EEN 340
SIGNALS
& SYSTEMS

SPRING 2008
TEST 1
50 MINUTES

85/100

NDU
ECCE DEPARTMENT
S. C. ELMURR

NAME: Armando AbiNader

NOTE1: OPEN BOOK. OPEN NOTES. CLOSED OLD TESTS AND SOLUTIONS.
NOTE2: SHOW ALL WORK IN ORDER TO RECEIVE FULL CREDIT.

1. 20 Pts. A continuous-time signal x(t) is shown in Fig.P1. Sketch and label carefully each of the following signals.

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

(1) 16 (2) 15 (3) 15 (4) 19 (5) 20

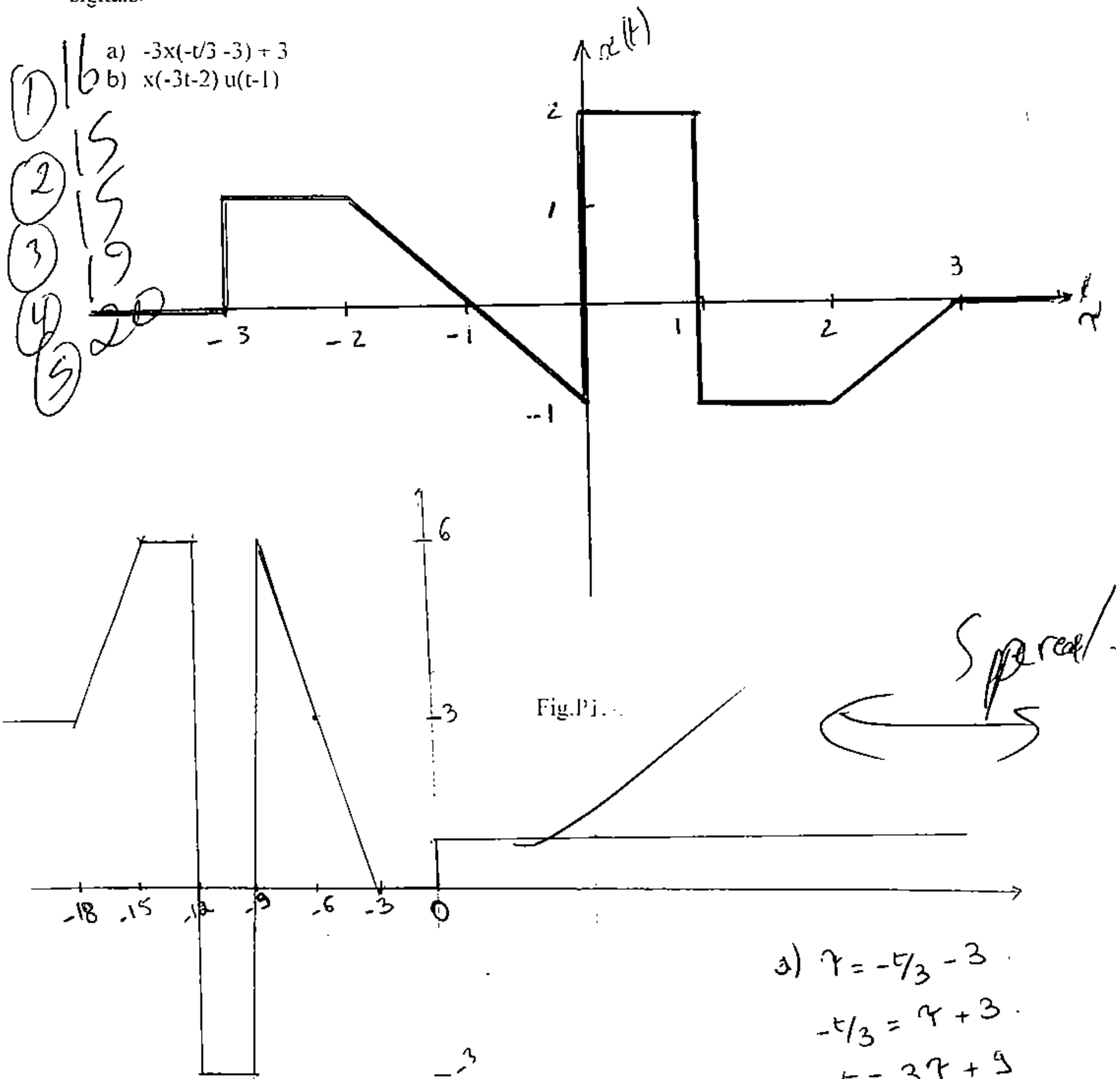


Fig.P1.

