4th Jan 2024

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1604 **G**

Unique Paper Code : 2512012303

Name of the Paper : Signals and Systems

Name of the Course : **B.Sc. (H) Electronics (CORE)**

Semester : III

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. There are **seven** questions in all, out of which you have to attempt any **five** questions.
3. **First** Question is Compulsory.
4. **All** questions carry equal marks.
5. Use of Scientific Calculator is allowed.

P.T.O.

1. (a) (i) Prove that $\int_{-\infty}^{\infty} x(t)\,\delta(t)\,dt = x(0)$

(ii) Evaluate $\int_{0}^{5} \delta(t)\sin 2\pi t\,dt$.

(b) Differentiate between Time-invariant and time-variant systems. Determine whether or not the following system is time-invariant.

$$y[n] = x^2[n-1]$$

(c) Find Fourier transform of the signal $x(t) = t.e^{-at}\,u(t)$.

(d) Find the inverse Laplace transform of $X(s) = \frac{1}{(s+4)^2}$.

(e) Give the impulse response of discrete time memory less LTI systems.

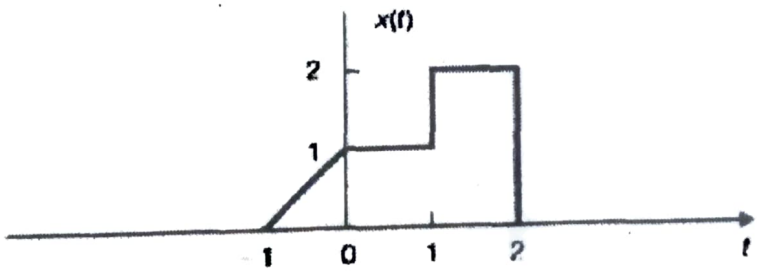
(f) Sketch the waveform of discrete time unit step signal u[n] and u[−2n + 2]. (3×6)

2. (a) Determine whether x(t) = tu(t) is energy signal or power signals.

(b) A continuous-time signal x(t) is as shown below. Sketch and label the following signals.

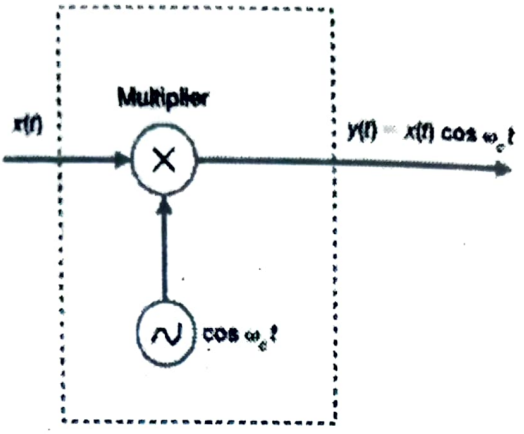
(i) $x(t)[u(t) - u(t-1)]$

(ii) $x(t)\,\delta\left(t-\frac{3}{2}\right)$



(c) Show that the product of two even signals or two odd signals is an even signal and that the product of an even and an odd signal is an odd signal. (6×3)

3. (a) Consider the system shown in figure below. Determine whether it is (a) memoryless, (b) causal, (c) linear, (d) time-invariant, or (e) stable system.



(b) Determine the convolution Sum of two sequences

$x[n] = \{1,4,3,2\}$; $h[n] = \{1,3,2,1\}$

$\uparrow$

the sequence x[n] starts at n = –1 and h[n] starts at n = 0.

