Solution & Scheme of Evaluation

IAT-I, 5/03/19

Signals & Systems

17EC42

ECE (A)

Q1 a) $x(t) = 1 + t\cos(t) + t^2\sin(t) + t^3\cos^2(t)\sin(t)$

$x(-t) = 1 - t\cos(t) - t^2\sin(t) + t^3\cos^2(t)\sin(t)$ — 1

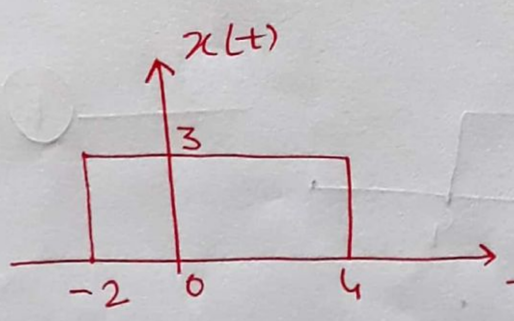
$$x_e(t) = \frac{x(t) + x(-t)}{2}$$ — 1

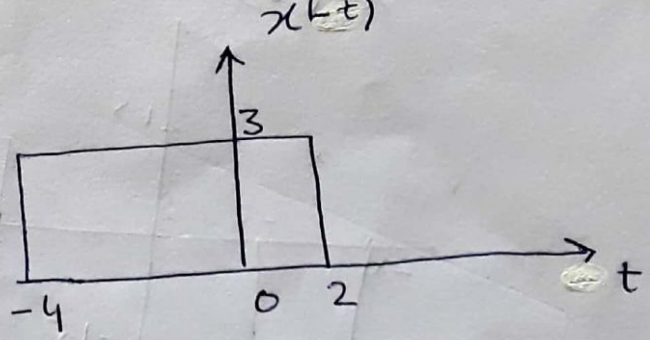
$$x_o(t) = \frac{x(t) - x(-t)}{2}$$

$x_e(t) = 1 + t^3\cos^2(t)\sin(t)$ — 1

$x_o(t) = t\cos(t) + t^2\sin(t)$

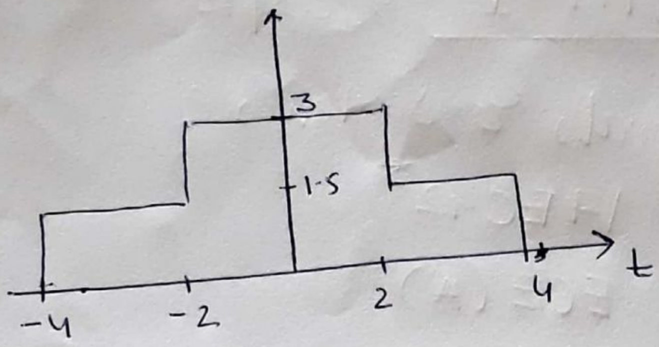
b)





