

(3 Hours)

[Total marks: 80]

- Question no. 1 is compulsory.
- Attempt any Three questions from remaining.

Q. 1 Answer **any 4** questions from the given questions. 20

- a. Determine energy and power of given signal.

$$x(t) = 3 \cos 5 \Omega t$$

- b. Test the given system for linearity, causality, stability and time invariance.

$$y(t) = x(t^2)$$

- c. Find the initial value $x(0)$ and final value $x(\infty)$ of given Z-domain signals.

$$X(Z) = \frac{2Z^{-1}}{1 - 1.8Z^{-1} + 0.8Z^{-2}}$$

- d. Realize following FIR system with minimum no of multipliers.

$$h(n) = \{-0.5, 0.8, -0.5\}$$

- e. Explain applications of signals and systems in communication.

- f. Give advantage of state space analysis for system analysis.

Q.2 a. Perform convolution of $x_1(t)$ and $x_2(t)$ using convolution theorem and sketch resultant waveform. Where 10

$$x_1(t) = u(t) - u(t-1)$$

$$x_2(t) = u(t) - u(t-2)$$

b. Find response of LTI system if impulse response of system is 10

$$h(t) = 2e^{-3t}u(t) \text{ for input } x(t) = 2e^{-5t}u(t) \text{ using Fourier Transform.}$$

Q.3 a. Determine inverse Z-transform of the function by using Residue method. 10

$$X(Z) = \frac{3 + 2z^{-1} + z^{-2}}{1 - 3z^{-1} + 2z^{-2}}$$

b. List any 4 properties of Z-transform. 04

- c. Find response of time invariant system with impulse response 06
 $h(n) = \{1, 2, 1, -1\}$ to an input signal $x(n) = \{1, 2, 3, 1\}$

- Q.4 a. The state space representation of a discrete time system is given by 10

$$A = \begin{pmatrix} 2 & -1 \\ 3 & 1 \end{pmatrix} \quad B = \begin{pmatrix} 1 \\ 2 \end{pmatrix} \quad C = [1 \quad 3] \quad D = [3]$$

Derive the transfer function of the system.

- b. Find the digital network in direct form I and II for the system described by the 10
 difference equation

$$y(n] = x(n) + 0.5 x(n-1) + 0.4 x(n-2) - 0.6 y(n-1) - 0.7 y(n-2)$$

- Q. 5 a. Determine Fourier series representation of the half wave rectifier output given 10
 by equation,

$$x(t) = A \sin \Omega_0 t \quad ; \text{ for } t=0 \text{ to } \frac{T}{2}$$

$$= 0 \quad ; \text{ for } t = \frac{T}{2} \text{ to } T$$

- b. Determine Fourier transform of 10

$$x(t) = 1 - t^2 \quad ; \text{ for } |t| < 1$$

$$= 0 \quad ; \text{ for } |t| > 1$$

- Q.6 Write short note on *any two*. 20

- a. ROC in Z-transform and Laplace transform.
- b. Gibbs Phenomenon.
- c. Relation of ESD, PSD with Auto-correlation.