EE321 Second Homework Assignemt

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1 Introduction to System Response and Linear Convolution

1. **Zero State Response and Linear convolution:**

   (a) A LTI system has an impulse response function

   $$h(t) = (t-3)[u(t-3) - u(t-5)]$$

   and the input signal

   $$x(t) = u(t+2) - u(t-2).$$

   i) Find the time duration, the starting time and ending time of the zero state response of the system to the input signal; ii) Is the system causal? Why (explanation required)? iii) Find the expression of zero state response $y(t)$ using the linear convolution integral by hand; iv) Calculate zero state response using linear convolution function, conv(), in Matlab.

   (b) Repeat problem 1a) with the signals in figure (1).

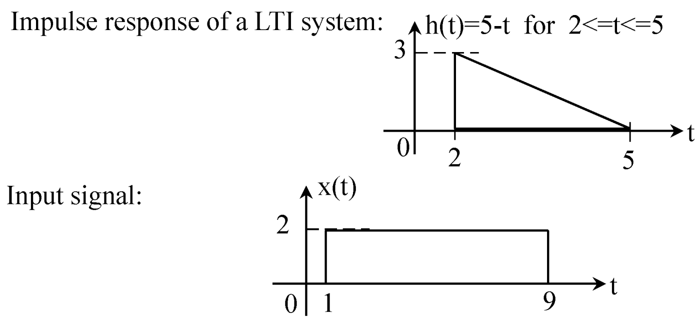

Figure 1:

   (c) Find the zero state response of a LTI system with impulse response $h(t) = 2e^{-2t}u(t-3)$ and input $x(t) = 2u(t-1)$ and verify your results by showing the first 10 seconds of output signal $y(t)$ in Matlab.

2. **LTI System Transfer functions, Differential equations and Stability:**

   (a) A LTI system is described by the following canonical differential equation.

   $$\frac{d^2y(t)}{dt^2} - 6\frac{dy(t)}{dt} + 8y(t) = 2\frac{dx(t)}{dt}$$

   i) Find the polynomials $A(s)$ and $B(s)$ and its transfer function $H(s)$; ii) Find the poles (solve $A(s) = 0$) and zeros (solve $B(s) = 0$) of the system; iii) Is this system stable? Why?

(b) The dynamic behavior of a LTI system is described by the following transfer function.

$$H(s) = \frac{2s^2 - 5}{s^3 - 2s + 4}$$

i) Find the differential equation expression of the system; ii) Find poles and zeros and plot them using Matlab function zplane(); iii) Is this system stable? Why?

(c) The dynamic behavior of a LTI system is described by its impulse response function: $h(t) = (e^{-t} - 2e^{-2t})u(t)$. Show that the LTI system is stable using absolute integration.

3. **Problems in text book:** 2.4-8 (a and c), 2,4-16 (a, b and c), 2.7-1 and 2.7-2.