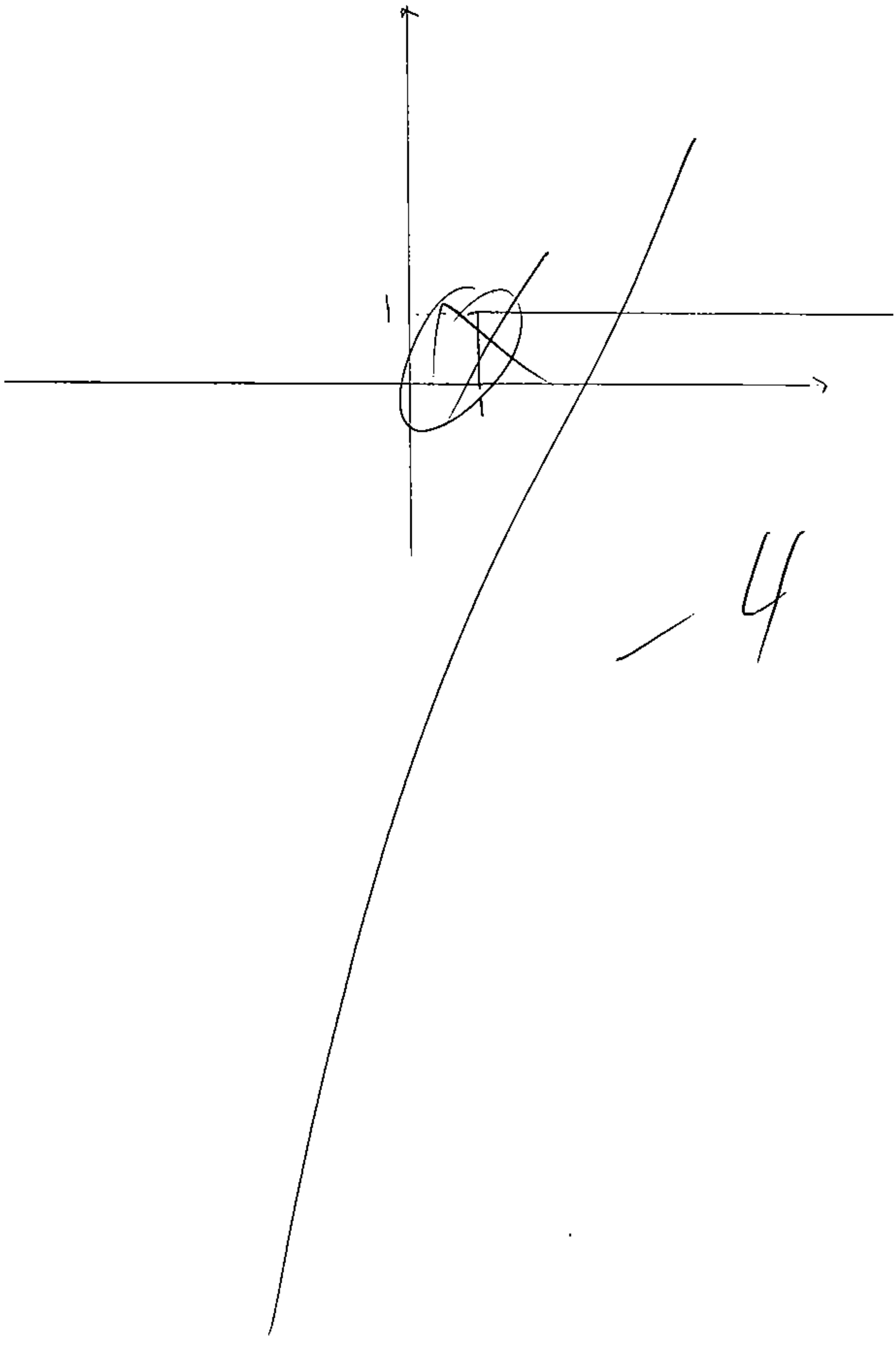
a) $\tau = -t/3 - 3$

$-t/3 = \tau + 3$

$-t = 3\tau + 9$

$t = -3\tau - 9$

b)



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2. 15 Pts. Two discrete-time signals $x_1[n]$ and $x_2[n]$ are shown in Fig.P2. Find $x_1[n]$ as a function of $x_2[n]$