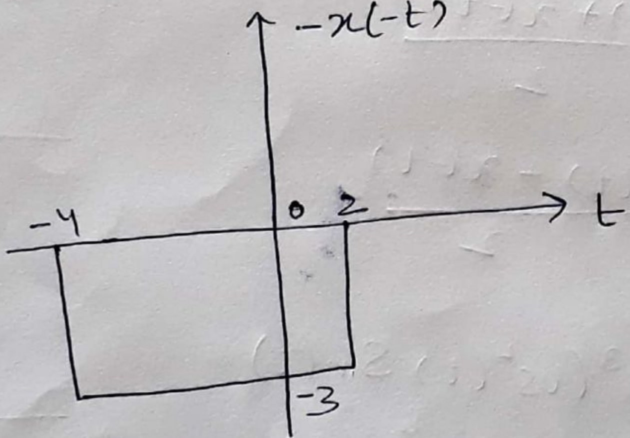
— 1

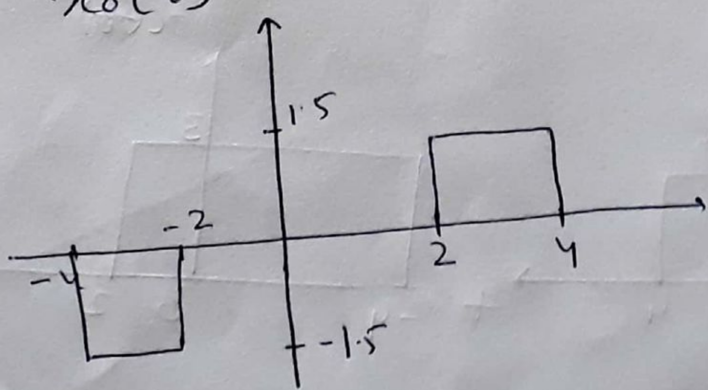
$$x_e(t) = \frac{x(t) + x(-t)}{2}$$



1

$$x_o(t) = \frac{x(t) - x(-t)}{2}$$





1

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Q2

a) $x[n] = \cos\left(\frac{n\pi}{5}\right)\sin\left(\frac{n\pi}{5}\right)$

$\cos A \sin B = \frac{1}{2}\left(\sin(A+B) - \sin(A-B)\right)$

$x[n] = \frac{1}{2}\left\{\sin\left(\frac{2n\pi}{5}\right)\right.$

$x[n+N] = \frac{1}{2}\sin\left(\frac{2\pi}{5}(n+N)\right)$

$= \frac{1}{2}\sin\left(\frac{2\pi}{5}n + \frac{2\pi}{5}N\right)$

$\frac{2\pi}{5}N = 2\pi$

$N = 5 \in \mathbb{Z}$ —— 2

$\therefore$ $x[n]$ is periodic with period $= 5$ —— 0.5

b) $x[n] = \cos(3n)$

$N = \frac{2\pi}{3}$: NOT INTEGER

$\therefore$ $x[n]$ is not periodic. —— 2.5

Q c)

