s})\ (\mathbf{0.5}+\boldsymbol{s})$. Sketch the polar plot and hence find the following i. Gain cross over frequency ii. Phase cross over frequency iii. Gain margin iv. Phase margin	*CO4*	*PO8, 9*	**10**
		b)	Use Nyquist stability analysis to determine the stability range of K if G(s)H(s)=K/ s (s+5) (s-2).	*CO4*	*PO8, 9*	**10**
			UNIT - V			
	7	**a)**	Define State, state variables, and state space.	*CO4*	*PO8, 9*	**06**
		b)	Find the state transition matrix for A =$\begin{bmatrix}0 & -1\\2 & -3\end{bmatrix}$	*CO4*	*PO8, 9*	**08**
		c)	Consider the system given by, $dy^3/dt^3+9\ dy^2/dt^2+26\ dy/dt+24y= 6u$ obtain its state model.	*CO4*	*PO8, 9*	**06**

****