TYPE – A
(Multiple Choice Type Questions)

i. In a series R, L, C circuit, the number of state variable is
a. 3 b. 2 c. 1 d. 0

ii. Lyapunov's stability criterion can be used for determination of
a) Linear system b) Non-linear system
c) Both (a) & (b) d) None of these.

iii. Describing function is based on
a) First harmonic approximation b) approximation at an operating point
c) Stability of an operating point d) finding of Lyapunov function.

iv. Comment on the controllability of the system is given as

$$A=\begin{bmatrix}-2 & 0\\ 0 & -1\end{bmatrix} \quad B=\begin{bmatrix}1\\ 1\end{bmatrix} \quad C=\begin{bmatrix}1 & 0\end{bmatrix}$$

v. The eigen values of the matrix $\begin{bmatrix}a & 1\\ a & 1\end{bmatrix}$ are

b. (a+1), 0 b. a, 0 c. (a-1), 0 d. 0, 0

vi. A state variable system $X(t)=\begin{bmatrix}0 & 1\\ 0 & -3\end{bmatrix}x(t)+\begin{bmatrix}1\\ 0\end{bmatrix}U(t)$, find state transition matrix?

vii. For a system with transfer $H(s)=\frac{3(s-2)}{S^2+4S-2S+1}$, find system matrix?

viii. Comment on the controllability of the system is given as

$$A=\begin{bmatrix}-2 & 0\\ 0 & -1\end{bmatrix} \quad B=\begin{bmatrix}1\\ 1\end{bmatrix} \quad C=\begin{bmatrix}1 & 0\end{bmatrix}$$

TYPE – B
(Short Type Questions)

1. State and prove Calay Hamilton Theorem.
2. Determine State Transition Matrix for the system given by

$$\begin{bmatrix}\dot{X}_1\\ \dot{X}_2\end{bmatrix}=\begin{bmatrix}1 & 4\\ -2 & -5\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u$$

$$y=\begin{bmatrix}2 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

3. Obtain the matrices A, B, and C in Controllable Canonical Form for the following transfer function

$$\frac{Y(s)}{U(s)}=\frac{10S^2+5S+4}{4S^3+5S^2+4S+8}$$

4. Test the sign definiteness of the following quadratic scalar function:

$$V(X)=x_1^2+4x_2^2+x_3^2+2x_1\,x_2-6x_2\,x_3-2x_1\,x_3$$

5. For the given discrete time system Find the state transition matrix.

$$x(k+2)+5x(k+1)+6x(k)=u(k),\ x(0)=x(1)=0$$

6. Obtain the matrices A, B, and C in Controllable Canonical Form for the following transfer function

$$\frac{Y(s)}{U(s)}=\frac{5S+4}{S^3+2S^2+4S+8}$$

TYPE – B
Long Type Questions

1. Derive describing function of a relay with saturation & dead zone nonlinearity.

2. A system is described by

$$x_1' = -x_1 + x_2 + x_1 (x_1^2 + x_2^2)$$

$$x_2' = -x_1 - x_2 + x_1 (x_1^2 + x_2^2)$$

Determine the asymptotic stability using Lyapunov's second method.

3. Determine the observer gain matrix for a system having

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

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

The required pole location is as: S = -3, S= -4 and S= -5

4. Obtain the transfer function for the given system

$$A = \begin{bmatrix} 0 & 1 \\ -20 & -9 \end{bmatrix} \cdots and \cdots B = \begin{bmatrix} 0 \\ 1 \end{bmatrix} .....C = \begin{bmatrix} 1 & 0 \end{bmatrix}$$