May June 2012

Total No. of Questions—12] [Total No. of Printed Pages—8

Seat No.	

[4162]-151

S.E. (E&TC) (First Semester) EXAMINATION, 2012

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*) Figures to the right indicate full marks.

(*iv*) Assume suitable data, if necessary.

SECTION I

1. (*a*) (*i*) Define unit impulse function and write its relation with unit step in CT and DT. [5]

(*ii*) Find even and odd part of $x(t) = u(t)$. [5]

(*b*) Find whether the following CT and DT signals are periodic, if yes, find the period :

(*i*) $x(t) = 4\cos\frac{\pi}{100}t + 2\cos\frac{\pi}{180}t$

P.T.O.

(*ii*) $x(t) = 5 \sin 200\pi t$

(*iii*) $x[n] = \cos 5\pi n$

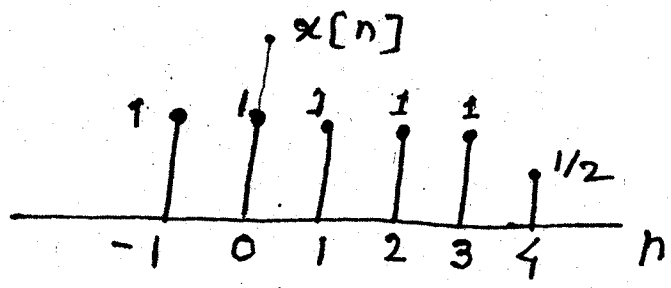
(*iv*) $x[n] = \cos\left[\frac{\pi n}{2}\right] - \sin\left[\frac{\pi n}{8}\right]$. [8]

Or

2. (*a*) (*i*) Define energy signal and power signal. [2]

(*ii*) Determine whether $x(t) = u(t)$ is power signal or energy signal. [6]

(*b*) Sketch the following signals if $x[n]$ is as shown below :



(*i*) $x[2n + 1]$

(*ii*) $x[n] \cdot u[2 - n]$

(*iii*) $x[n - 1] + \delta[n - 3]$

(*iv*) $x[4 - n] + u[n]$

(*v*) $\frac{1}{2}x[n]$. [10]

3. (*a*) Determine convolution integral of $x(t) = u(t)$ with $h(t) = \text{rect}\left(\frac{t}{w}\right)$. [8]

(*b*) The impulse response of DT-LTI system is given below :

$$h[n] = (0.99)^n \; u[n + 3].$$

(*i*) Determine whether the system is stable or not.

(*ii*) Justify whether the system is causal or anticipatory. [8]

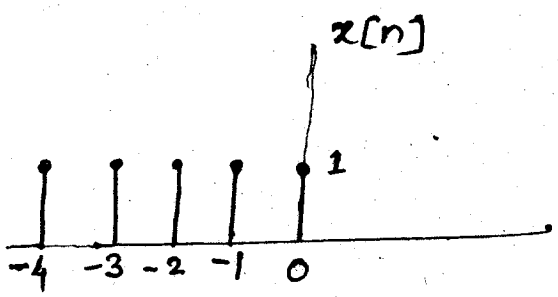
Or

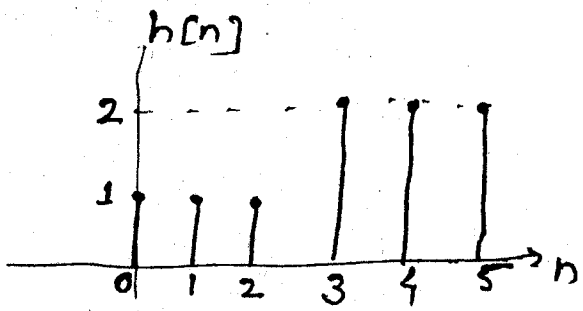
4. (*a*) Test the stability of the LTI systems whose impulse responses are given below :

(*i*) $h(t) = t \cdot e^{-t} \; u(t)$

(*ii*) $h(t) = Ae^{-2t} \; u(t)$. [8]

(*b*) Convolve the D.T. signal $x[n]$ and $h[n]$ by tabulation method. [8]





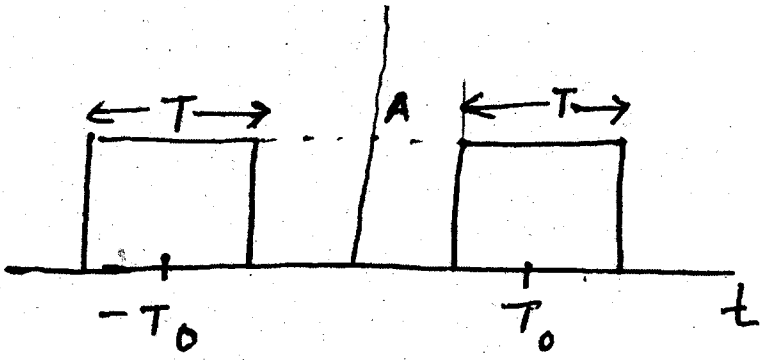
5. (*a*) State and prove the following properties of Fourier transform :

