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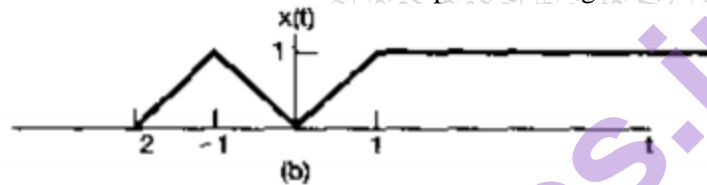
   (a) $x(t) = [\sin(4t - 1)]^2$

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

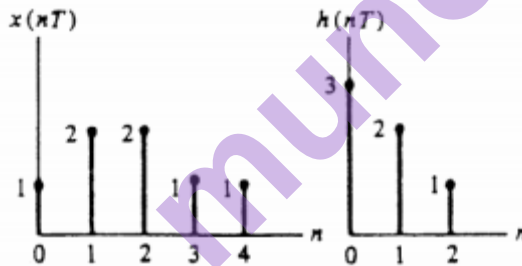b   State and prove differentiation property of Z transform and Laplace transform.   **(05)**

c   Determent energy or power of following signals   **(05)**
   1. $X(t) = x(t) = 0.9\, e^{-3}t\, u(t)$ 2. $x[n] = u[n]$

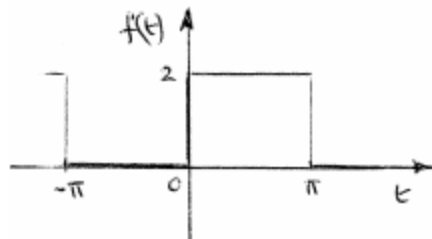d   Determine and draw the even and odd part of the signal   **(05)**

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)**

72163   Page **1** of **2**

$f(t) = \quad 0$, when $-\pi \le t \le 0$

$\quad\quad\quad 2$, when $0 \le t \le \pi$

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)**

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

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

88A89FBA80932F83D9895BA53BE5F55C