EEN 340
SIGNALS
&TRANSFORMS

TEST 1
75 MN

NDU
EE&CCE DEPARTMENT

NOTE1: OPEN BOOK, OPEN NOTES, CLOSED NEIGHBOURS.
NOTE2: SHOW ALL WORK IN ORDER TO RECEIVE FULL CREDIT.
NOTE3: START EACH PROBLEM ON A NEW PAGE.

1. 15 Pts. A continuous-time signal $x(t)$ is shown in Fig.P1. Sketch and label carefully each of the following signals.

a) $2x(t/3 - 2) + 1$
b) $x(-4t + 3)u(t+4)$

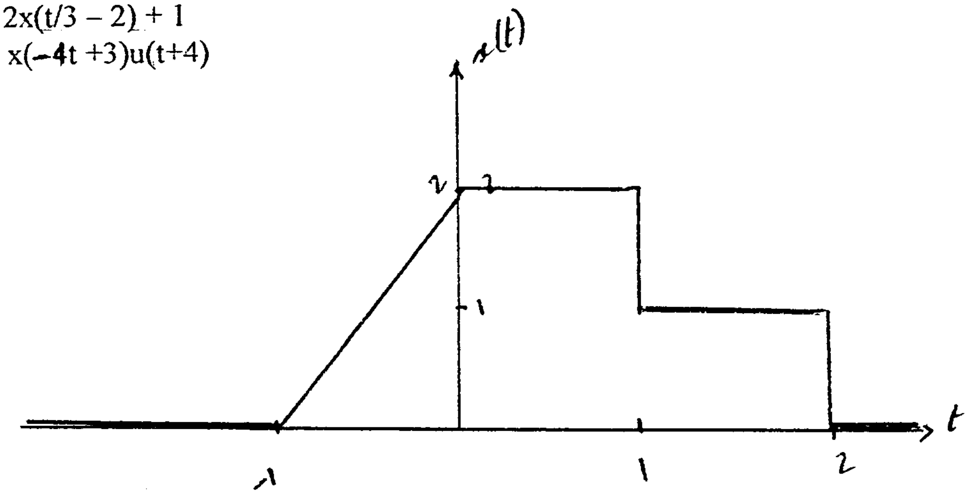

Fig.P1.

2. 15 Pts. A discrete-time signal $x[n]$ is shown in Fig.P2. Sketch and label carefully each of the following signals.

a) $x[2n - 3] + 1$
b) $2x[-n/4 + 1] - 1$

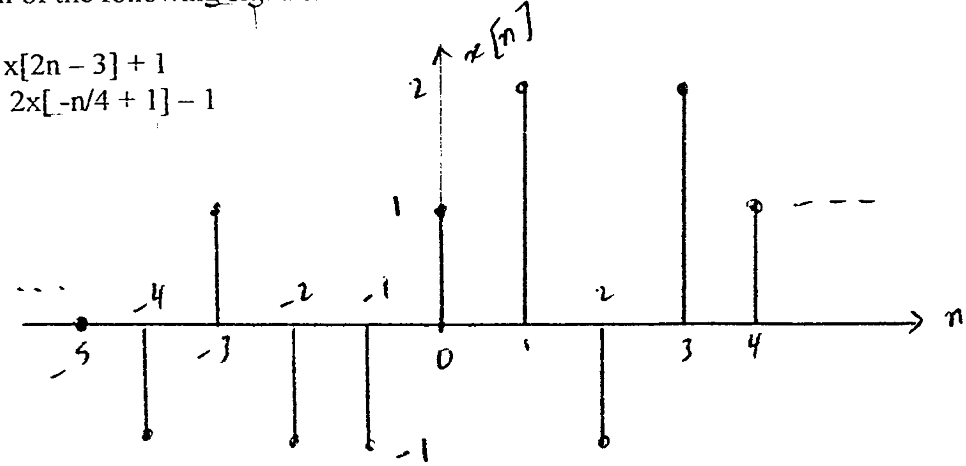

Fig.P2

3. 10 Pts. Given the two signals in Fig.P3:

Express $x_2(t)$ as a function of $x_1(t)$.