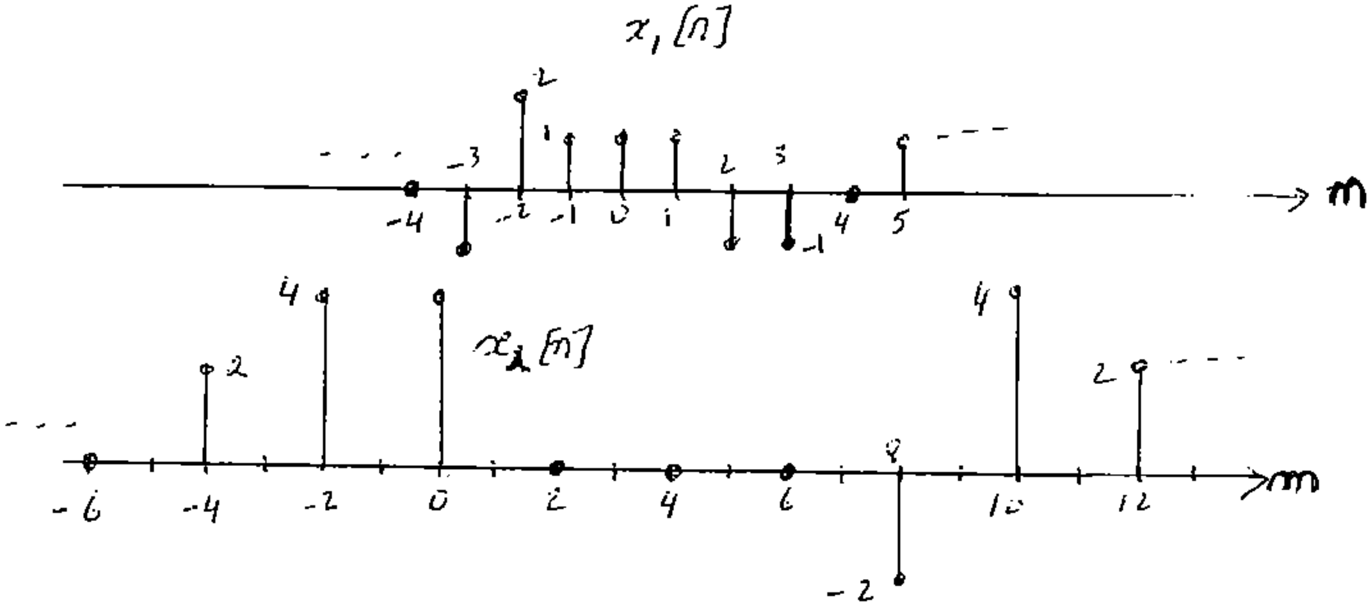


Fig.P2

$$x_1[m] = -\frac{1}{2} x_2[-2m + 4] + 1.$$

~~scale~~ scale of x_1 : 10
scale of x_2 : 20

amplitude at x_1: 3
amplitude at x_2: 6

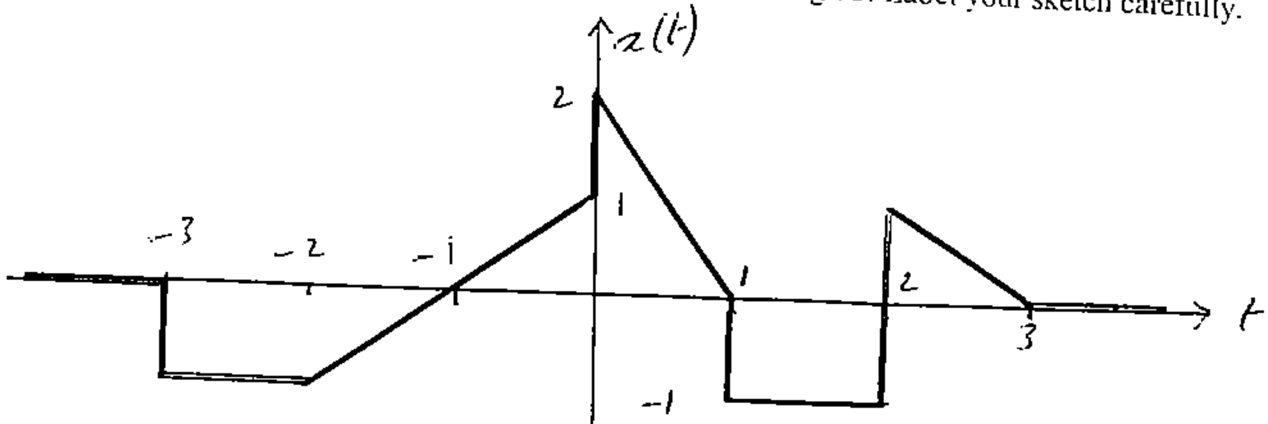
$m = -2m + a$
$2 = -2 + a$
$a = 4$
$6 = -10 + a$
$a = 4$

$2 = -\frac{1}{2} x_2[8] + \text{offset}$

$2 = -\frac{1}{2}(-2) + \text{offset}$

$2 = 1 + \text{offset} \Rightarrow \text{offset} = 1.$

3. 15 Pts. Determine and sketch the even part of the signal depicted in Fig.P3. Label your sketch carefully.



