EE150 Homework2

1. (4*5points)Compute the convolution $y[n] = x[n] * h[n]$ of the following pairs of signals:

   (a) $\alpha \neq \beta$

   $$x[n] = \alpha^n u[n], h[n] = \beta^n u[n]$$

   (b) $x[n] = h[n] = \alpha^n u[n]$

   (c) $x[n] = (-\frac{1}{2})^n u[n-4] \quad h[n] = 4^n u[2-n]$

   (d) $x[n] = \begin{cases} 1, \ 3 \leq n \leq 8, \\ 0, \ otherwise \end{cases} h[n] = \begin{cases} 1, \ 4 \leq n \leq 15, \\ 0, \ otherwise \end{cases}$

2. (20points) Find the response y(t) of the LTI system with impulse response h(t) to the input x(t). Sketch your results.

$x(t) = u(t) - u(t-2) + u(t-5)$, $h(t) = e^{2t}u(1-t)$

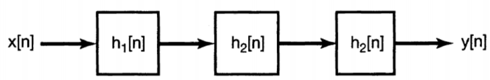
3. (2*10points)Consider the cascade interconnection of three causal LTI systems, illustrated in Figure P(a). The impulse response $h_2[n]$is

$$h_2[n] = \delta[n] + \delta[n-1],$$

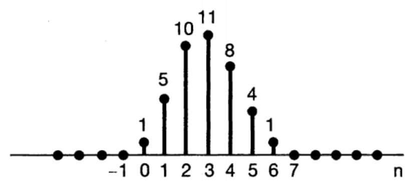
and the overall impulse response is as shown in Figure P(b).

(a) Find the impulse response$h_1[n]$.

(b) Find the response of the overall system to the input $x[n] = \delta[n] - \delta[n-1]$.



(a)



(b)

4. (4*5points)Determine whether each of the following statements concerning LTI systems is true or false. Justify your answers (if True, please prove briefly; if False, please give a counter-example).

   (a) If h(t) is the impulse response of an LTI system and h(t) is periodic and nonzero, the system is unstable.

   (b) The inverse of a causal LTI system is always causal.

   (c) If a discrete-time LTI system has an impulse response h[n] of finite duration, the system is stable.

   (d) If an LTI system is causal, it is stable.

5. (2*10points)For causal LTI systems described by the following differential (a) and differential (b) equations.:

   (a) $y[n] - \frac{1}{3}y[n-1] = x[n-1]$

       Draw block diagram representations and determine the system output $y_1[n]$ when the input is $x_1[n] = K\delta[n]$

   (b) $y(t) + (\frac{1}{2})dy(t)/dt = (\frac{1}{2})x(t)$

       Draw block diagram representations and determine the system output $y_2(t)$ when the input is $x_2(t) = e^{2t}u(t)$.