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BT-4/J07 8660

Signal and Systems

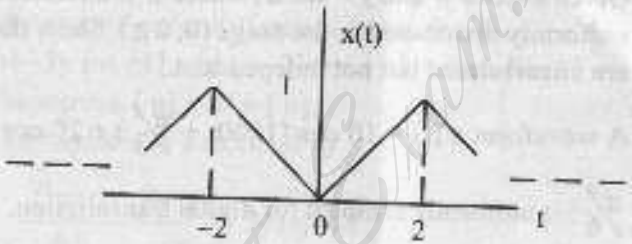
Paper : EE–208 E

Time : Three Hours] [Maximum Marks : 100

Note :– Attempt any **FIVE** questions.

UNIT–I

1. (a) Determine the Fourier series representation of the following signal with period T = 4



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(b) State and prove the following properties of continuous time Fourier series :

(i) Time Reversal

(ii) Multiplication. 8

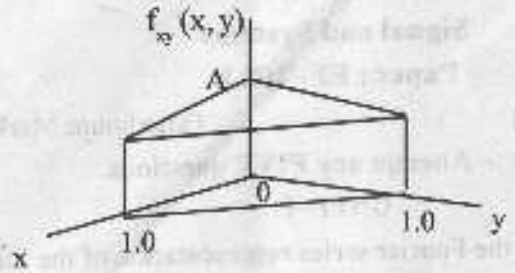
2. (a) Find out the Fourier transform of the following signal

$$x(t) = \frac{4t}{\left(1+t^2\right)^2}.$$ 10

(b) Compute the Laplace transform of the signal

$x(t) = \sum_{n=0}^{\infty} e^{-at}\,\delta(t-nT)$ where $T > 0$ and sketch the pole-zero plot. 10

3. (a) The joint PDF of random variables X and Y is shown below. Determine (i) A (ii) $f_x(x)$ (iii) $f_y(y)$ and (iv) $f_{x/y}(x/y)$.



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(b) Given $x = \cos\theta$ and $y = \sin\theta$, where θ is a random variable uniformly distributed in the range $(0, 2\pi)$. Show that x and y are uncorrelated but not independent. 8

4. (a) A waveform $x(t) = 10\cos(1000t + \pi/3) + 20\cos(2000t + \pi/6)$ is uniformly sampled for digital transmission.

(i) What is the minimum allowable time-interval between sample values ?

(ii) If we want to reproduce one hour of this waveform, how many sample values need to be stored ?

(iii) Show graphically that the samples uniquely characterize the waveform. 2+3+5

(b) Find the inverse z-transform of $X(z) = \dfrac{1 - 2z^{-1}}{1 + \frac{5}{2}z^{-1} + z^{-2}}$.

10

UNIT–III

5. (a) Discuss the methods used for representation of

(i) Memoryless Signals (ii) Signals with Memory. 12

(b) Test the following systems for linearity, time-invariance and Causality.

(i) $y[n] = x[-n+3]$ (ii) $y[n] = x[n] \cos(w_0 n)$. 8

(a) Differentiate between the following terms, giving example of each case.

(i) Time-invariant system and time-varying system

(ii) Lumped parameter and distributed parameter systems. 10

(b) Write a technical note on SIMO and MIMO systems. 10

UNIT–IV

(a) Discuss the state-variable representation of an LTI system. 10

(b) Determine the response $y(n) \geq 0$ of the system described by the second order difference equation

$y(n) - 3y[n-1] - 4y[n-2] = x[n] + 2x[n-1]$

to the input $x[n] = 4^n u[n]$. 10

(a) An LTI system is described by

$$\frac{d^2y(t)}{dt^2} - \frac{dy(t)}{dt} - 2y(t) = x(t)$$

Determine the transfer function of the system and test it for causality and stability. 12

(b) How is the response of an LTI system determined for the stochastic signals? 8