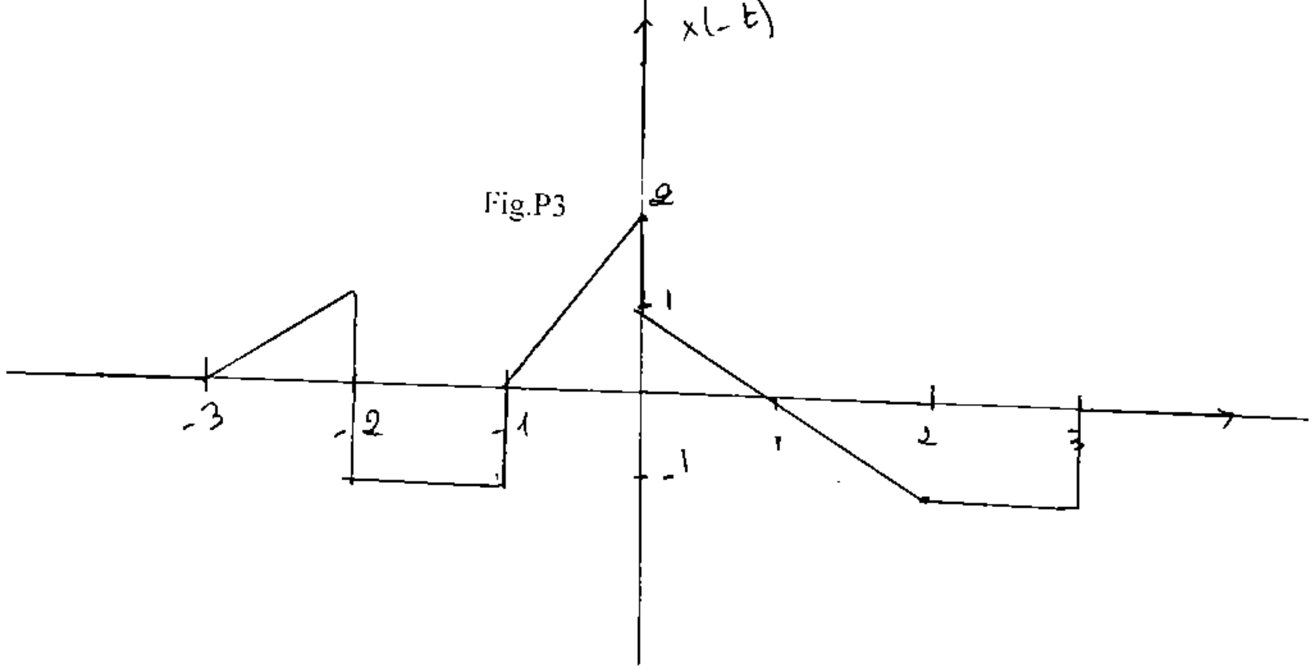
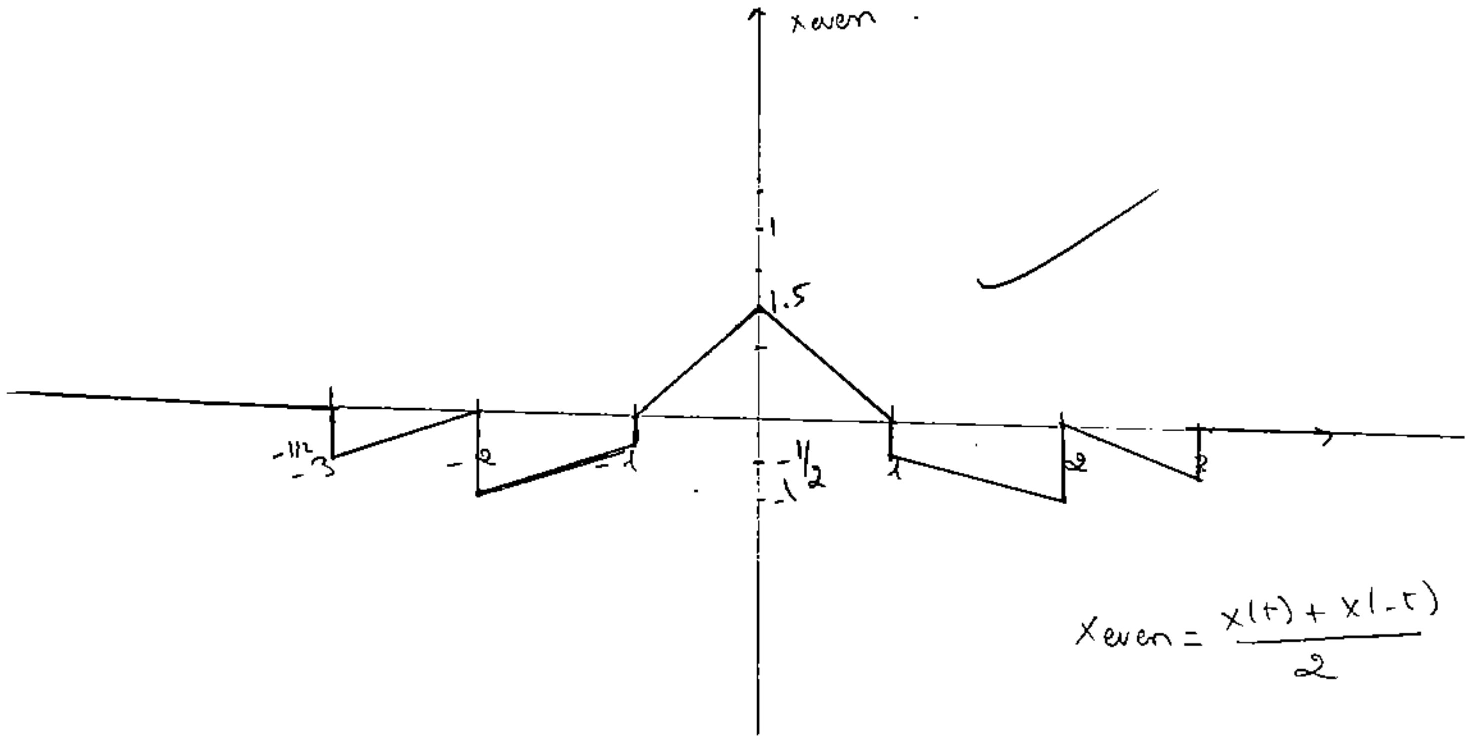
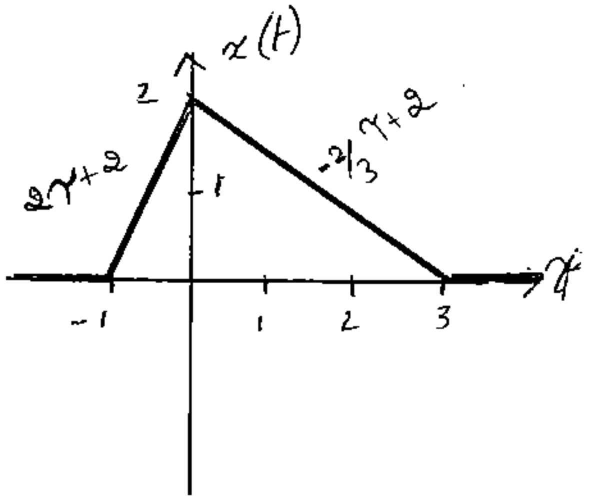


