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BT-4/M–14

SIGNAL AND SYSTEMS

Paper–EE-208-E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt **five** questions in all, selecting at least **one** question from each section.*

Section–1

1. (a) Explain even and odd signals with examples. Find the even and add components of the signal :

$x(t) = 7t^3 + 5t^2 + 2t + 4.$ 5

(b) Find the Fourier transform of a unit step function. 5

(c) Explain the time-shifting and frequency shifting property of Fourier transform. 10

2. (a) State the Convolution theorem and give its significance. Prove the following properties of convolution :

(i) Distributive property, and

(ii) Associative property. 10

(b) (i) Explain the Dirichlet conditions for convergence of Fourier transform. 5

(ii) Determine the Laplace transform of t sint. 5

Section–2

3. (a) State and prove sampling theorem. 10

(b) What is discrete time decimation and interpolation? What is its significance ? Mathematically show the effect of decimation and interpolation in the frequency domain. 10

4. (a) What is PDF ? How do we get PDF from probability distribution function ? 10

(b) Find the inverse z-transform of

$$x(z) = \frac{1 - z^{-1} + z^{-2}}{\left(1 - \frac{1}{2}z^{-1}\right)(1 - 2z^{-1})(1 - z^{-1})}$$

with ROC $1 < |z| < 2$. 10

Section–3

5. (a) What do you mean by causal and non causal system and lines and non linear system ? Given a continuous time system with input x(t) and output y (t) related by $y(t) = x(\sin(t))$. Find the following :

(i) Is this system causal ?

(ii) Is this system linear ? 10

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(b) Write a note on the following :

(i) SISO

(ii) MISO. 10

6. (a) For the following input output relationships, determine whether the corresponding system is linear, time invariant or both ?

(i) $y(t) = t^2 x(t-1)$

(ii) $y[n] = x^2[n-2]$ 10

(b) Determine whether the system described by $y(t) = \cos(x(t))$ is :

(i) Memoryless (ii) Stable

(iii) Causal (iv) Linear

(v) Time invariant. 10

Section–4

7. (a) What do you mean by transfer function ? 5

(b) What are the advantage of using state variable technique for system modelling ? 5

(c) Consider a stable LTI system that is characterised by differential equation :

$$\frac{d^2}{dt^2}y(t) + 4.\frac{d}{dt}y(t) + 3y(t) = \frac{d}{dt}x(t) + 2x(t).$$

Find the impulse response of the system. 10

8. (a) State and prove the causality and stability property of LTI system. 10

(b) Define transfer function. Find the transfer function of the system described by the following differential equation :

$$\frac{d^2}{dt^2}y(t) + 11\frac{d}{dt}y(t) + 24y(t) = \frac{5d}{dt}x(t) + 3x(t)$$

with zero initial conditions. 10

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