(*i*) Differentiation in time domain

(*ii*) Frequency shifting. [6]

(*b*) (*i*) Find the Fourier Transform of sine signal. [5]

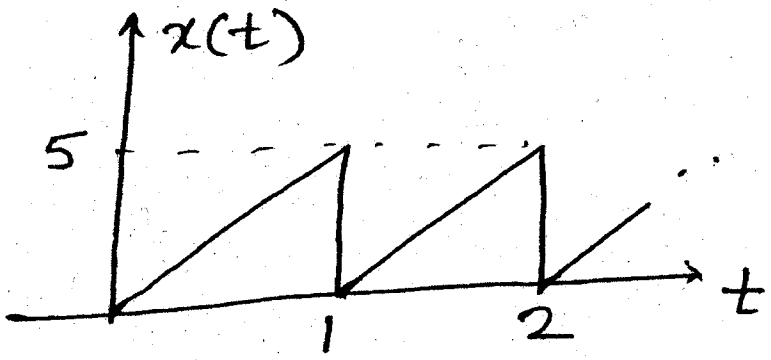
(*ii*) Find the Fourier Transform using time shifting property for the following signal. [5]



Or

6. (*a*) Write the equations for three types of Fourier series representation. [6]

(*b*) Find exponential Fourier series for the following signal. [10]



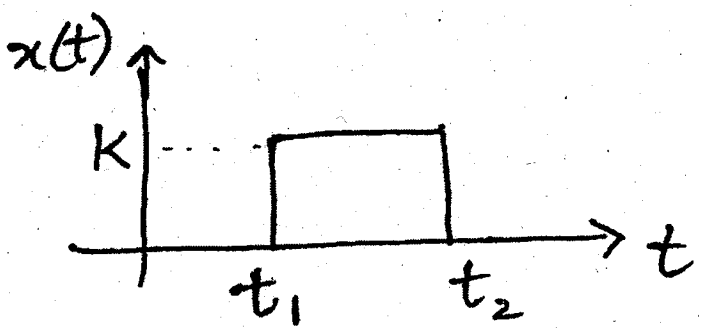
SECTION II

7. (*a*) The transfer function of LTI system is given by

$$H(s) = \frac{2s - 1}{s^2 + 3s + 2}.$$

Determine the impulse response of the system. [6]

(*b*) Find the Laplace transform of the shifted gate pulse shown below. [6]



(*c*) Find the final value of

$$X(s) = \frac{2s + 3}{s^3 + 5s^2 + 6s}.$$ [6]

Or

8. (*a*) Determine the partial fraction expansion and hence Inverse Laplace transform of

$$X(s) = \frac{s^2 + 2s - 2}{s(s + 2)(s - 3)} \quad \text{ROC } \text{Re}(s) > 3.$$ [8]

(*b*) Prove :

(*i*) Time shifting and

(*ii*) Differentiation in time domain properties of Laplace transform. [10]

9. (*a*) The signal $x(t) = 10\sin(10t)$ is applied to a system whose transfer function is

$$H(f) = 3\text{rect}\left(\frac{f}{4}\right)e^{-j4\pi f}.$$

Find the output energy spectral density. [8]

(*b*) State :

(*i*) Rayleigh's Energy Theorem

(*ii*) Parsvel's Power Theorem. [4]

(*c*) Given :

$$\text{rect}(t) = A \quad -\frac{1}{2} < t < \frac{1}{2}$$

$$= 0 \quad \text{otherwise.}$$

Find Energy Spectral Density. [4]

Or

10. (*a*) Find the cross-correlation between the signals :

$x_1[n] = \{\underset{\uparrow}{1}, 2, 3, 4\}$ $x_2[n] = \{\underset{\uparrow}{0}, 1, 2, 3\}$. [8]

(*b*) State the properties of ESD and prove its relation with autocorrelation. [8]

11. (*a*) Three students A, B and C are given a problem in Maths. The probabilities of their solving the problem are $\frac{3}{4}$, $\frac{2}{3}$ and $\frac{1}{4}$ respectively. Determine the probability that the problem is solved if all of them try to solve the problem. [6]

(*b*) Define the terms Expectation, Variance and Standard Deviation.

Determine the above terms for uniform random variable whose p.d.f. is given by

$$f(x) = \frac{1}{b-a} \qquad a \leq x \leq b$$

$$= 0 \qquad \text{elsewhere.}$$

 [10]

Or

12. (*a*) The probability density function of a random variable X is given by $f(x) = xe^{-x} \cdot u(x)$. Determine :

(*i*) CDF

(*ii*) Evaluate $P(X \leq 1)$

(*iii*) $P(1 < X \leq 2)$

(*iv*) $P(X > 2)$. [8]