Total number of printed pages–7

53 (EC 302) SISY

2014

LINEAR SYSTEMS AND SIGNALS

Paper : EC 302

Full Marks : 100

Pass Marks : 30

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Determine whether the following signals are energy or power signal 2×3=6

   (i) $x(t)=sin^2 w_0 t$

   (ii) $x(t)=rect\,(t/\tau)$

   (iii) $x(t)=A.e^{-at}.u(t); a>0$

Contd.

(b) Sketch the following : 2+2=4

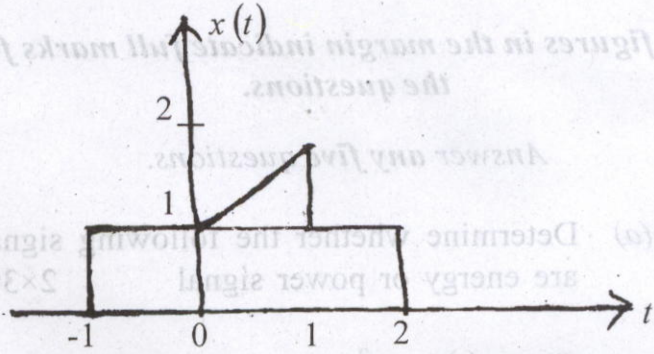
(i) $2u(t+2)-2u(t-3)$

(ii) $r(t)-r(t-1)-r(t-3)+r(t-4)$

(c) For the signal $x(t)$ shown find the signal 2+2=4

(i) $x(5/3t)$

(ii) $x\left(\frac{1}{2}t-2\right)$



(d) Find even and odd components of the following : 2+2=4

(i) $x(t)=e^{jzt}$

(ii) $x(n)=\{-3, 1, \underset{\uparrow}{2}, -4, 2\}$

(e) Find whether the signal $x(t) = u(t+2) - u(t-2)$ is casual or non-casual signal. Give reason for your answer. 2

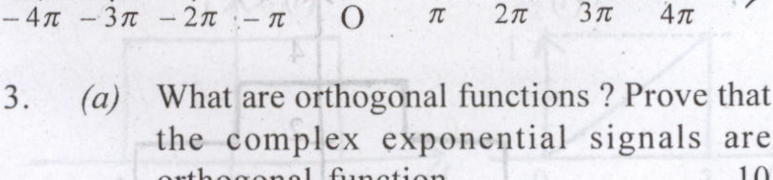
2. (a) Define Fourier series. Give Dirichlet conditions for Fourier series. 5

(b) Find the complex exponential Fourier series representation of the following signals 5

(i) $x(t) = 4\cos 2w_0 t$

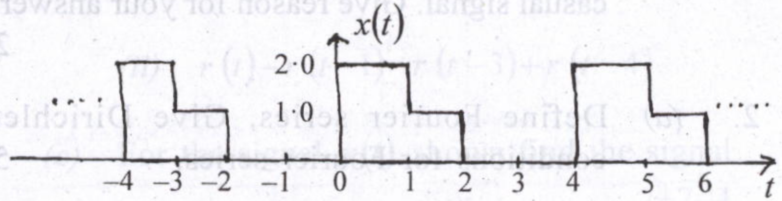
(ii) $x(t) = 3\sin 4w_0 t$

(c) Find the Fourier series expansion for the waveform shown below : 10



3. (a) What are orthogonal functions ? Prove that the complex exponential signals are orthogonal function. 10

(b) Compute the exponential Fourier series of the signal shown in the figure. 10



4. (a) Using properties of Fourier transform, find the Fourier transform of the following : 5