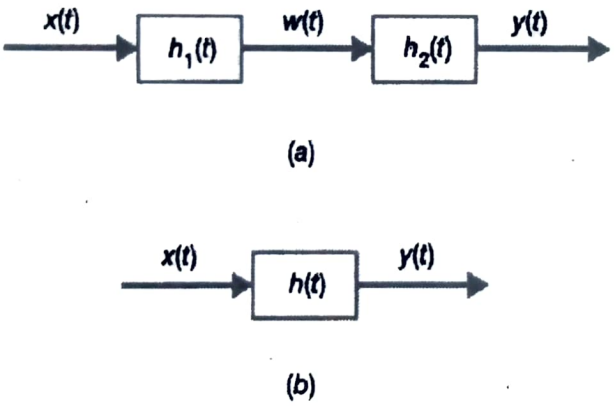
(c) The LTI system shown in Figure(a) is formed by connecting two systems in cascade. The impulse

response of the system are given by $h_1(t)$ and $h_2(t)$ respectively and

$h_1(t) = e^{-2t}u(t)$ $\quad$ $h_2(t) = 2e^{-t}u(t)$

(i) Find the impulse response h(t) of the overall system shown in figure (b).

(ii) Determine if the overall system is BIBO stable



4. (a) Find the convolution of the following

$x_1(t) = u(t)$; $x_2(t) = u(t)$

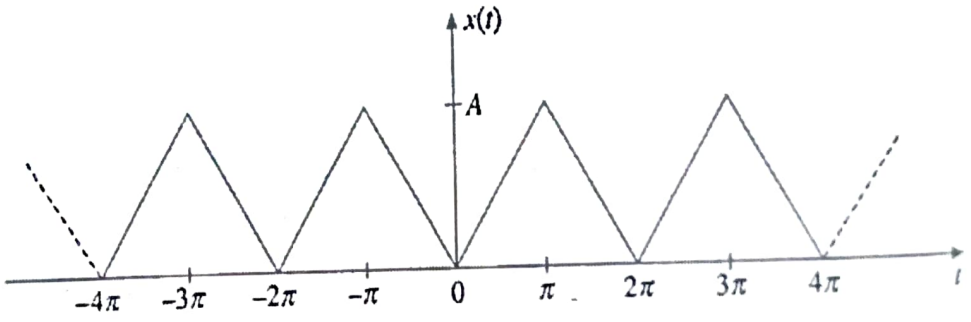
(b) State and prove in continuous time LTI system the distributive property of the convolution.

(c) Give the block diagram representation for the causal continuous time system described by the first order differential equation.

$$\frac{dy(t)}{dt} + 2y(t) = 5x(t)$$

(6×3)

5 (a) Obtain the trigonometric Fourier series for the waveform shown in figure



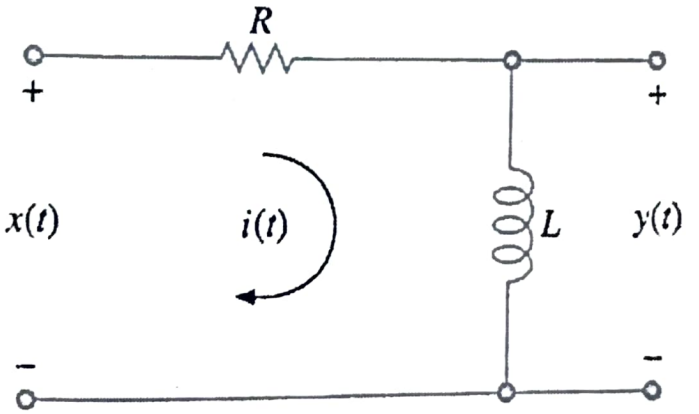
(b) Determine the discrete Fourier series representation of the given sequence

$$x[n]=\cos\frac{\pi}{4}n$$

(10,8)

6. (a) State and prove the convolution property of the Fourier Transform.

(b) Find the phase response and magnitude response of the RL circuit



(9,9)

7. (a) Find initial value x(0) of the signal x(t) if

$$X(s)=\frac{s+4}{s^2+3s+5}$$

(b) Find the delta response of the LTI system describe by transfer function

$$H(s)=\frac{5}{s^2+4s+5}$$

(c) A LTI system is described by the differential equation

$$\frac{d^2}{dt^2}y(t)+6\frac{d}{dt}y(t)+8y(t)=\frac{d}{dt}x(t)+x(t)$$

For initial conditions $\frac{d}{dt}y(0) = 3$, $y(0) = 1$ and $x(t) = u(t)$, Find the transfer function and the output signal $y(t)$.

(4,4,10)