Problem 1.1 Express the following complex numbers in rectangular (Cartesian) form:

1.  \( e^{j0} + e^{j\pi} + e^{j\pi/2} = \)

2.  \( e^{j\pi/2} + e^{-j\pi/2} + e^{j\pi} = \)

3.  \( e^{j\pi/4} + e^{j3\pi/4} + e^{j5\pi/4} + e^{j7\pi/4} = \)

4.  \( e^{j3\pi/4} - e^{-j\pi/4} = \)

Problem 1.2 A discrete-time (D.T.) linear, time-invariant (LTI) system produces the output \( y_p[n] \) for the input \( p[n] \) as shown below. Sketch the input signal \( x[n] = p[n] + 2p[n-1] - p[n-3] \) in the space provided, then determine and sketch the corresponding output \( y[n] \) when \( x[n] \) is the input to the same system.
Problem 1.3 A discrete-time LTI system is described by the following block diagram:

```
     +
    /\  
   /   
  ||  -0.8 ||
  ||     ||D
  ||  y[n]||
  ||---\||
   \    /
    \  /
    x[n]  
```

Determine and sketch the output of this system to the input

\[ x[n] = (-0.4)^n u[n]. \]

Problem 1.4 A discrete-time signal

\[ x[n] = \cdots 0 \ 1 \ -1 \ 1 \ 0 \ 0 \ \cdots \quad (n = 0) \]

is input into a discrete-time system with the following input-output relationship:

\[ y[n] = x[n] + x[n - 1] + 0.25y[n - 1]. \]

1. Determine the impulse response for the system.
2. Determine and sketch the output of the system.

Problem 1.5 Determine whether or not the following systems are linear and/or time-invariant:

1. \( y(t) = \int_{-\infty}^{t} e^{a\tau} x(t - \tau) d\tau \)
2. \( y(t) = x(t) \cos(4t) \)
3. \( y(t) = x(t) x(t-1) \)
4. \( y(t) = \frac{dy(t)}{dt} + \frac{dx(t)}{dt} - x(t) \)