Assignment #2

1. Explain sifting property of discrete-time unit impulse.
2. Explain impulse response and step response for continuous-time LTI system.
3. Write down steps to obtain convolution integral.
4. Explain properties of LTI system in detail.
5. Find and plot convolution of $x[n] = \delta[n] + 2\delta[n-1] - \delta[n-3]$ and $h[n] = 2\delta[n+1] + 2\delta[n-1]$.
6. Consider an input $x[n]$ and a unit impulse response $h[n]$ given by $x[n] = \left(\frac{1}{2}\right)^{n-2} u[n-2]$ $h[n] = u[n+2]$.
7. Compute and plot $y[n] = x[n] * h[n]$, where $x[n] = \begin{cases} 1, & 3 \le n \le 8 \\ 0, & elsewhere \end{cases}$, $h[n] = \begin{cases} 1, & 4 \le n \le 15 \\ 0, & elsewhere \end{cases}$
8. Compute the convolution of $x(t) = u(t-3) - u(t-5)$ and $h(t) = e^{-3t}u(t)$.
9. Consider a causal LTI system whose input $x[n]$ and output $y[n]$ are related by the difference equation $y[n] = \frac{1}{4}y[n-1] + x[n]$. Determine $y[n]$ if $x[n] = \delta[n-1]$.

Answers

5. $y[n] = 2\delta[n+1] + 4\delta[n] + 2\delta[n-1] + 2\delta[n-2] - 2\delta[n-4]$
6. $2\left[1 - \frac{1}{2}^{n+1}\right]u[n]$
7. $y[n] = \begin{cases} n-6, & 7 \le n \le 11 \\ 6, & 12 \le n \le 18 \\ 24-n, & 19 \le n \le 23 \\ 0, & elsewhere \end{cases}$
8. $y(t) = \begin{cases} 0, & -\infty < t \le 3 \\ \frac{1-e^{-3(t-3)}}{3}, & 3 < t \le 5 \\ \frac{(1-e^{-6})e^{-3(t-5)}}{3}, & 5 < t \le \infty \end{cases}$
9. $(\frac{1}{4})^{n-1}u[n-1]$