U.S.N.										

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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**

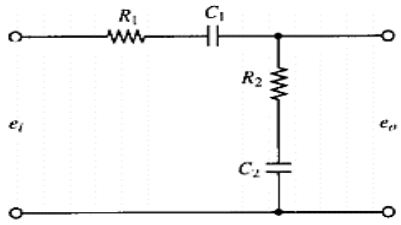
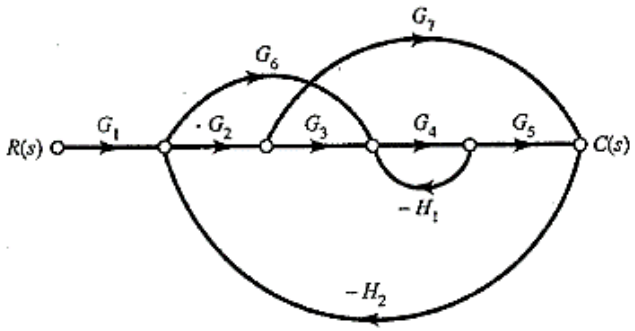
Branch: ES Cluster (ECE/ ET/EIE) **Duration: 3 hrs.**

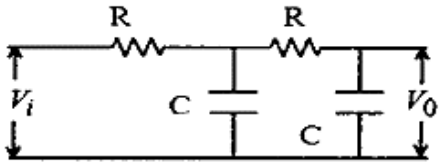
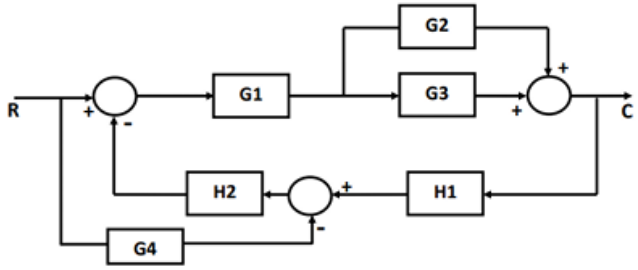
Course Code: 23ES4ESCST **Max Marks: 100**

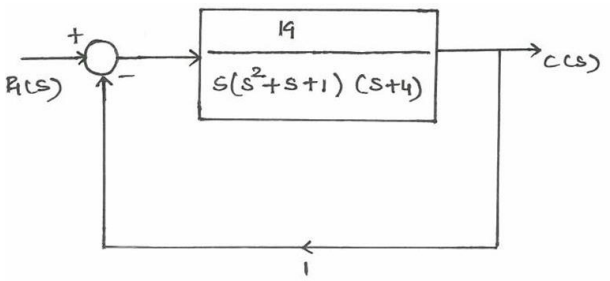
Course: CONTROL SYSTEMS

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

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)		Find the Transfer function for the circuit shown in figure 1a.  figure 1a	*1*	*1*	**6**
	b)		Using Mason's Formula, Find the Transfer function C(s)/R(s) for the signal flow graph shown in figure 1b.  figure 1b	*1*	*1*	**8**
	c)		Write any 6-block diagram reduction techniques.	-	-	**6**
			OR			
2	a)		For the two-stage RC low-pass filter shown in figure 2a find the transfer function.	*1*	*1*	**6**

			 figure 2a			
	b)	Represent the block diagram given in Figure 2b using the signal flow graph and find the transfer function of the system using Mason's gain formula.  Figure 2b	*1*	*1*	**8**
	c)	Give one example of open loop electrical system and closed loop electrical system with proper justification.			**6**
		UNIT - II			
3	a)	A unity feedback system is characterized by an open-loop transfer function $$G(S) = \frac{K}{S(S+10)}$$ Determine the gain 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 a unit-step input.	*2*	*2*	**8**
	b)	Explain the steady state error and static error constant with relevant equations.	*2*	*2*	**8**
	c)	Draw the output response of a second order control system and mark all time response parameters.	*2*	*2*	**4**
		OR			
4	a)	Derive an expression for output response of a first order control system for a unit step input. Draw the output response.	*2*	*2*	**8**
	b)	A unity feedback system is characterized by an open-loop transfer function. $$G(S) = \frac{9}{S(S+2)}$$ Determine its natural frequency, damped frequency, settling time, peak overshoot and time to peak overshoot for a unit-step input.	*2*	*2*	**8**

		c)	Determine the unit step response of the system if closed loop poles of a negative feedback system are located on real axis at -2 and -1 of S plane.	*2*	*2*	**4**
			UNIT - III			
	5	a)	Sketch the root loci for the unity feedback system whose open loop gain is given by $$G(S) = \frac{K}{S(S+1)\,(S^2+4S+13)}$$	*2*	*2*	**12**
		b)	Find the range of k using RH criteria for the system shown in figure 5b to be stable.  figure 5b	*2*	*2*	**8**
			OR			
	6	a)	Sketch the root loci for the unity feedback system whose open loop gain is given by $$G(S) = \frac{K(S+1)}{S^2(S+3.6)}$$	*2*	*2*	**12**
		b)	Using RH criteria determine whether the stability of the system having characteristic equation $S^4 + 10S^3 + 36S^2 + 70S + 75=0$ and has roots more negative than S = -2	*2*	*2*	**8**
			UNIT - IV			
	7	a)	Construct Bode plot for the given function and determine Phase Margin and Gain Margin $$G(s) = \frac{80}{s(s+2)(s+20)}$$	*2*	*2*	**10**
		b)	Sketch the polar plot of the given function $$G(S)H(S) = \frac{1}{S(S+1)}$$	*2*	*2*	**10**
			OR			
	8	a)	Using Nyquist stability criterion, Investigate the stability of a closed-loop system whose open-loop transfer function is given by,	*2*	*2*	**10**

			$G(S)H(S) = \frac{10}{(S+2)(S+1)}$			
		b)	Draw Bode plot and Nyquist plot for the transfer function $G(S)H(S) = \frac{1}{(S+1)}$	*2*	*2*	**10**
			UNIT - V			
	9	a)	Represent the differential equation given below in a state model $\frac{d^3y}{dt^3} + \frac{d^2y}{dt^2} + 6\frac{dy}{dt} + 7y = 2u(t)$	*1*	*1*	**10**
		b)	A state variable description of a system is given by the matrix equation Find (i) The Transfer function (ii) The State transition matrix (iii) State diagram $\dot{X} = \begin{bmatrix} -1 & 0 \\ 1 & -2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$ $Y = [\,1 \quad 1\,]\,X$	*1*	*1*	**10**
			OR			
	10	a)	Obtain the state model of the system whose transfer function is given by $\frac{Y(s)}{U(s)} = \frac{24}{s^3+9s^2+26s+24}$	*1*	*1*	**10**
		b)	Discuss state space model with an example. List the Advantages and Disadvantages of State Space Analysis. What are the applications of State Space Analysis?	*1*	*1*	**10**

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