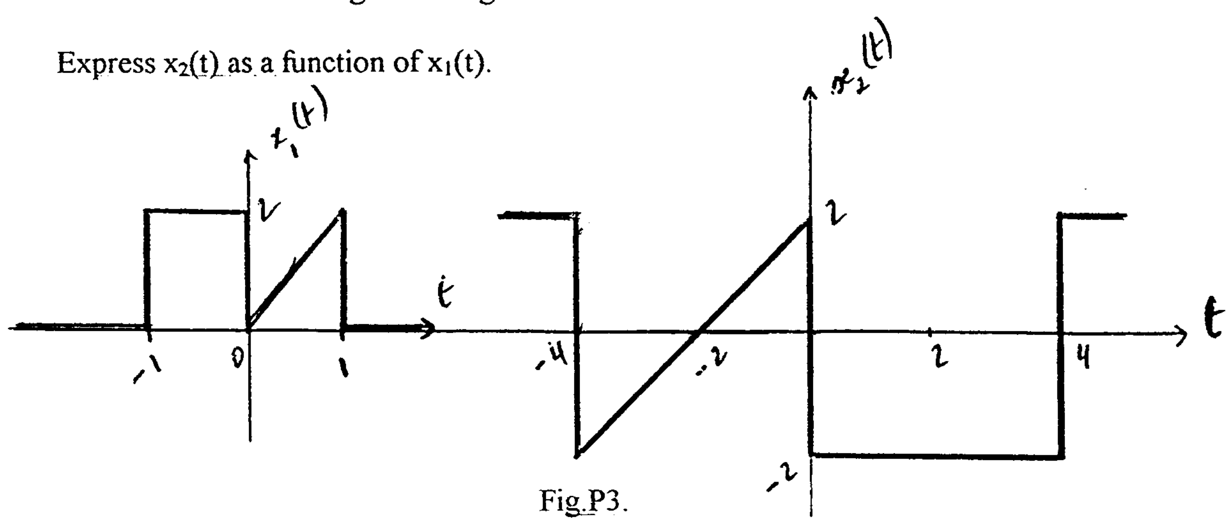

Fig.P3.

4. 15 Pts. Write a mathematical function of the waveform shown in Fig.P4. using the procedure in example 2.11 in your book.

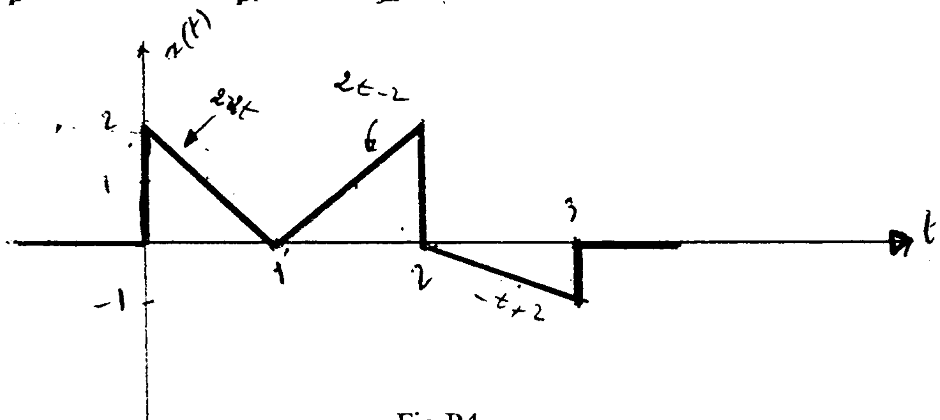

Fig.P4

5. 15 Pts. Determine and sketch the even and odd parts of the signal depicted in Fig.P5. Label your sketches carefully.