$\sin(2t) + \sin(3\pi t) = x(t)$

$T_1 = \pi$ ——— 1

$T_2 = 2/3$

$\frac{T_1}{T_2} = \notin$ Rational no. ——— 1

——— 0.5

$\therefore x(t)$ is aperiodic

d) $x(t) = e^{(-1+j)t}$

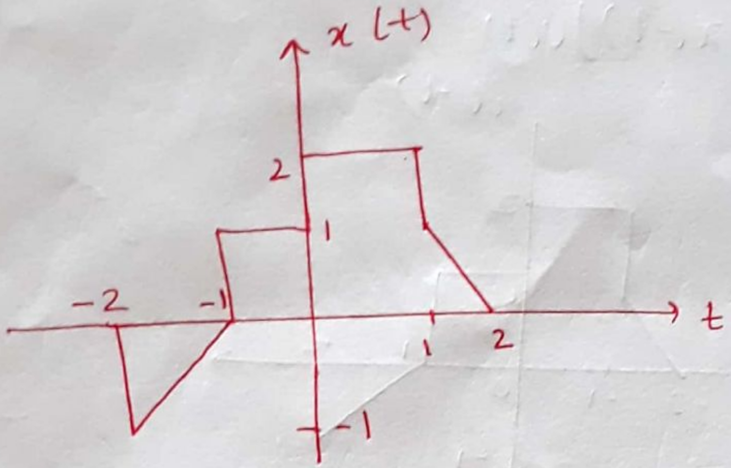
e^{-t} is aperiodic

$\therefore x(t)$ is aperiodic ——— 2.5

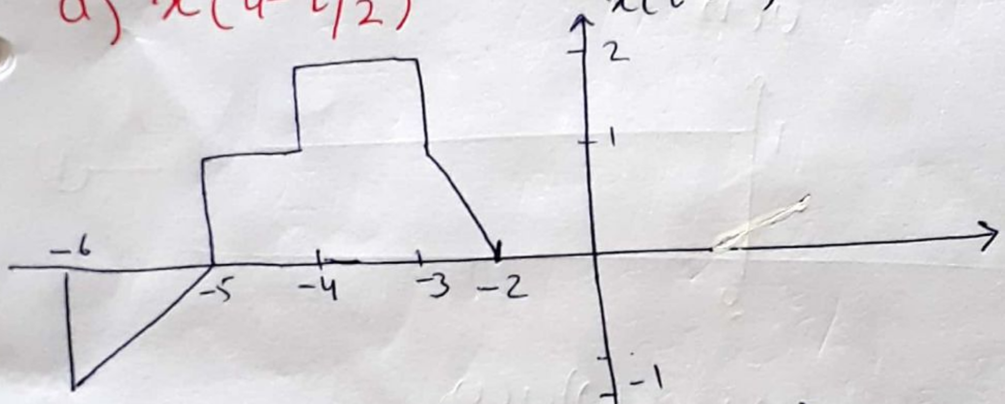
1

1

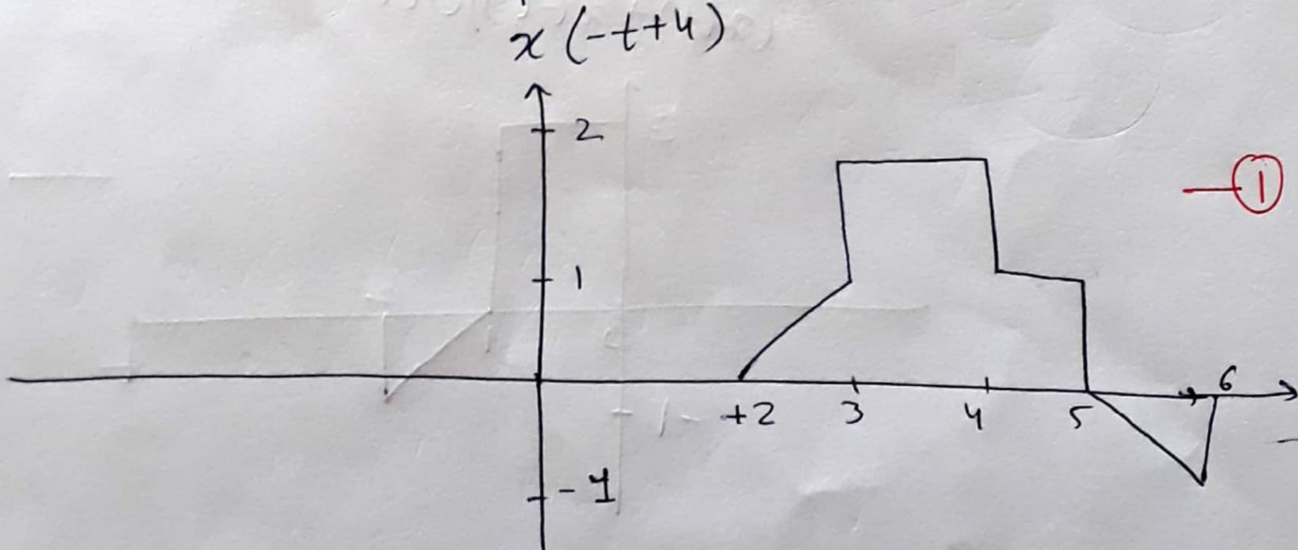
Q3


x(t)
2
1
-2
-1
1
2
t
-1

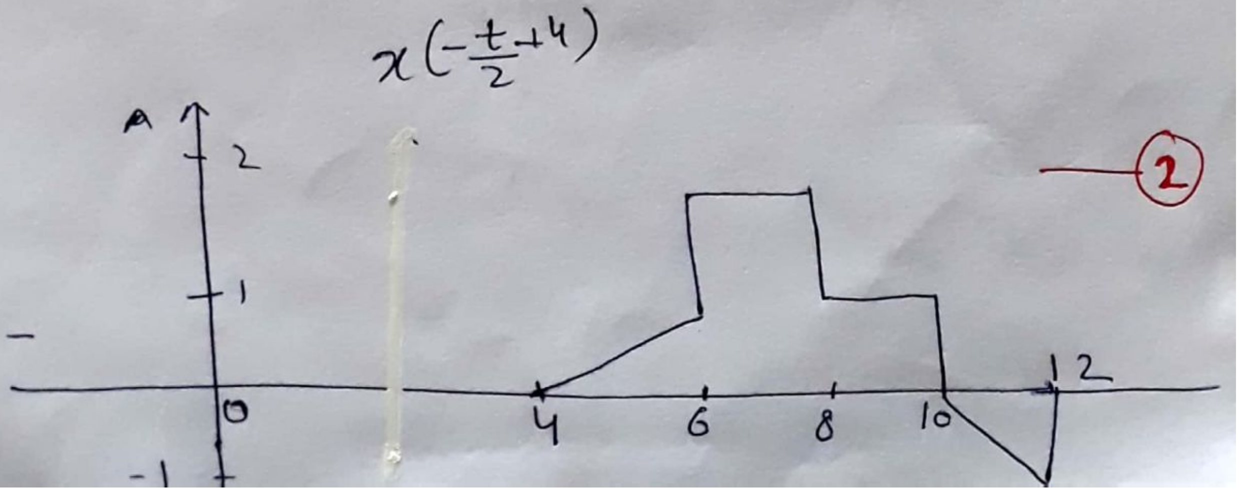
