

Is the system completely state controllable and completely observable?

(c) Discuss the phase variable form of state space representation of system.

Q3. Answer any two parts of the following:

[10x2]

(a) Discuss the Liapunov's direct method of stability.

(b) Consider a second order system described by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

The equilibrium state is the origin. Determine the Liapunov function and the stability of this state.

(c) Discuss the following:

(i) Limit Cycle

(ii) Jump Resonance

Q. 4. Answer any two parts of the following:

[10x2]

(a) Determine z-transform of the following functions:

(i) $e^{-at} \sin \omega t$

(ii) $1^{(k+n)}$

(b) Solve the difference equation

$$x(k+2) - 3x(k+1) + 2x(k) = 4^k ; \quad x(0)=0, x(1)=1$$

(c) Discuss the relationship between z-domain and s-domain.

Q. 5. Answer any two parts of the following:

[10x2]

(a) Discuss the Jury's stability criterion. Consider the characteristic polynomial

$$F(z) = 2z^4 + 7z^3 + 10z^2 + 4z + 1$$

Check the stability of this system.

(b) Define optimal control and performance index. Write the performance indices of minimum time, minimum fuel, minimum energy, and minimum error tracking optimal control problems.

(c) What is adaptive control system? What are the schemes of adaptive control? Discuss in brief.