

Total number of printed pages-6

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.

Contd.

- (b) Determine whether the following signals are periodic or not, if periodic find out the fundamental frequency —

2×2=4

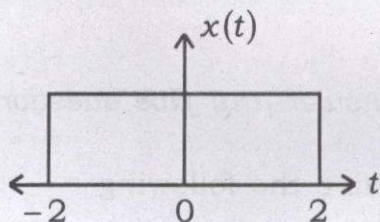
(i) $2\cos 5\pi t + \sin 3\pi t$

(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) $\int_0^3 \delta(t) \sin 5\pi t dt$

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

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

- (b) Find the convolution of — $2 \times 4 = 8$

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

(ii) $\cos u(t) * u(t-3)$

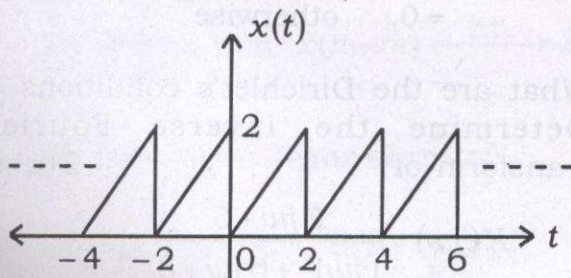
- (c) Determine the convolution of following using graphical and matrix method —

$$4 + 2 = 6$$

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

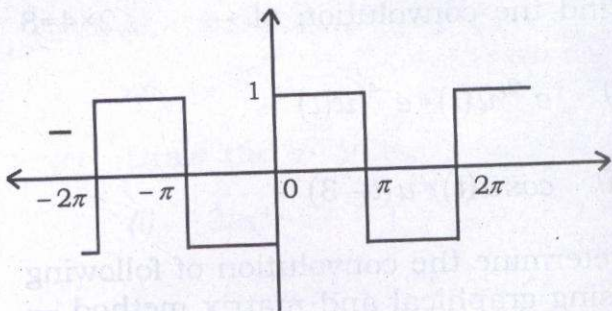
$$x_2[n] = [1, 4, 3]$$

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 Fourier series for the following waveform — 7



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

(i) $\sin \omega_0 t u(t)$

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

(iii) $x(t) = 1 - t^2; 0 < t < 1$
 $= 0, \text{ otherwise}$

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

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

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

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

$$(ii) \quad x(n) = b^n u(-n-1) + (0.5)^n u(n)$$

3+5=8

(c) Determine the inverse Z-transform of

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

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) $x(t) = \text{sinc}^2 100\pi t$

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