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

Autonomous Institute Affiliated to VTU

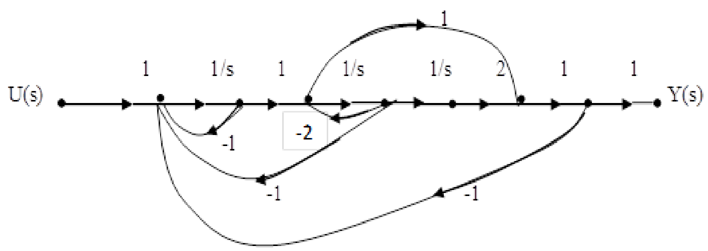
July 2023 Semester End Main Examinations

Programme: B.E. **Semester: VI**
Branch: Electronics and Instrumentation Engineering **Duration: 3 hrs.**
Course Code: 19EI6PE3MC **Max Marks: 100**
Course: Modern Control Theory **Date: 17.07.2023**

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)	Enumerate the different types of common physical non-linearities and explain any two.	*CO1*	*PO4*	**10**
	b)	Obtain the describing function of saturation non-linearity.	*CO1*	*PO1*	**10**
		UNIT-II			
2	a)	Determine the Canonical State Model of the System, whose transfer function in T(S) = 2(S+5) / (S+2) (S+3) (S+4)	*CO2*	*PO2* *PO5* *PO9* *PO10*	**10**
	b)	Consider the Matrix A. Compute e^{At} $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$	*CO2*	*PO2* *PO5* *PO9* *PO10*	**10**
		OR			
3	a)	For a System represented by state equation. $\dot{X}(t) = AX(t)$ The response in $x(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$ when $x(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$ and $x(t) = \begin{bmatrix} e^{-t} \\ -e^{-t} \end{bmatrix}$ when $x(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$ Determine the System Matrix A and the State Transition Matrix	*CO2*	*PO2* *PO5* *PO9* *PO10*	**12**

		b)	The State diagram of a linear system is as shown in Fig 3(b). Assign state variables and obtain state model.  Fig 3(b)	*CO2*	*PO2* *PO5* *PO9* *PO10*	**08**
			UNIT - III			
	4	a)	Describe the block diagram of a digital control system and explain each block in detail.	*CO1*	*PO1*	**06**
		b)	Elaborate Jury's stability test to determine system stability test and write the necessary and sufficient conditions	*CO2*	*PO2* *PO5* *PO9* *PO10*	**07**
		c)	Evaluate the observability of the system whose state space matrix is given as follows. $A = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & -2 & -3 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \quad C = [3 \quad 4 \quad 1]$	*CO4*	*PO2*	**07**
			OR			
	5	a)	Explain Linear Discrete systems and obtain pulse transfer function of the same in z-domain.	*CO3*	*PO3*	**07**
		b)	The characteristic equation for a closed loop discrete time system is given by the following expression. Determine its stability using jury's stability test $Q(z) = z^3 - 1.8z^2 + 1.05z - 0.20 = 0$	*CO3*	*PO3*	**06**
		c)	Estimate the state controllability by Gilberts test for the system with state matrix is as follows. $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$	*CO4*	*PO2*	**07**
			UNIT - IV			
	6	a)	What is lead compensator? Give an example	*CO5*	*PO4*	**05**
		b)	Design a feedback compensation scheme using bode plot technique for a unity feedback system with open loop transfer functionG(S) = 3/S(S+1) to satisfy the phase margin of system to be at least 45^0.	*CO5*	*PO4*	**15**

			UNIT - V			
	7	a)	Explain the procedure for designing a lead compensator using the root locus method. Mention advantages of lead compensator.	*CO5*	*PO4*	**10**
		b)	The closed loop transfer function of a system is given by $\frac{C(s)}{R(s)} = \frac{4}{s^2+2s+4}$. The damping ratio of the closed loop poles is 0.5 and the undamped natural frequency of the closed loop poles is 2 rad/s, design a lead compensator to modify the undamped natural frequency to 4 rad/s without changing the value of damping ratio.	*CO5*	*PO4*	**10**

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