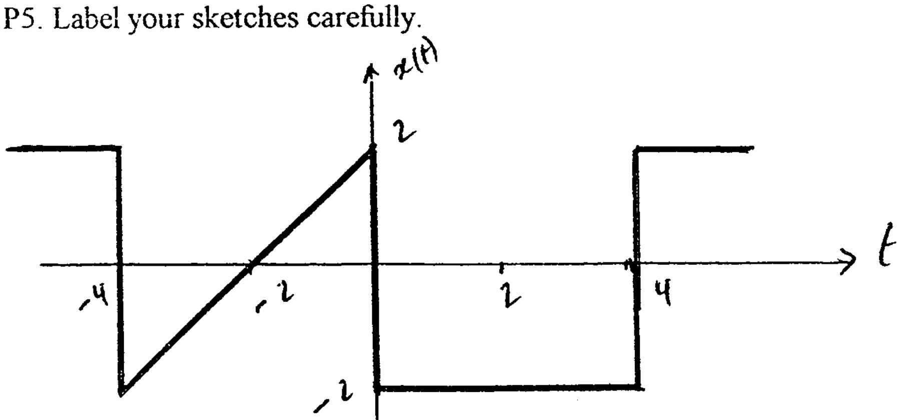

Fig.P5.

6. 20 Pts. For the LTI system shown in Fig.P6, the input is x(t), the output is y(t), and the impulse response is h(t). Use the convolution integral to find the output y(t).

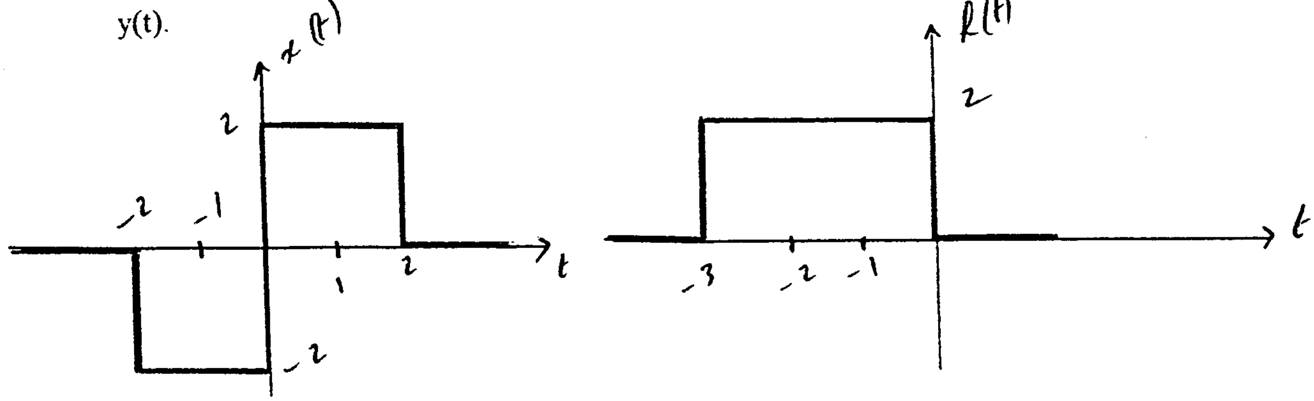

Fig.P6.

7. 10 Pts. Determine the stability and causality for the LTI systems with the following impulse responses.

a) $h(t) = e^{-t}u(t + 1)$
b) $h(t) = e^{t}u(-t - 1)$

Solution:

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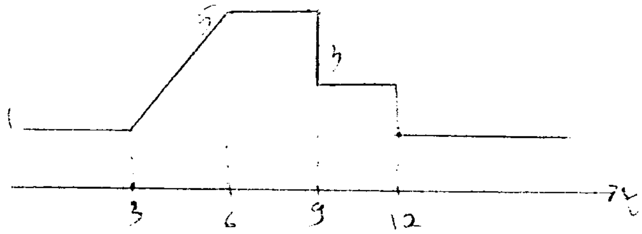
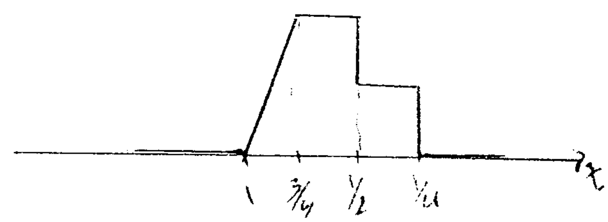
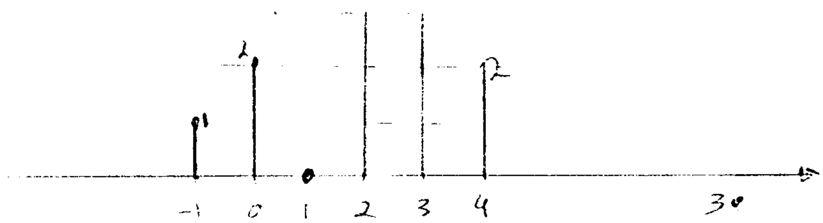
1) $\tau = \frac{t}{3} - 2 \rightarrow t = 3\tau + 6$ $\qquad$ $\tau = -4t + 3 \rightarrow t = -\frac{\tau}{4} + \frac{3}{4}$