Fig.P3



$$x_{even} = \frac{x(t) + x(-t)}{2}$$

4. 30 Pts. For the LTI system shown in Fig.P4. 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). (Do not integrate)



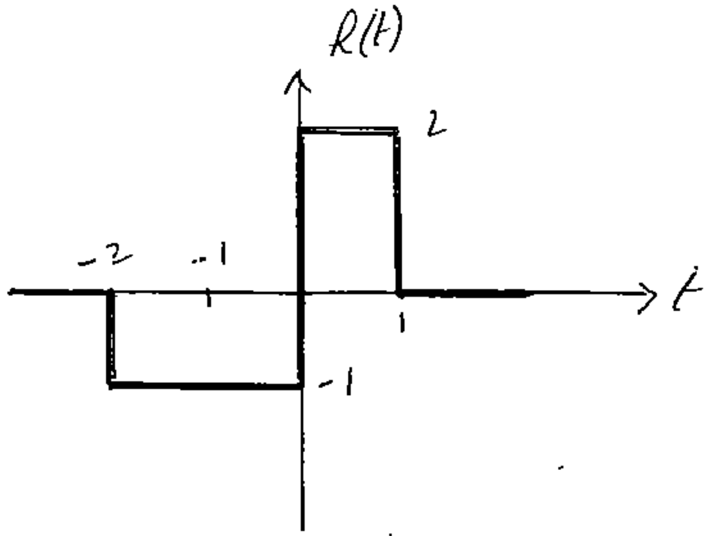


Fig.P4

$y(t) = x(t) * h(t)$

$= \int_{-\infty}^{+\infty} x(\tau)\, h(t-\tau)\, d\tau$

$y = ax + b$
$2 = b$
$y = ax + 2$
$0 = -a + 2$
$a = 2$

$y = ax + b$
$b = 2$
$y = ax + 2$
$0 = 3a + 2$
$3a = -2$
$a = -2/3$

① $t+2 \le -1 \Rightarrow t \le -3$ $y(t) = 0$

② $-3 \le t \le -2$ $y(t) = \int_{-1}^{t+2} = 0$

$-2 \le t \le -1$

③ $-1 \le t \le 0$ $y(t) = \int_{-1}^{t} (2\tau+2)\,2\, d\tau + \int + \int -3$

④ $0 \le t \le 1$ $y(t) = \int_{t-1}^{0} 2(2\tau+2)\, d\tau + \int_{0}^{t} 2\left(-\frac{2}{3}\tau+2\right) d\tau + \int -2$

⑤ $1 \le t \le 3$ $y(t) = \int_{t-1}^{t} 2\left(-\frac{2}{3}\tau+2\right) d\tau + \int -2$

⑥ $3 \le t \le 4$ $y(t) = \int_{t-1}^{3} 2\left(-2/3\,\tau+2\right) d\tau$

$t \ge 4$ $y(t) = 0$

5. 20 Pts. For the discrete LTI system shown in Fig.P5, find the impulse response h[n].

