N.B.: (1) Q. No. 1 is compulsory
(2) Attempt any three questions from remaining questions.
(3) Solve every question in a serial order.

1. Attempt any four:
   a) What is Sinc(x) function? Plot graphically Sinc(x) function for the range of x : -2.5<x<2.5
   b) Obtain DTFT and plot the magnitude and phase response of h(n) = {0,1,1,1}
   c) Distinguish between power signals and energy signals. Is \( x(t) = \cos^2(\omega_0 t) \) is energy signal or power signal? Find its normalized energy or power.
   d) State and prove differentiation of Z-transform.
   e) Check whether the following system is linear, time variant, causal or otherwise : \( y(n) = x(n) + n*x(n+1) \)

2. a) Find the response of the system
   \[ x(t) = \frac{d^2y(t)}{dt^2} + 5 \frac{dy(t)}{dt} + 6y(t) \]
   Subject to the initial conditions \( y(0) = 2, y(0) = 1 \) and input \( x(t) = e^{-t}u(t) \).
   b) Find and sketch the Even and Odd components of the following:
   \( x(t) = t, \ 0 < t < 1 \)
   \( x(t) = 2-t, \ 1 < t < 2 \)
   c) State and prove frequency shift property of the Fourier transform.

3. a) Compute the convolution \( y(n) = x(n) * h(n) \) where
   \( X(n) = \{1,1,0,1,1\} \) and \( h(n) = \{1,-2,-3,4\} \)
   b) Find Inverse Z-transform of the following:
   \[ X(Z) = \frac{2Z^2 + 3Z}{Z^2 + Z + 1}, \text{ if } x(n) \text{ is causal.} \]
   c) Define ESD and PSD. What is the relation of ESD and PSD with autocorrelation?
4. a) Find \( y(t) = x(t) * h(t) \) of the signal shown above using graphical convolution.

b) Obtain system function \( H(z) \) for
\[
y(n) + \frac{1}{2} y(n - 1) = x(n) - x(n - 1)
\]

Determine the poles and zeros and draw a pole zero plot.

c) Obtain DTFT and plot the magnitude and phase response of \( h(n) = \{2, 1, 2\} \)

5. a) Determine the Z transform and sketch ROC

1) \( x_1[n] = \left[\begin{array}{c} 1 \\ 3 \end{array}\right] \) \( n \geq 0 \)

2) \( x_2[n] = x_1[n + 4] \)

b) Obtain Laplace transform by using properties of Laplace transform only.

c) Determine Fourier transform of signum signal
6. a) Obtain initial Laplace transform of \( X(s) = \frac{2s^2 + 5s + 5}{(s + 2)(s + 1)^2} \) for all possible ROC conditions.

b) Obtain Fourier transform by using properties of Fourier transform only.