

(3 Hours)

[Total Marks: 80]

- 1) Question No. 1 is compulsory.
- 2) Out of remaining questions, attempt any three questions.
- 3) Assume suitable data, if required.

Q1 Attempt any four of the following (20)

a Verify whether the following signals are periodic. If periodic, find the fundamental period. (05)

(a) $x(t) = [\sin(4t - 1)]^2$

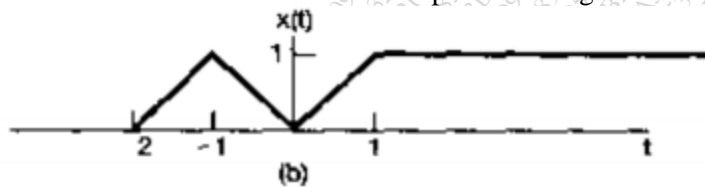
(b) $x[n] = \cos(4n + \pi/4)$

b State and prove differentiation property of Z transform and Laplace transform. (05)

c Determine energy or power of following signals (05)

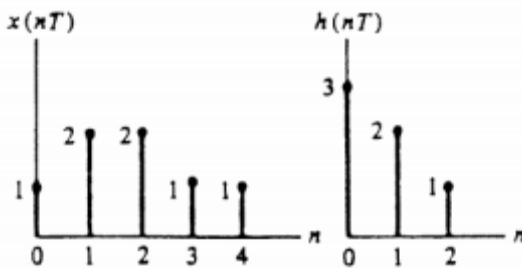
1. $X(t) = x(t) = 0.9 e^{-3t} u(t)$ 2. $x[n] = u[n]$

d Determine and draw the even and odd part of the signal (05)



e State and prove final value theorem of Laplace transform (05)

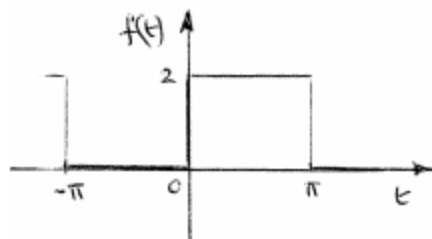
Q2 a Perform convolution on following signals. (10)



b Find the inverse Laplace transform of and draw possible ROCs (10)

$$\frac{30}{s^7} + \frac{8}{s-4}$$

Q3 a Determine the complex Fourier series for the function defined by - (10)



$$f(t) = \begin{cases} 0, & \text{when } -\pi \leq t \leq 0 \\ 2, & \text{when } 0 \leq t \leq \pi \end{cases}$$

The function is periodic outside of this range of period 2π .

b Explain role of ROC and properties of ROC with respect to Z transform (10)

Q4 a Determine the Fourier transform of the signal shown below. Draw the frequency domain signal.

$$f(t) = \cos(2\pi st)$$

b Find the autocorrelation, power and power spectral density of the signal (10)

$$X(t) = 3\cos t + 4\cos 3t.$$

Q5 a Calculate z-transform of the following signal: (10)

$$(i) x[n] = n\left(\frac{-1^n}{4}\right)u(n) * \left(\frac{-1^{-n}}{6}\right)u(-n)$$

$$(ii) x[n] = u[n - 5] - u[n - 10]$$

b State duality property of Fourier Transform. If FT of $e^{-t}u(t)$ is $1/(1+j\Omega)$, find the FT of $1/(1+t)$ using duality property. (10)

Q6 a An LTI system is characterized by the system function: (10)

$$H(z) = \frac{z}{\left(z - \frac{1}{4}\right)\left(z + \frac{1}{4}\right)\left(z - \frac{1}{2}\right)}$$

Write down possible ROCs for different possible ROCs. Determine causality and stability and impulse response of the system.

b Check if the system is linear and time variant (10)

1. $y(t) = t^2x(t) + 3$
2. $y(n) = x(-n) + 3 X(n+1)$
3. $y(n) = u(n) + u(n-1)$
4. $y(t) = r(t)$
5. $y(n) = \delta(t)$