ASSIGNMENT/ TUTORIAL – 3

EPOC 320C

LINEAR TIME INVARIANT SYSTEMS

Q1. Consider an input $x[n]$ and a unit impulse response $h[n]$ given by

$$x[n] = \alpha^n u[n]$$

$$h[n] = u[n] \quad \text{with} \quad 0 < \alpha < 1$$

Calculate $y[n]$ as : $y[n] = x[n] * h[n]$

Q2. Calculate $y[n] = x[n] * h[n]$ for

$$x[n] = \begin{cases} 1 & 0 \le n \le 4 \\ 0 & \text{otherwise} \end{cases}$$

$$h[n] = \begin{cases} \alpha^n & 0 \le n \le 6 \\ 0 & \text{otherwise} \end{cases}$$

Q3. Let $x(t)$ be the input to an LTI system with unit impulse response $h(t)$, where

$$x(t) = e^{-at} u(t), \quad a > 0$$

$$h(t) = u(t)$$

Calculate output of the system.

Q4. Consider an LTI system with input $x[n]$ and unit impulse response $h[n]$ specified as follows.

$$x[n] = 2^n u[-n]$$
$$h[n] = u[n]$$

Calculate the output response of LTI system

Q5 Let $y(t)$ denote the convolution of following two signals

$$x(t) = e^{2t} u(-t)$$
$$h(t) = u(t-3)$$

Calculate $y(t)$.

Q6. Consider an input $x[n]$ and a unit impulse response $h[n]$ given by

$$x[n] = \left(\frac{1}{2}\right)^{n-2} u[n-2]$$
$$h[n] = u[n+2]$$

Determine and plot the output $y[n] = x[n] * h[n]$

Q7. Consider the signal

$$h[n] = \left(\frac{1}{2}\right)^{n+1} \{u[n+3] - u[n-10]\}$$

Express A & B in terms of n so that following equation holds:

$$h[n-k] = \begin{cases} \left(\frac{1}{2}\right)^{n-k-1}, & A \le k \le B \\ 0, & \text{elsewhere} \end{cases}$$

Q8. Compute and plot the convolution $y[n] = x[n] * h[n]$ where

$$x[n] = \left(\frac{1}{3}\right)^{-n} u[-n-1] \quad , \quad h[n] = u[n-1]$$

Q9. A linear system S has relationship

$$y[n] = \sum_{k=-\infty}^{\infty} x(k)\, g(n-2k)$$ between its input $x[n]$ and its output $y[n]$, where

$$g[n] = u[n] - u[n-4]$$

(a) Determine $y[n]$ when $x[n] = \delta[n-1]$

(b) Determine $y[n]$ when $x[n] = \delta[n-2]$

(c) Is S LTI? Why?

(d) Determine $y[n]$ when $x[n] = u[n]$.

Q10. Determine and sketch the convolution of following 2 signals.

$$x(t) = \begin{cases} t+1 & 0 \le t \le 1 \\ 2-t & 1 \le t \le 2 \\ 0 & \text{elsewhere} \end{cases}$$

$$h(t) = \delta(t+2) + 2\delta(t+1)$$