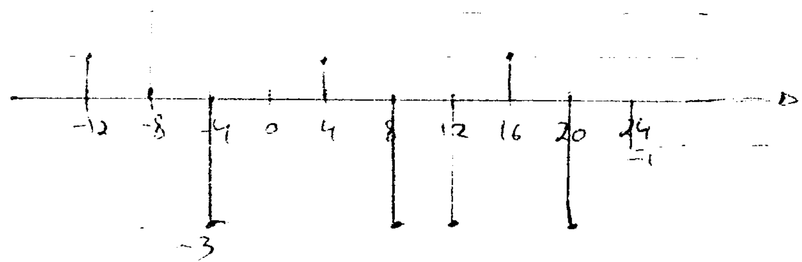




2) $m = 2n - 3$ $\qquad \rightarrow n = \frac{m}{2} + \frac{3}{2}$



$m = \frac{-n}{4} + 1 \rightarrow n = -4m + 4$



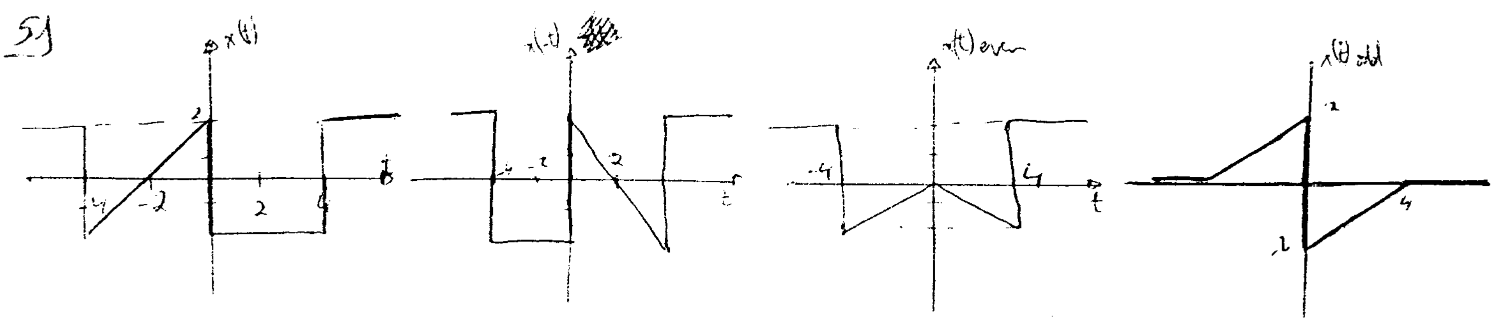
3) $x_2(t) = -2x_1\left(-\frac{t}{4}\right) + 2$

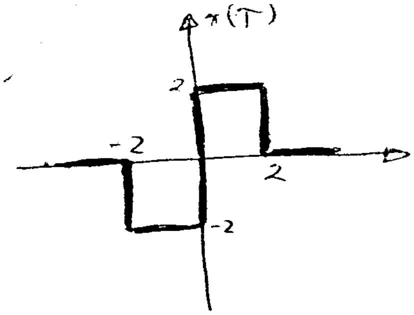
$t = 0$	$x_1(t) = 0$	$x_2(t) = 2$
$t = 0$	$x_1(t) = 2$	$x_2(t) = -2$
$t = 4$	$x_1(t) = 2$	$x_2(t) = 2$
$t = 4$	$x_1(t) = 0$	$x_2(t) = -$

