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

[3862]-161

S.E. (E & TC/Elex)(First Semester) EXAMINATION, 2010

SIGNALS AND SYSTEMS

(2008 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. **:—** (*i*) Answer any *three* questions from each Section.

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

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

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

SECTION I

1. (*a*) Determine whether the signal is an energy or power signal. Find the value of the same. (Refer Fig. 1) : [6]

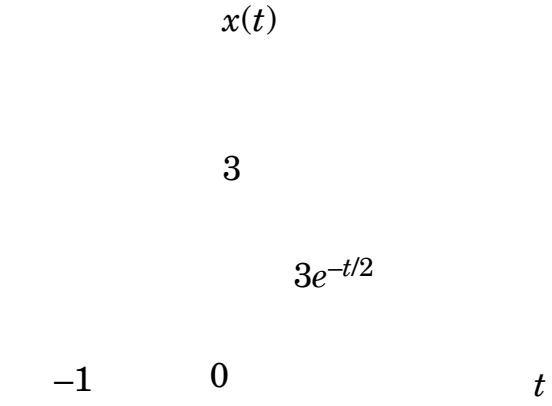

Fig. 1

P.T.O.

(*b*) Determine whether the signal is periodic or aperiodic. If periodic, find its period :

(*i*) $x(t) = 2 \cos \frac{2\pi t}{3} + 3 \cos \frac{2\pi t}{7}$ [4]

(*ii*) $x[n] = \cos 2n$. [2]

(*c*) Find the odd and even parts of the signal (Refer Fig. 2) : [6]

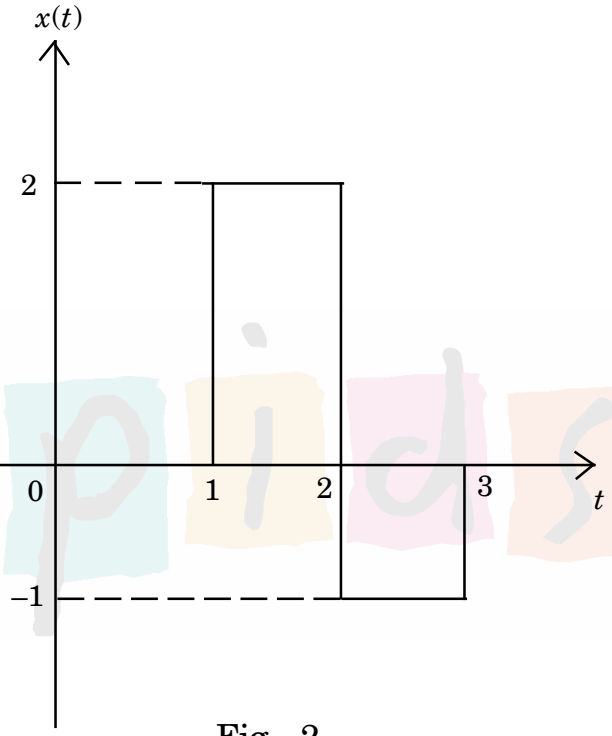

Fig. 2

Or

2. (*a*) Sketch the following waveforms : [5]

(*i*)

(*ii*) .

(*b*) Determine if the following systems is memoryless, causal, linear, time invariant and stable : [7]

$y(t) = \sin [x (t + 2)]$.

(*c*) Determine if the given system is static, causal, stable if impulse reponse $h(t)$ is given by $h(t) = e^{-2t}. u(- t)$. [6]

3. (*a*) State the properties of convolution integral. [3]

(*b*) Find the step response of the system whose impulse response is : [6]

(*i*)

(*ii*) $u[n]$.

(*c*) Compute the convolution of and

. [7]

