UCLA DEPARTMENT OF ELECTRICAL ENGINEERING

EE102: SYSTEMS & SIGNALS

Midterm Examination I
Jan 28, 2016

Put Your Discussion Session in the Corner$\rightarrow\rightarrow\nearrow\nearrow$
(* Otherwise Your Midterm might be LOST)

Your name:_____

Instructions: Closed Book except one double sided cheat sheet, Calculators are NOT Allowed

Good Luck!

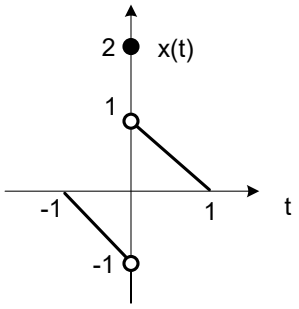
Table 1: Score Table

Question	i	ii	iii	Score
1	3	4	3	10
2	2	4	4	10
3	5	5		10
4	5	5		10
5	10			10
Total				50

Question 1 (10 pt)

(i) (3 pt) Plot the even and odd decompositions of signal $x(t)$, where

$$x(t) = \begin{cases} -1-t, & \text{if } -1 \le t < 0, \\ 2, & \text{if } t = 0, \\ 1-t, & \text{if } 0 < t \le 1. \end{cases}$$

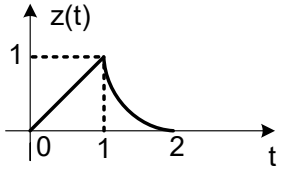


(ii) (4 pt) Consider the following signal

$$y(t) = \cos(2\pi t) - \sin(5\pi t) + \cos\left(\frac{3\pi}{2}t + \frac{\pi}{2}\right).$$

Is $y(t)$ periodic? If yes, what is the fundamental period? If no, why?

(iii) (3 pt) The following figure shows signal $z(t)$.



Plot $z(t+3)$, $z(-2t-5)$ and $z\left(\frac{t}{3}+4\right)$.

Question 2 (10 pt)
The input/output (IPOP) relationship for a system S is

$$y(t) = \int_0^t e^{-(t-\tau)} x(\tau) u(\tau) d\tau, \quad t \geq 0,$$

where $x(t)u(t)$ is the input signal and $y(t)$ is the output signal.
(i) (2 pt) Find the impulse response function (IRF) $h(t, \tau)$.
(ii) (4 pt) State propertirs of system S: TV/TI? C/NC?
(iii) (4 pt) Find the outputs corresponding to the following inputs

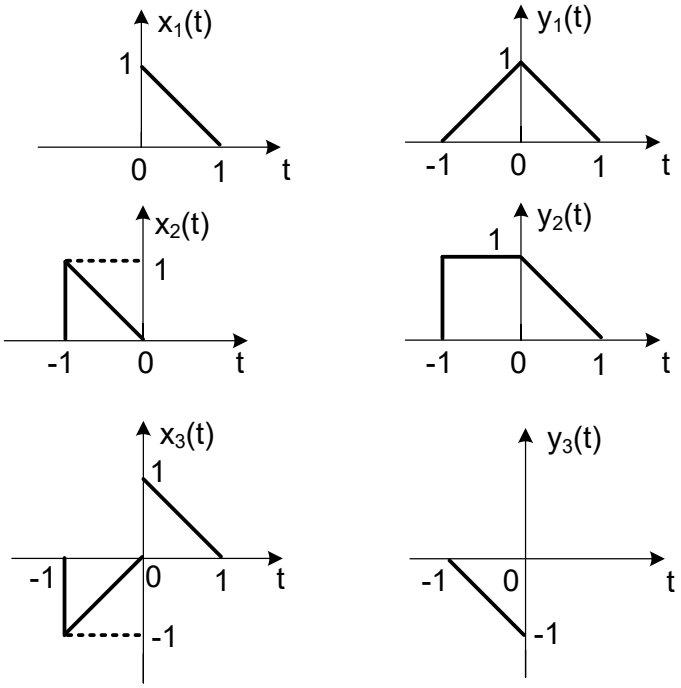
$$\begin{aligned} x(t) =& u(t-2), \\ x(t) =& r(t) = tu(t). \end{aligned}$$

Question 3 (10 pt)

For a given system S, consider outputs $y_1(t)$, $y_2(t)$ and $y_3(t)$ corresponding to inputs $x_1(t)$, $x_2(t)$ and $x_3(t)$, respectively, as shown in the figure.

(i) (5 pt) Is the system S linear or not? Why?

(ii) (5 pt) Is the system S TI or TV? Why?



Question 4 (10 pt)
Given IRF of a LTI system

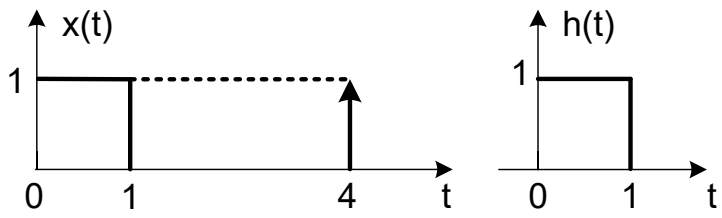
$$h(t) = u(t)u(1-t)$$

and the input signal

$$x(t) = u(t)u(1-t) + \delta(t-4).$$

(i) (5 pt) Find the expression of output signal $y(t)$.
(ii) (5 pt) Plot $y(t)$.

(You can solve it graphically or mathematically)



Question 5 (10 pt)
Consider cascade system S_1S_2 as follows:

$$x(t) \to [S_1] \to y(t) \to [S_2] \to z(t).$$

The IPOP relation for S_1 is given by:

$$y(t) = \begin{cases} \int_0^t e^{-(t-\sigma)} x(\sigma)u(\sigma)d\sigma, & \text{if } t \geq 0, \\ 0, & \text{otherwise} \end{cases}$$

while the IPOP relation for S_2 is

$$z(t) = e^{-t}y(t)u(t).$$

Find the IRF $h_{12}(t, \tau)$ of the cascaded system S_1S_2.