BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: MTEC | **SEMESTER : I**
BRANCH: EEE | **SESSION : MO/2024**

SUBJECT: EE503 MORDEN CONTROL THEORY

TIME: 3 Hours | **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Define the following in term of state space model a) System variable b) State variable c) State space d) State vector	[5]	1	1
Q.1(b)	For the given transfer function obtain the state space model $\frac{Y(s)}{U(s)} = \frac{2(s+3)}{s^2+3s+9}$ (a) First companion Form (b)Second companion Form	[5]	1	1,2
Q.2(a)	$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \left[\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}\right] + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$ $Y = [1 \quad 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ Find the Unforce response of the system.	[5]	2	1,2,3
Q.2(b)	Consider a system described by its differential equation $\ddot{y} + 3\dot{y} + 5y = 0$ .Obtain the state space representation	[5]	2	1,2,
Q.3(a)	The state variable description is $[\dot{x}] = \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$ Determine state transition matrix of the system assuming all initial condition is zero	[5]	3	1,2,3
Q.3(b)	Obtain the transfer function of the system given below and hence comment on the order of the system $\dot{x} = \begin{bmatrix} -1 & 0 \\ 0 & -3 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u \; ; \qquad y = [1 \quad 0 \quad] x$	[5]	3	1,2,3
Q.4(a)	Investigate the following system for controllability and observability $\dot{x} = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$ $y = [1 \quad 0] x$	[5]	4	1,2,3

PTO

Q.4(b)	Obtain the eigen values and eigen vectors for the system given below	[5]	4	123

$$\dot{X} = \begin{bmatrix} -1 & 0 & 2 \\ 0 & -3 & 1 \\ -1 & 1 & -4 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} u$$

Q.5(a)	Consider a second order system described as	[5]	5	2,3,4

$$\dot{x} = \begin{bmatrix} -1 & 3 \\ 0 & -2 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$$

Required to place a close loop pole at (-5,-3). Find the required state feedback gain matrix.

Q.5(b)	For the system given below, an observer is to be designed to estimate the state variables. Select the observer gain and write the equations describing the observer dynamics.	[5]	5	2,3,4

$$\dot{x} = \begin{bmatrix} -4 & -4 \\ 1 & -2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$$

Observer eigen value should be (-5,-5)

::::::20/11/2024::::::E