(3 Hours)   **[Total marks: 80]**

- Question no. 1 is compulsory.
  Attempt any Three questions from remaining.
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Q. 1   Answer *any 4* questions from the given questions.   20

a.   Determine energy and power of given signal.

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

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(∞) 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

$h(t) = 2e^{-3t}u(t)$ for input $x(t) = 2e^{-5t}u(t)$ 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)-0.7y(n-2)

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

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

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

b. Determine Fourier transform of 10

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

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

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.

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