Roll No. .... **Total Pages : 04**

BT-4/M-20 **34106**

SIGNALS AND SYSTEMS

EE-206N

Time : Three Hours] [Maximum Marks : 75

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

Unit I

1. (a) How to represent even and odd signals ? Give one example each. Show that the product of two even signals is even signal or product of two odd signals is even signal, and product of an even and odd signal is odd signal.

(b) Given the continuous-time signal specified by :

$$x(t) = \begin{cases} 1-|t| & -1 \le t \le 1 \\ 0 & \text{otherwise} \end{cases}$$

Determine the resultant discrete-time sequence obtained by uniform sampling of $x(t)$ with a sampling interval of (a) 0.25 s, (b) 0.5 s, (c) 1.0 s.

(c) Show that complex exponential sequence $x[n] = e^{j\Omega_0 n}$ is periodic only if $\Omega_0/2\pi$ is a rational number. **5+5+5**

2. (a) Consider a continuous-time system whose input $x(t)$ and output $y(t)$ are related by $\frac{dy(t)}{dt} + ay(t) = x(t)$ where a is a constant.

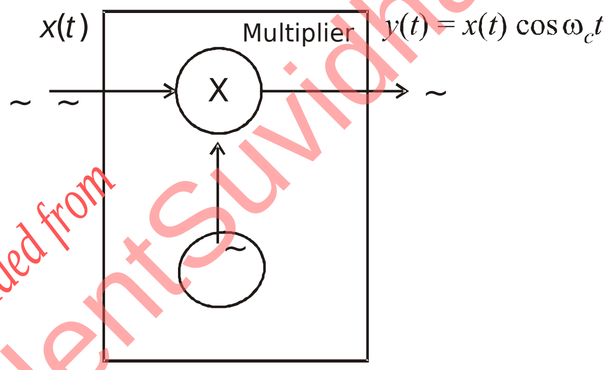
(a) Find $y(t)$ with auxiliary condition y_0 and $x(t) = Ke^{-bt}u(t)$. **5**

(b) Consider the system shown in the figure. Determine whether it is a :

(i) Memoryless (ii) Casual

(iii) Linear (iv) Time-invariant

(v) Stable. **10**



Unit II

3. (a) For two random variables X and Y joint density function is :

$f_{xy}(x, y) = 1$ for $0 < x < 1$ and $0 < y < 1$.

Then find the this distribution function for any x and y. **5**

(b) Express the relations to represent properties of continuous-time LTI systems for :

(i) Systems with or without Memory

(ii) Causality

(iii) Stability in terms of convolution integral. **10**

4. (a) The random variable X is represented as its density function :

$f_x(x) = \lambda e^{-\lambda x}$ for $x > 0$; λ = constant,

$f_x(x) = 0$ otherwise

Then find the expected value E[x] and E[x^2]. **10**

(b) Verify the convolution integral cumulative and associated properties. **5**

Unit III

5. (a) Determine the complex exponential Fourier series of $x(t)$ periodic square wave given by

$$x(t) = \sum_{k=-\infty}^{\infty} c_k e^{jk\omega_0 t}; \quad \omega_0 = \frac{2\pi}{T_0}.$$

(b) Prove that Parseval's identify or Parseval's theorem. **15**

6. (a) What is Shanon's sampling theorem? Using an example also discuss aliasing. Find the minimum sampling interval to satisfy Shanon's rule for

$x(t) = \cos(2\pi t) + \cos(5\pi t)$.

(b) Define properties of CTFT. **15**

Unit IV

7. (a) Find the DFT $X[k]$ of $x[n] = \{0, 1, 2, 3\}$.

(b) Find IDFT $x[n]$ from $X[k]$ obtained above in 7. a.

(c) Find the inverse Laplace transform for the $X(s)$

$$X(s) = \frac{2s+4}{s^2+4s+3} \text{ for :}$$

(i) $\mathrm{Re}(s) > -1$

(ii) $\mathrm{Re}(s) < -3$

(iii) $-3 < \mathrm{Re}(s) < -1$. **15**

8. (a) For a general continuous-time signal $x(t)$, give the Laplace transform $X(s)$.

(b) Show that the bilateral Laplace transform of $x(t)$ can be computed from two unilateral Laplace transforms. **15**