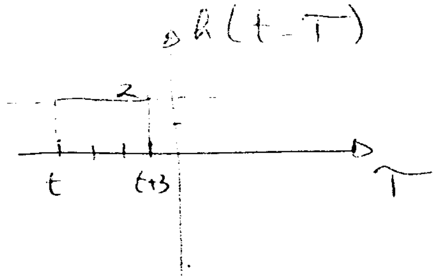
4) $(-2t+2)(u(t) - u(t-1)) + (2t-2)(u(t-1) - u(t-2)) + (-t+2)(u(t-2) - u(t-3))$

$2u(t) - 2tu(t) + 4(t-1)u(t-1) - 2u(t-2) - 3(t-2)u(t-2) + (t-3)u(t-3) + u($

5)







$t+3 \le -2$; $t \le -5$ $\qquad \boxed{y(t)=0}$

$-2 \le t+3 \le 0$; $-5 \le t \le -3$ $\qquad y(t) = \int_{-2}^{t+3} -4\,dT = -4T\Big|_{-2}^{t+3} = -4(t+3)+4(-2) = \boxed{-4t-20}$ $\quad t=-5 \quad t=-3$

$t+3 \ge 0$ and $t \le -2$ $\qquad -3 \le t \le -2$

$$y(t) = \int_{-2}^{0} -4\,dT + \int_{0}^{t+3} 4\,dT = -4T\Big|_{-2}^{0} + 4T\Big|_{0}^{t+3}$$

$$= 0 - 8 + 4t + 12 = \boxed{4t+4} \qquad \begin{matrix} t=-3 & y(t)=-8 \\ t=-2 & y(t)=-4 \end{matrix}$$

$t+3 \le 2$; $t \ge -2$

$-2 \le t \le -1$

$$y(t) = \int_{t}^{0} -4\,dT + \int_{0}^{t+3} 4\,dT = -4T\Big|_{t}^{0} + 4T\Big|_{0}^{t+3} = 4t + 4(t+3) = 8t+12$$

$$\begin{matrix} t=-2 & y(t)=-4 \\ t=-1 & y(t)=4 \end{matrix}$$

$t+3 \ge 2$; $t \le 0$ $\qquad -1 \le t \le 0$

$$y(t) = \int_{t}^{0} -4\,dT + \int_{0}^{2} 4\,dT = -4T\Big|_{t}^{0} + 4T\Big|_{0}^{2} = 4t+8 \qquad \begin{matrix} t=-1 & y(t)=4 \\ t=0 & y(t)=8 \end{matrix}$$

$0 \le t \le 2$

$$y(t) = \int_{t}^{2} 4\,dT = 4T\Big|_{t}^{2} = 8-4t \qquad \begin{matrix} t=0 & y(t)=8 \\ t=2 & y(t)=0 \end{matrix}$$

$t \ge 2 \quad y(t)=0$

$$y(t) = \begin{cases} 0 & ; \ t \le -5 \\ -4t-20 & ; \ -5 \le t \le -3 \\ 4t+4 & ; \ -3 \le t \le -2 \\ 8t+12 & ; \ -2 \le t \le -1 \\ 4t+8 & ; \ -1 \le t \le 0 \\ 8-4t & ; \ 0 \le t \le 2 \\ 0 & ; \ t \ge 2 \end{cases}$$

7) $\displaystyle\int_{-\infty}^{\infty} e^{-t} u(t+1) = \int_{-1}^{\infty} e^{-t}dt = -e^{-t}\Big|_{-1}^{\infty} = e^{1} = 2.718$

$\displaystyle\int_{-\infty}^{\infty} e^{+t} u(-t-1) = \int_{-\infty}^{-1} e^{t}dt = e^{t}\Big|_{-\infty}^{-1} = e^{-1} = 0.367$

STABLE non Causal For

BOTH