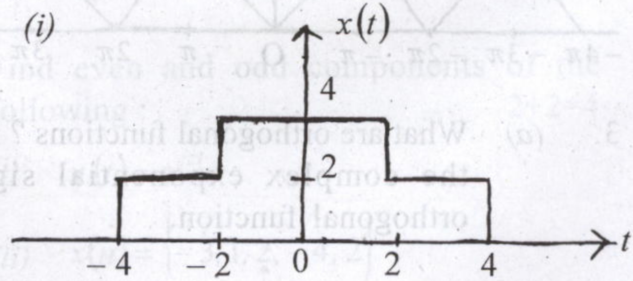
(i) $x(t) = u(-t)$

(ii) $x(t) = \delta(t+2) + \delta(t+1) + \delta(t-1) + \delta(t-2)$

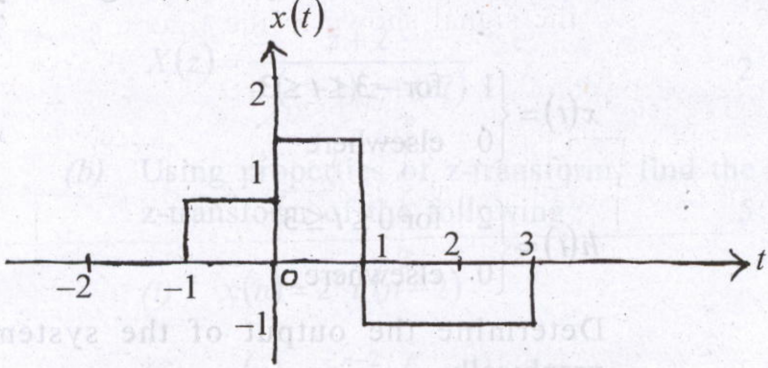
(b) State and prove Parseval's Relation for continuous time Fourier transform. 5

(c) Determine the Fourier transform of the signals shown in figure : 5+5=10

(i)



(ii)

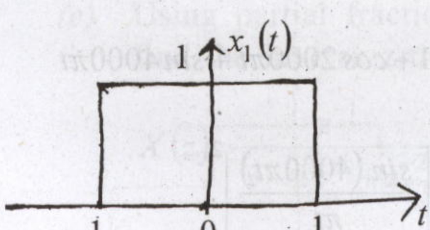


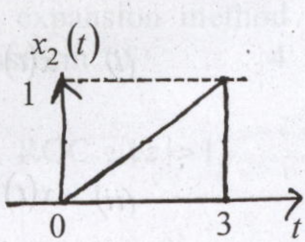
5. (a) Find the convolution of the following signals : 3+3=6

(i) $x_1(t) = e^{-2t}u(t)$; $x_2(t) = e^{-4t}u(t)$

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

(b) Find $x_1(t) * x_2(t)$ for the functions $x_1(t)$ and $x_2(t)$ shown in figures 7





(c) The functions to the system are given by 7

$$x(t)=\begin{cases}1 & \text{for } -3\le t\le 3\\ 0 & \text{elsewhere}\end{cases}$$

$$h(t)=\begin{cases}2 & \text{for } 0\le t\le 3\\ 0 & \text{elsewhere}\end{cases}$$

Determine the output of the system graphically.

6. *(a)* State sampling theorem. Explain different types of sampling techniques. 8

(b) What do you mean by interpolation ? Name the methods used to reconstruct signals. Obtain the transfer function of zero order hold. 8

(c) Find the Nyquist rate and Nyquist sampling interval for the following signals : 4

(i) $x(t)=1+\cos 2000\pi t+\sin 4000\pi t$

(ii) $x(t)=\left[\dfrac{\sin(4000\pi t)}{\pi t}\right]^2$

7. *(a)* Find $x(\alpha)$ if

$$X(z) = \frac{z+2}{4(z-1)(z+0{\cdot}7)}$$ 2

(b) Using properties of z-transform, find the z-transform of the following : 5

(i) $x(n) = 2^n u(n-2)$

(ii) $x(n) = \alpha^{n-2} u(n-2)$

(c) Find z-transform and ROC of

$x(n) = a^n u(n) - b^n u(-n-1)$ 6

Sketch the ROC and pole-zero location.

(d) Using long division, determine the inverse z-transform of 3

$$X(z) = \frac{z}{2z^2 - 3z + 1} \text{ ; ROC ; } |z| > 1$$

(e) Using partial fraction expansion method find the inverse z-transform of 4

$$X(z) = \frac{z^{-1}}{3 - 4z^{-1} + z^{-2}} \text{ ; ROC ; } |z| > 1$$
