53 (IE 403) LSAS

2017

LINEAR SYSTEM AND SIGNALS

Paper : IE 403

Full Marks : 100

Time : Three hours

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

*Answer **any five** questions.*

1. *(a)* Define the following : 6

   (i) Deterministic signal

   (ii) Causal system

   (iii) Memoryless system

   (iv) Unit step signal

   (v) Unit impulse signal and

   (vi) Linear system.

(b) Determine whether the following signals are periodic or not, if periodic find out the fundamental frequency — 2×2=4

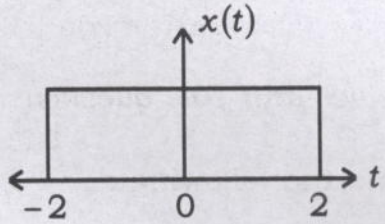
(i) $2ws5\pi t + sin3\pi t$

(ii) e^{j3n}

(c) Draw the following signals — 2×2=4

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

(ii) $x\left(\frac{t}{2}+3\right)$ if



(d) Evaluate the following — 2×3=6

(i) $\sum_{n=-2}^{5} e^{3n}\delta(n-4)$

(ii) $\int_0^t t^2\delta(t-3)dt$

(iii) $\int_0^3 \delta(t)sin5\pi t\,dt$

2. (a) Test the linearity, time invariance and causality of the following signal

$y(t) = 2x(t) + 4$ 6

(b) Find the convolution of — 2×4=8

(i) $e^{-2t}u(t) * e^{-4t}u(t)$

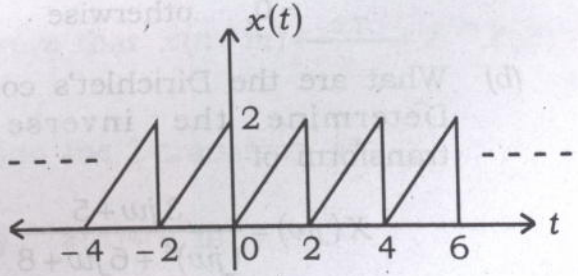
(ii) $cosu(t) * u(t-3)$

(c) Determine the convolution of following using graphical and matrix method — 4+2=6

$x_1[n] = [2, 5, 6, 7]$

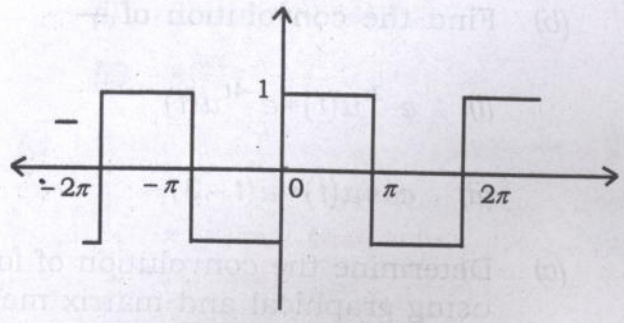
$x_2[n] = [1, 4, 3]$

3. (a) Find the trigonometric Fourier series for the following signal : 7



(b) Prove the linearity and time shifting property of Fourier series. 6

(c) Obtain the exponential Fouier series for the following waveform — 7



4. (a) Derive the Fourier transform of the following signals 3×4=12

(i) $\sin w_0 t\, u(t)$

(ii) $e^{-t} \sin 5t\, u(t)$

(iii) $x(t) = 1 - t^2 ; \quad 0 < t < 1$

$= 0, \quad$ otherwise

(b) What are the Dirichlet's conditions ? Determine the inverse Fourier transform of 2+6=8

$$X(jw) = \frac{3jw + 5}{(jw)^2 + 6jw + 8}$$

5. (a) What are the conditions for the existence of Laplace transform ? Write the advantages of Laplace transform. 2+2=4

(b) Determine the L.T. and the ROC of the following signals 2×4=8

(i) $x(t) = e^{-t}u(t) + e^{-5t}u(t)$

(ii) $x(t) = t^2 u(t)$

(c) Find the inverse Fourier transform of the following — 2×4=8

(i) $X(s) = \frac{s+4}{s^2+5s+6}$

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

6. (a) Prove that $x(n-m) \xleftrightarrow{Z.T.} Z^{-m}X(Z)$ 4

(b) Find the Z-transform of

(i) $x(n) = a^n u(n)$

(ii) $x(n) = b^n u(-n-1) + (0{\cdot}5)^n u(n)$

3+5=8

(c) Determine the inverse Z-transform of

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

8

7. (a) Define the sampling theorem ? What is the nyquist frequency and nyquist interval ? What is the basic function of sampling ? 2+1+1=4

(b) What are the effects of undersampling ? With necessary diagram explain the operation of impulse and natural sampling. 2+4+4=10

(c) Determine the nyquist frequency and interval for the following 3+3=6

(i) $x(t) = sinc^2 100\pi t$

(ii) $x(t) = 10 \sin 40\pi t \cos 60\pi t$
