EE 150L
Signals and Systems Lab

Lab2 System Analysis in Time Domain

Student Id: 2021533025

Name: 王柯皓

1. About system response
   a) Describe the characteristics of zero-input responses and zero-state response briefly. What is the difference between the initial conditions of the two responses?
   b) Consider a linear system whose zero-input response $y_{zi}(t) = (4e^{-t} - 3e^{-2t})u(t)$ and the system full response $y(t) = (3e^{-t} - 2e^{-2t} + te^{-t})u(t)$, what is the zero-state response of the system?

a) For zero-input responses there's no input to the system, and only the initial state of the system acts on the system. For zero-state responses, the initial state is zero, and only the input acts on the system.

b) since $y(t) = y_{zi}(t) + y_{zs}(t)$

we have known $y_{zi}(t)$ and $y(t)$

then $y_{zs}(t) = y(t) - y_{zi}(t)$

$= (3e^{-t} - 2e^{-2t} + te^{-t})u(t) - (4e^{-t} - 3e^{-2t})u(t)$

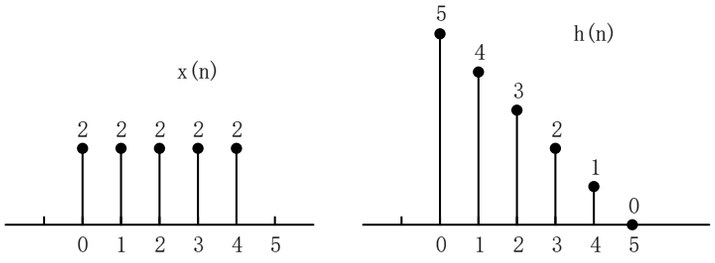
$= (e^{-2t} - e^{-t} + te^{-t})u(t)$

so the zero-state response of the system is $y_{zs}(t) = (e^{-2t} - e^{-t} + te^{-t})u(t)$

2. Convolve the following two signals and record the result as y(n).

a) Please describe the convolution process in detail (both formulas and schematic are accepted).

b) What is the relationship between the length of y(n) and the length of x(n) and h(n)?



$$y[n] = x[n] * h[n] = \sum_{k=-\infty}^{\infty} x[k]h[n-k]$$

$$= x[0]h[n] + x[1]h[n-1] + x[2]h[n-2] + x[3]h[n-3] + x[4]h[n-4]$$

$$= 2h[n] + 2h[n-1] + 2h[n-2] + 2h[n-3] + 2h[n-4]$$

$$= 2\{5u[n] - u[n-1] - u[n-2] - u[n-3] - u[n-4] - u[n-5]\}$$

$$+2\{5u[n-1] - u[n-2] - u[n-3] - u[n-4] - u[n-5] - u[n-6]\}$$

$$+2\{5u[n-2] - u[n-3] - u[n-4] - u[n-5] - u[n-6] - u[n-7]\}$$

$$+2\{5u[n-3] - u[n-4] - u[n-5] - u[n-6] - u[n-7] - u[n-8]\}$$

$$+2\{5u[n-4] - u[n-5] - u[n-6] - u[n-7] - u[n-8] - u[n-9]\}$$

$$= 10u[n] + 8u[n-1] + 6u[n-2] + 4u[n-3] + 2u[n-4] - 10u[n-5]$$

$$- 8u[n-6] - 6u[n-7] - 4u[n-8] - 2u[n-9]$$

a) Substitution: t becomes τ⟶ f1 (τ), f2(τ);

Inversion translation: from f2 (τ) inversion ⟶ f2 (-τ) right shift t ⟶ f2 (t-τ);

Product： f1(τ) f2(t-τ);

Integration : τ is the integral from – ∞ to ∞ of the product term

b)The length of y[n] = the length of x[n] + the length of h[n] - 1