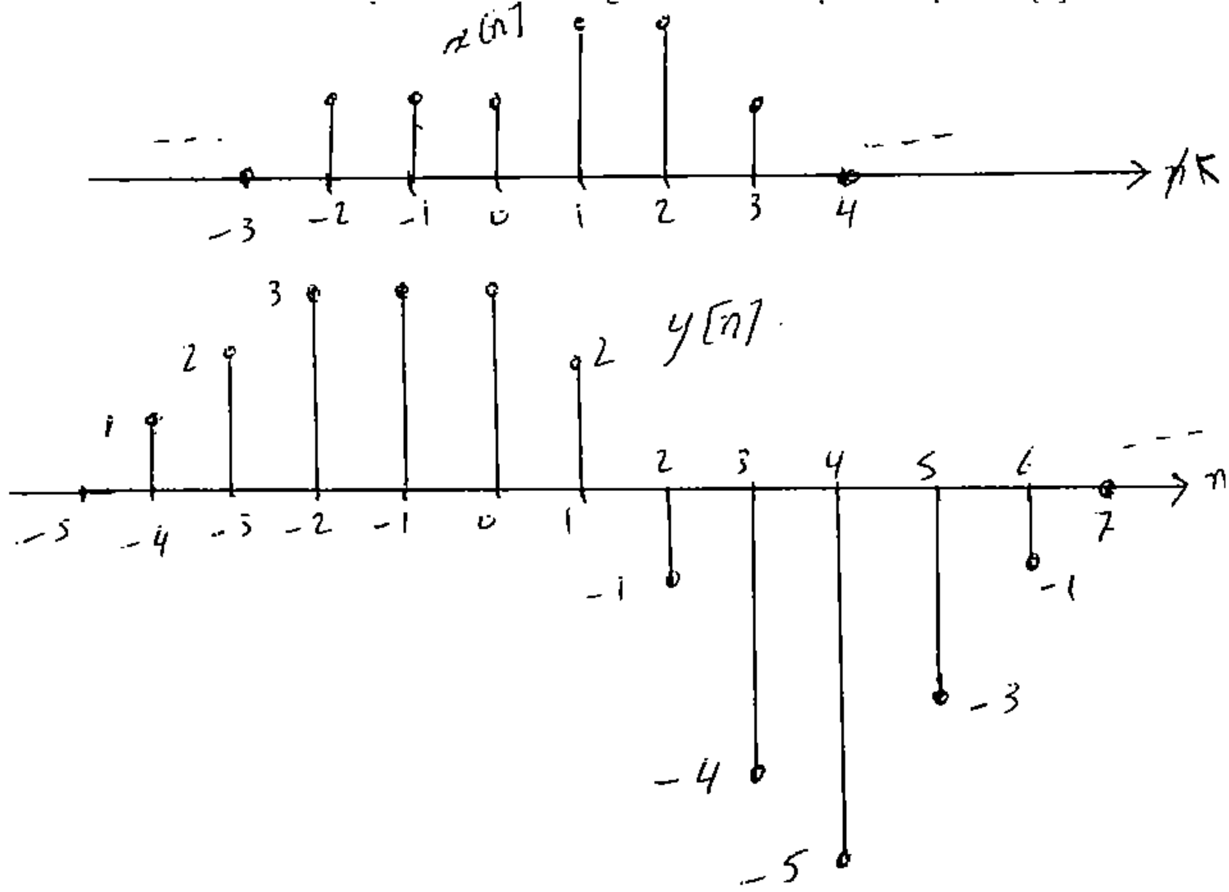


Fig.P5.