Or

4. Find the response $y(t)$ of the LTI system shown by the block diagram (Refer Fig. 3) : [16]

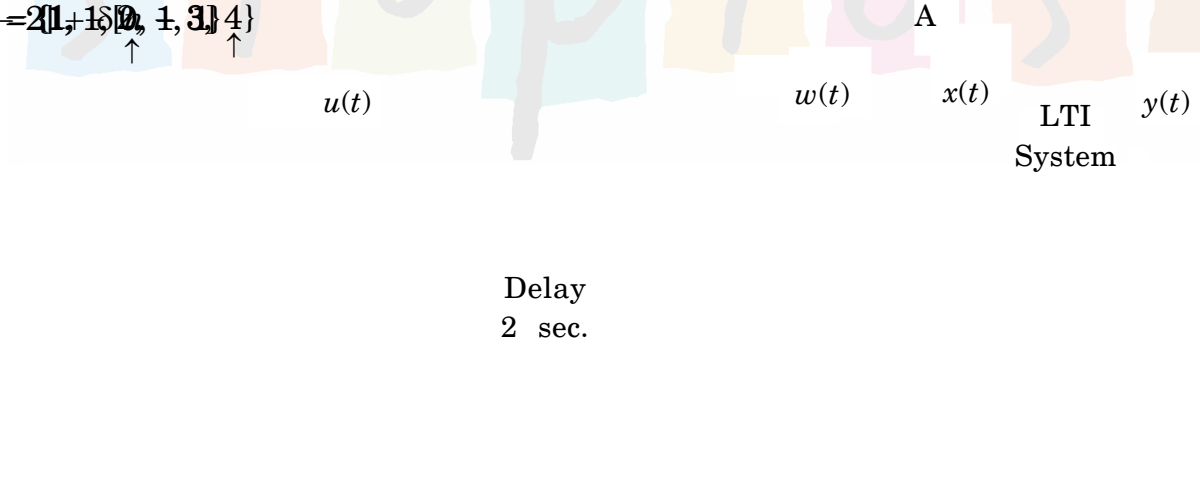

Fig. 3

where

$h(t) = e^{-2t}$ for $t > 0$

$= 0$ elsewhere.

5. (*a*) Obtain the exponential Fourier series of the rectangular pulse shown below (Refer Fig. 4) : [8]

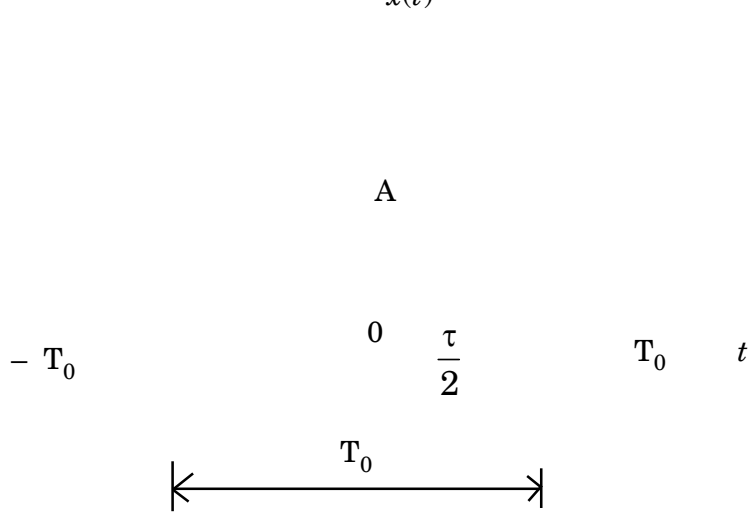

Fig. 4

(*b*) Draw the magnitude and phase spectrum of the signal in Q. 5(*a*) above. [8]

Or

6. (*a*) Obtain the Fourier transform of the signal shown below, using linearity property (Refer Fig. 5). [10]

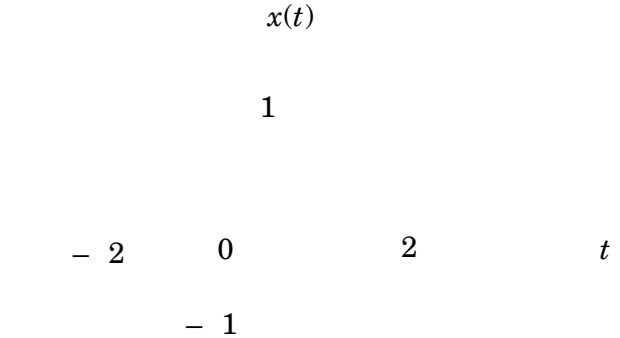

Fig. 5

(*b*) Obtain the Fourier transform of a unit step function and plot its magnitude and phase spectrum. [6]

