Elect

PRN:		Course Code :	ELE2701

Final Year **B. Tech** End Semester Examination Winter 2023

Modern Control System

Day and Date: Tuesday 28/11/2023 Max Marks: **100**

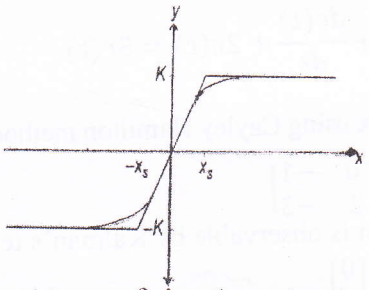
Time : 2.00 to 5.00 PM Duration: **03** hrs

Instructions: All questions are compulsory.

		Marks	Bloom's Level	CO
Q.1	**Attempt the following**			
a)	Obtain the state model of a given transfer function $\frac{Y(S)}{U(S)} = \frac{5S^2 + 6S + 8}{S^3 + 3S^2 + 7S + 9}$	08	L2	CO1
b)	Find the Eigen values, Eigen vectors and Modal matrix for a given system 1) $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix}$	08	L2	CO1
	OR			
b)	Construct the state model of the following differential equation where c(t) is the output and r(t) is input. $4\frac{d^3c(t)}{dt^3} + 4\frac{d^2c(t)}{dt^2} + \frac{dc(t)}{dt} + 2c(t) = 5r(t)$	08	L5	CO1
Q.2	**Attempt the following**			
a)	Obtain the state transition matrix using Cayley Hamilton method. $A = \begin{bmatrix} 0 & -1 \\ 2 & -3 \end{bmatrix}$	08	L2	CO2
b)	Determine whether the system is observable by Kalman's test. $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$, $C = [3 \ \ 4 \ \ 1]$	08	L3	CO2
	OR			
b)	Determine whether the system is observable by Gilberts test $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$, $C = [3 \ \ 4 \ \ 1]$	08	L3	CO2
Q.3	**Attempt any two from the following**			
a)	A system is given by $\dot{x} = Ax + Bu$ Where, $\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ By using state feedback control $u = -kx$, it is desired to have closed loop poles at $S = -1 \pm j2, S = -10$. Deterimine the state feedback gain matrix K using Direct substitution method.	08	L3	CO3

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b)	Consider the system $\dot{x} = Ax + Bu$ $y = Cx$ Where, $A = \begin{bmatrix} 0 & 20.6 \\ 1 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $C = [0 \quad 1]$ Determine the full order state observer so that desired Eigen values of observer matrix are $\mu 1 = -10, \mu 2 = -10$ by using transformation method.	08	L3	CO3
c)	Derive the transfer function of observer based controller.	08	L3	CO3
Q.4	**Attempt any two from the following**			
a)	Explain the different types of common physical non-linearity's present in the system.	08	L2	CO3
b)	Derive the following Describing function of nonlinear system. $k_N(X, w) = \frac{Y_1}{X} < \phi_1$	08	L3	CO3
c)	Explain the phenomenon of jump resonance in nonlinear system	08	L2	CO3
Q.5	**Attempt any Two of the following**			
a)	Derive the following describing function of ideal relay. $k_N(X, w) = \frac{4m}{\pi X}$	09	L3	CO4
b)	Derive the describing function for a electromehanical amplifier having saturation shown below. Take $X_s = \frac{+S}{2}$ and $-X_s = \frac{-S}{2}$ 	09	L3	CO4
c)	Describe the different types of singular points based on location of roots in s-plane	09	L2	CO4
Q.6	**Attempt any Two of the following**			
a)	Solve the following difference equation by Z transform method. $X(K+2) + 3X(K+1) + 2X(K) = 0,$ $Take\ X(0) = 0, X(1) = 1$	09	L2	CO4
b)	Explain the advantages and implementation problems in digital control system. Also draw its block diagram.	09	L2	CO4
c)	Explain the construction of phase trajectory using Isocline method.	09	L2	CO4

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