[This question paper contains 3 printed pages] **5962**

**Unique Paper code** : **2512012303**
**Name of Paper** : **Signal and Systems**
**Name of Course** : **B.Sc. (Hons) Electronics**
**Semester** : **III (Core)**
**Duration** : **3 hours**
**Maximum Marks** : **90**

**Instructions for the Candidates**

1. **Question 1 is compulsory.** Attempt **five** questions in all.
2. All questions carry equal marks.
3. Use of non-programmable Scientific Calculator is allowed.

Q1. Answer in brief the following: (3 x 6)

(i) Explain with example Energy and Power Signals.

(ii) Evaluate the following signal:

$$\int_{-\infty}^{\infty} e^{-at^2}\delta(t-5)dt$$

(iii) Write the given discrete signal in terms of δ(n).

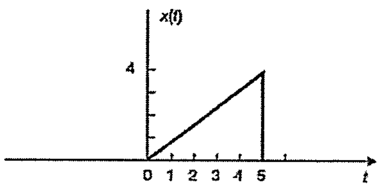
| N | -2 | -1 | 0 | 1 |
|---|---|---|---|---|
| X | -3 | 1 | 1 | -2 |

(iv) Sketch the signal x [n] = u[-n] – u[-n-2].

(v) State and prove the integration property of Fourier Transform.

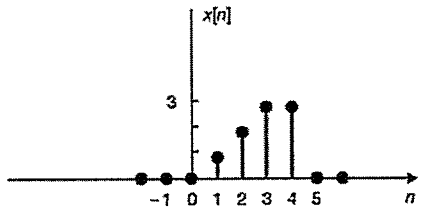
(vi) A capacitor, with capacitance 'C', has a current i(t) flowing through it and has a voltage v(t) across it in the time domain. Represent the capacitor in the s-domain with non- zero initial conditions.

Q2. (a). Sketch and label the even and odd components of the signals shown in Figure below.




(6)

(b) A discrete-time signal x[n] is shown in Figure below.




Sketch and label each of the following signals.

(i) x[n - 2]

(ii) (ii) x[2n]

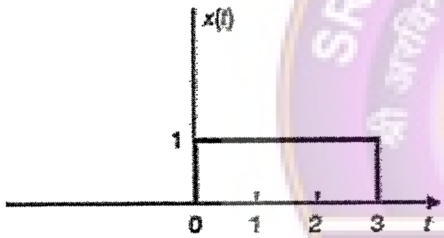
(iii) (iii) x[-n+2] (6)

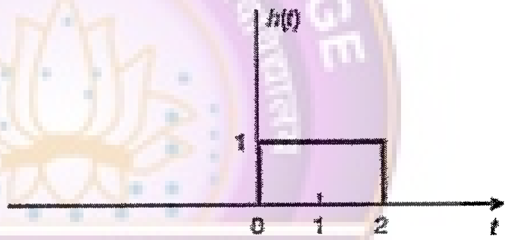
(c) Determine whether or not each of the following signal is periodic. If a signal is periodic, determine its fundamental period.

i. $x(t) = \cos\left(t + \frac{\pi}{4}\right)$

ii. $y(t) = 2\,u(t) + 2\sin(2t)$ (6)

Q3. (a) Evaluate y(t), the convolution of x(t) and h(t) i.e. $y(t) = x(t) * h(t)$. (7)
x(t) and h(t) are as shown below.




(b) A system has the input-output relation given by the relation (7)

$$y[n] = T\{x[n]\} = n\,x[n] .$$

Determine system is whether the system is
(i) memoryless, (ii) causal, (iii) linear, (iv) time-invariant, or (v) stable

(c) Output of a discrete time system is represented by the following difference equation (4)

$$y(n) = z(n-1) + \frac{1}{4}y(n-1)$$

Draw the block diagram representation of the system.

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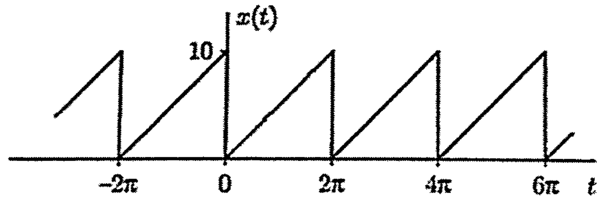
Q4. (a) Determine the convolution sum of two sequences (7)

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

The sequence x[n] starts at n= -1 and h[n] starts at n = 0.

(b) Find the trigonometric Fourier series for the waveform as shown below (7)




(c) Explain the BIBO stability criteria for a stable system. (4)

Q5 (a) Find the Fourier transform of x(t), where $\mathbf{x(t) = e^{-a|t|}}$, $\mathbf{a > 0}$ (7)

(b) Explain the duality property of Fourier transform and find the Fourier transform $G(\omega)$ of the signal g(t), where $g(t) = \frac{1}{1+t^2}$ . (7)

(c) Find the inverse Fourier transform of X(ω), where $X(\omega) = \frac{1}{(a+j\omega)^2}$ (4)

Q6 (a) Using the Fourier transform, find the convolution of the signals (7)

$$x(t) = te^{-t}\,u(t) \;\;\&\;\; y(t) = te^{-2t}\,u(t)$$

(b) Find the inverse Fourier transform of (7)

$$X(\omega) = \frac{3 + j\omega}{(1 + j\omega)^2}$$

(c) Determine the Laplace transform of x(t) = t u(t) (4)

Q7 (a) Consider the system described by the following differential equation: (7)

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

Find the transfer function H(s) and the impulse response h(t) of the system.

(b) Find the inverse Laplace transform of X(s), for the given region of convergence

$X(s) = \frac{5s+13}{s(s^2+4s+13)}$ Re(s) > 0. (7)

(c) Find y(t) the convolution of x(t) and h(t), given that x(t) = h(t) = u(t), using Laplace transform.

$$y(t) = x(t) * h(t).$$ (4)



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