1. (10%) Determine if the following systems are (1) memoryless (2) causal (3) linear (4) time-invariant
   (a) \( y(t) = x(2-t) \)
   (b) \( y(t) = x(t/3) \)
   (c) \( y[n] = 2x[n]u[n] \) where \( u[n] \) is the unit step function

2. (10%) A system is a cascade of two subsystems. The impulse responses of the two subsystems are
   \( h_1[n] = \delta[n] - \delta[n-1] + 2\delta[n-2] - \delta[n-3] \) and
   \( h_2[n] = -\delta[n-1] + 2\delta[n-2] + \delta[n-3] \) where \( \delta[n] \) is the unit impulse function.
   Find the impulse response of the system.

3. (15%) Find the Fourier transform of the following signal.

   ![Signal Diagram]

4. (15%) Let the transfer function of a system be
   \[ H(s) = \frac{1}{(s-1)(s+1)} \]
   (a) If the system is causal, find its impulse response.
   (b) If the system is stable, find its impulse response.

5. (15%) Let the difference equation of a system be
   \[ y[n] = \frac{1}{4} y[n-1] - \frac{3}{8} y[n-2] = -x[n] + 2x[n-1] \]
   (a) Determine the transfer function of the system.
   (b) Determine the impulse response of the system.
6. (10%) Let the impulse response of a system be $e^{-2t}u(t)$ and the input of the system be $u(t + 6) - 2u(t + 1) + 3u(t - 3)$ where $u(t)$ is the unit step function. Find the output of the system.

7. (15%) Let $|X(j\omega)|$ be the magnitude spectrum of $x(t)$. Suppose $|X(j\omega)| = 0$ for $|\omega| > \omega_m$. Given the signal $y(t) = x(t)[\cos(2\pi t) + \sin(10\pi t)]$, determine the maximum value of $\omega_m$ for which $x(t)$ can be reconstructed from $y(t)$ and specify a system that will perform the reconstruction.

8. (10%) Find the inverse $z$-transform of

$$X(z) = \frac{16z^2 - 4z + 1}{8z^2 + 2z - 1} \text{ with ROC } |z| > \frac{1}{2}$$