

Total No. of Questions—12]

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S.E. (E&TC/Elex.) (First Semester) EXAMINATION, 2011

SIGNALS AND SYSTEMS

(2008 PATTERN)

Time : Three Hours

Maximum Marks : 100

N.B. :— (i) Answer *three* questions from Section I and *three* questions from Section II.

(ii) Answers to the two Sections should be written in separate answer-books.

(iii) Neat diagrams must be drawn wherever necessary.

(iv) Your answers will be valued as a whole.

(v) Assume suitable data, if necessary.

SECTION I

1. (a) Sketch the following signal

$$x(t) = \begin{cases} 5 - t & 4 \leq t \leq 5 \\ 1 & -4 \leq t \leq 4 \\ t + 5 & -5 \leq t \leq -4 \\ 0 & \text{otherwise} \end{cases}$$

Also determine total energy of signal $x(t)$. [8]

P.T.O.

(b) Check whether the following systems are : [8]

(i) Static/Dynamic

(ii) Causal/Non-causal

(iii) Stable/Unstable

(iv) Time invariant/Time variant

(I) $y(t) = x(t + 10) + x^2(t)$

(II) $y[n] = \frac{1}{3}\{x[n] + x[n - 1] + x[n - 2]\}.$

Or

2. (a) Sketch the following signals : [8]

(i) $x(t) = -u(t + 3) + 2u(t + 1) - 2u(t - 1) + u(t - 3)$

(ii) $x(t) = \sum_{k=-\infty}^{\infty} \delta(t - 3k)$

(iii) $x[n] = \left(\frac{1}{3}\right)^n \cdot u[n]$

(b) Determine whether the signals are periodic or non-periodic :

(i) $x[n] = \cos^2\left(\frac{\pi}{8}n\right)$

(ii) $x[t] = \cos\left(\frac{\pi}{3}t\right) + \sin\left(\frac{\pi}{4}t\right)$

Determine energy or power of signal

$$x(t) = 6 \cdot e^{-j5t}$$

$$x[n] = \left(\frac{1}{2}\right)^n \cdot u[n]. \quad [8]$$

3. (a) Evaluate the convolution integral for input $x(t)$ and impulse response $h(t)$ shown in Fig. 1 and Fig. 2. [12]

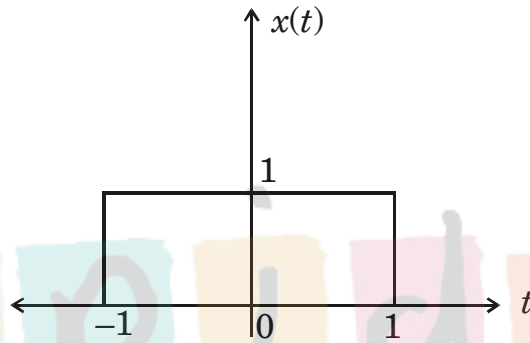


Fig. 1

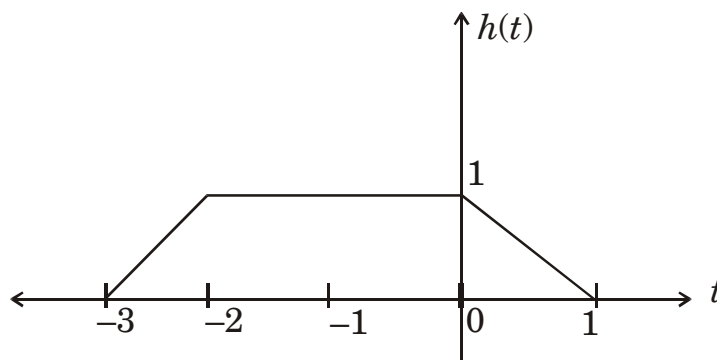


Fig. 2

- (b) For each of the following impulse responses determine whether corresponding system is memoryless, causal and stable, justify answer. [6]

$$h(t) = e^{-2t} \cdot u(t).$$

Or

4. (a) Evaluate the convolution integral for input $x(t)$ and impulse response $h(t)$

$$x(t) = \text{rect}(t)$$

$$h(t) = \text{rect}(t). \quad [8]$$

- (b) Find the step response of the first order recursive system

with impulse response $h[n] = \left(\frac{1}{3}\right)^n \cdot u[n]. \quad [8]$

- (c) State *three* properties of convolution. [2]

5. (a) Find Fourier Transform of $\sin c$ function. Plot its magnitude spectrum $x(t) = \text{sinc}(t)$. [8]

- (b) State Dirichlet conditions for existence of Fourier Series. [3]

- (c) Find Fourier series of the following functions : [5]

$$x(t) = \sin \omega_0 t.$$

Or

6. (a) Find Fourier Transform of the following function using properties :

$$y(t) = \frac{d}{dt} \{te^{-3t} \cdot u(t) * e^{-2t} \cdot u(t)\}. \quad [8]$$

(b) State and prove the following properties of CTFT : [8]

(i) Time scaling

(ii) Convolution.

SECTION II

7. (a) Determine Laplace Transform and sketch its ROC : [8]

(i) $x(t) = e^{-2t} \cdot u(t) + e^{-3t} \cdot u(t)$

(ii) $x(t) = \sin 3t \cdot u(t)$

(b) State and prove properties of Laplace Transform : [8]

(i) Differentiation in time domain

(ii) Frequency shifting.

Or

8. (a) Find the Laplace transform of

$$\begin{aligned} x(t) &= (t - 2)^3 && \text{for } t > 2 \\ &= 0 && \text{otherwise} \end{aligned} \quad [8]$$

(b) Find $f(\infty)$, final value of the function whose Laplace Transform is given as

$$F(s) = \frac{5}{s} - \frac{1}{s - 4}. \quad [4]$$

(c) State properties of ROC of LT. [4]

9. (a) Find autocorrelation, PSD and power of the signal

$$x(t) = 7 + 6 \sin (200 \pi t + 30^\circ). \quad [10]$$

- (b) Show that autocorrelation and ESD form Fourier pair of each other. [6]

Or

10. (a) Show that autocorrelation and ESD form Fourier pair of each other, for the following function

$$x(t) = e^{-5t} \cdot u(t). \quad [10]$$

- (b) Define, prove and write the properties of the following :

Cross-correlation of energy signal. [6]

11. (a) A box contains 5 yellow, 7 pink and 4 green balls. A ball is drawn at random. Find the probability that it is :

(i) Pink

(ii) Not green

(iii) Green or Yellow. [8]

- (b) Explain two-distribution function. [6]

- (c) Define the terms : [4]

(i) Mean value

(ii) Moment

(iii) Standard deviation

(iv) Mean square.

Or

12. (a) Two dice are thrown at random several times. The random variable assigns the sum of the numbers appearing on dice to each outcome (event). Find the CDF for random variable. [8]
- (b) State the properties of PDF. [4]
- (c) Find the mean, second moment and standard deviation of 'X' when

$$F_x(X) = Ae^{-Ax} u(x). \quad [6]$$

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