SECTION II

7. (*a*) A 0.5 F capacitor is in the network which is initially charged to 10 V and switch is closed at $t = 0$. Find $i(t)$ for $t > 0$ using Laplace transform (Refer Fig. 6) : [8]

$$X(s) = \frac{2s + 3}{s^2 + 5s - 7}$$

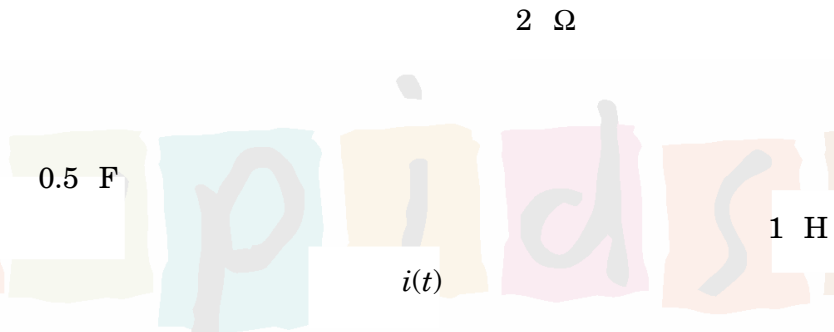

Fig. 6

(*b*) Find the Laplace transform of $x(t) = e^{-3t} \cdot u(-t)$ and plot its R.O.C. [5]

(*c*) Find the initial and final value of $x(t)$ given : [5]

Also state the Initial and Final value theorem.

Or

8. (*a*) Obtain Laplace transform of the waveform shown in Fig. 7 : [8]

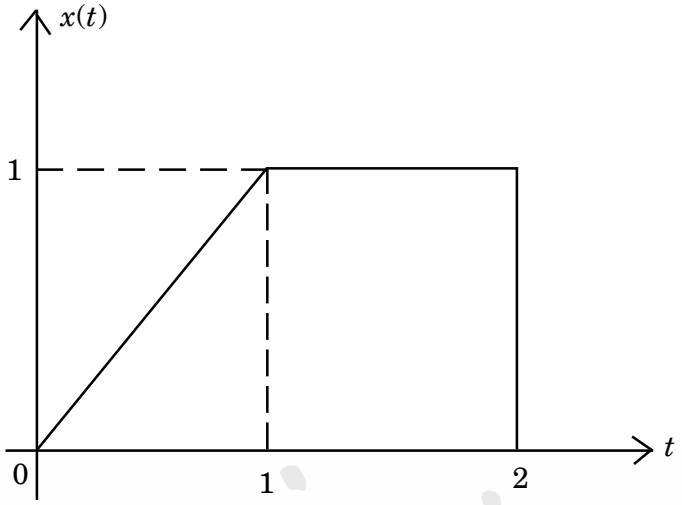

Fig. 7

(*b*) Using properties of Laplace transform, find if : [5]

$$X(s) = \frac{4s}{s^2 + 2s + 1}$$

(*i*) $x(5t)$

(*ii*) $x(t) * u(t)$.

(*c*) Find the time domain representation of the signal given : [5]

$$X(s) = \frac{s^2 + 4s + 3}{(s + 2)(s^2 + 2s + 1)}.$$

9. A time domain signal $x(t) = e^{-4t} u(t)$. [16]

Find :

(*i*) Autocorrelation function

(*ii*) Spectrum X(*f*)

(*iii*) Energy spectral density

(*iv*) Energy

(*v*) Plot of autocorrelation

(*vi*) Plot of ESD.

Or

10. (*a*) Obtain the cross correlation of the following sequences : [8]

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

(*b*) List the properties of energy spectral density and power spectral density. [8]

11. (*a*) A box contains 3 white, 4 red and 5 black balls. A ball is drawn at random. Find the probability that it is : [6]

(*i*) Red

(*ii*) Not black

(*iii*) Black or White.

(*b*) Explain Poisson's and Gaussian distribution function. [6]

(*c*) Find the expectation of random variable X which is defined by : [4]

X = –2 with probability 1/4

= 3 with probability 1/2

= 1 with probability 1/4

Find $E[X^2]$.

Or

12. (*a*) Each letter of the word ATTRACT is written on a separate card. The cards are then thoroughly shuffled and four of them are drawn in succession. What is the probability of getting result as TACT ? [4]

(*b*) With an example explain the concept of continuous R.V. and Discrete R.V. What is the P.D.F. and C.D.F. ? Plot PDF of uniform distributed R.V. over an interval (0 to 2π). [8]

(*c*) A continuous R.V. X has the following density function : [4]

$$0 < X < 2$$

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

Find :

(*i*) The normalising factor k

(*ii*) The probabilities that $0.2 < X < 0.5$.