Register No : ____________________

THE KAVERY ENGINEERING COLLEGE

(An Autonomous Institution)

M.E DEGREE END SEMESTER THEORY EXAMINATIONS, NOV /DEC 2024

First Semester

Power System Engineering

PPST2413 – System Theory

Regulations – 2024

Duration : 3 Hrs *Maximum : 100 Marks*

*PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)*

Q.No	*Questions*	*BLT*	*CO*	*Marks*
1.	Differentiate linear and nonlinear systems.	UN	1	2
2.	Interrupt the concept of state and state variable.	UN	1	2
3.	How the eigen vectors are calculated when eigen values are different?	RE	2	2
4.	If $A = \begin{bmatrix} 0 & a \\ a & 0 \end{bmatrix}$ what is e^{At}.	AN	2	2
5.	Mention the significance of observability test.	RE	3	2
6.	Define reducibility.	RE	3	2
7.	How to define stability in sense of Lyapunov?	UN	4	2
8.	When does a non-linear system become asymptotically stable?	UN	4	2
9.	How the placement of pole affects the stability of the system?	UN	5	2
10.	Draw the schematic diagram of a state feedback control system.	RE	5	2

*PART – B (ANSWER ALL QUESTIONS) (Marks 5*13 = 65)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
11.	a	Analyze the state model of an armature-controlled DC motor.	AN	1	13
		Or			
	b	A system has the transfer function $\frac{y(s)}{u(s)} = \frac{1}{s^3+10s^2+27s+18}$. Determine the state model by any one of the methods.	AN	1	13
12.	a	For a system represented by state equation $\dot{X}(t) = AX(t)$, the response is $X(t) = \begin{bmatrix} e^{-2t} \\ -2e^{-2t} \end{bmatrix}$ where $X(0) = \begin{bmatrix} 1 \\ -2 \end{bmatrix}$ 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.	AN	2	13
		Or			
	b	The system matrix A of a discrete time system is given by $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$. Compute the state transition matrix A^k using Cayley Hamilton theorem.	AN	2	13
13.	a	Consider the following system $[\dot{x}] = \begin{bmatrix} 0 & -1 & 0 \\ -3 & 0 & -2 \\ 12 & 7 & 6 \end{bmatrix} [x] + \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix} [u]$ and $c = [1 \quad 1 \quad 2]$. Check the controllability and observability condition.	AN	3	13
		Or			

			BLT	CO	Marks
	b	Convert the following state model into Jordan canonical form and therefore comment on controllability and observability. $$\dot{x}(t)=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -2 & -4 & -3\end{bmatrix}x(t)+\begin{bmatrix}1 & 0\\ 0 & 1\\ -1 & 1\end{bmatrix}u(t).$$ $$y(t)=\begin{bmatrix}0 & 1 & -1\\ 1 & 2 & 1\end{bmatrix}x(t).$$	AN	3	13
14.	a	Discuss about Lyapunov's direct method for the stability analysis of nonlinear systems.	UN	4	13
		Or			
	b	Describe Krasovskii and variable gradient method for constructing Lyapunov function.	UN	4	13
15.	a	Describe the effect of feedback on controllability and observability.	UN	5	13
		Or			
	b	Explain about full order and reduced order observer.	UN	5	13

*PART – C (Marks 1*15 = 15)*

Q.No		*Questions*	*BLT*	*CO*	*Marks*
16.	a	The desired observer poles are located at $s=-6$, $s=-6$, $s=-6$. Obtain the transfer function of the observer controller.	AN	5	15
		Or			
	b	Consider the system described the state model $\dot{X}=AX$, $Y=CX$ where $A=\begin{bmatrix}1 & 1\\ 1 & -2\end{bmatrix}$ and $C=[1 \quad 0]$. Design a full order state observer. The desired eigen values for the observer matrix are $\mu_1=-5$ and $\mu_2=-5$.	AN	5	15