a) $x(4-t/2)$


x(t+4)
2
1
-6
-5
-4
-3
-2
-1

— 1


x(-t+4)
2
1
+2
3
4
5
6
-1

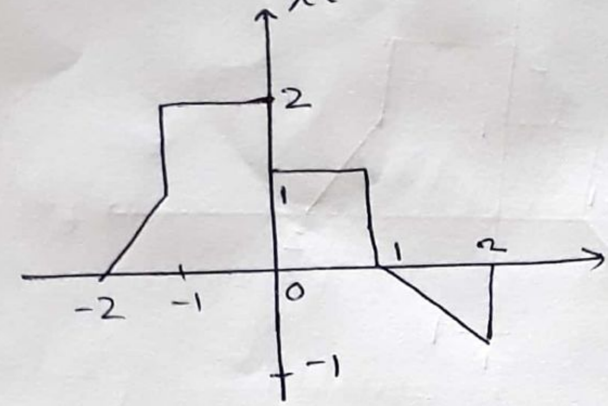
— 1


$x(-\frac{t}{2}+4)$
2
1
0
4
6
8
10
12
-1

— 2

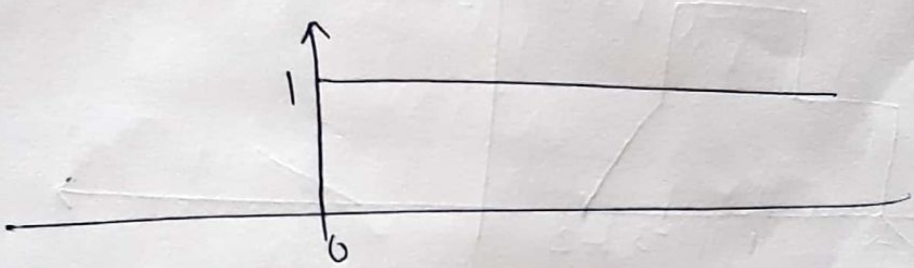
b) $[x(t) + x(-t)]u(t)$

$x(-t)$



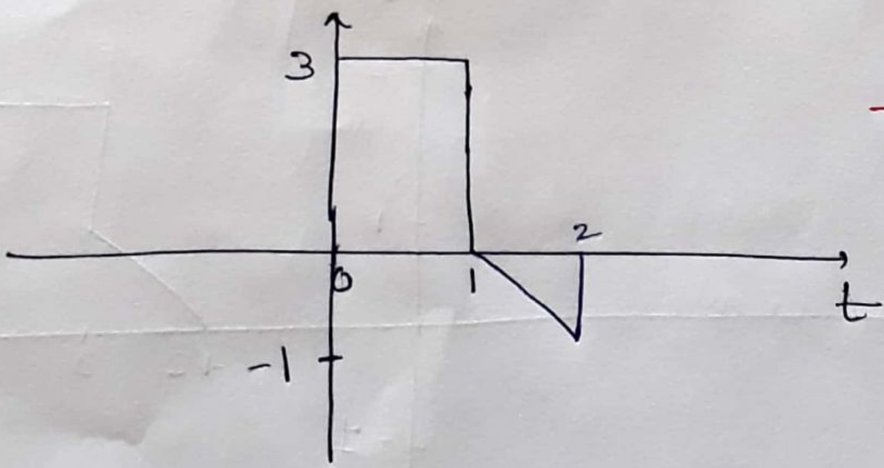
— (1)

$u(t)$



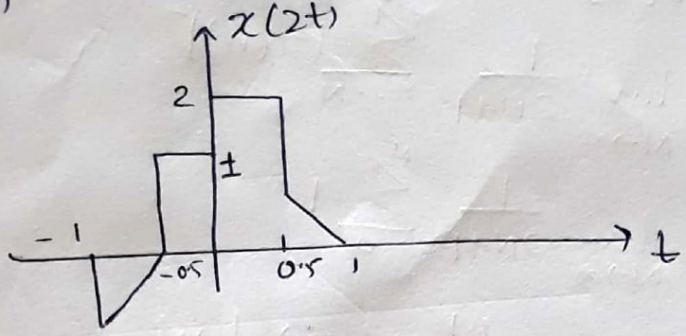
— (1)

$(x(t) + x(-t))u(t)$

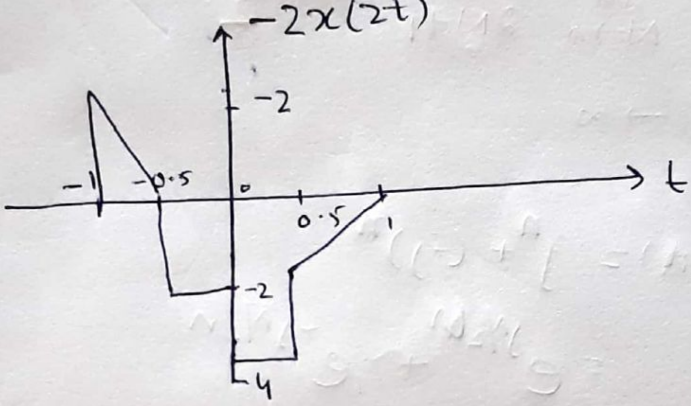


— (1)

Q3 c) $-2x(2t)$

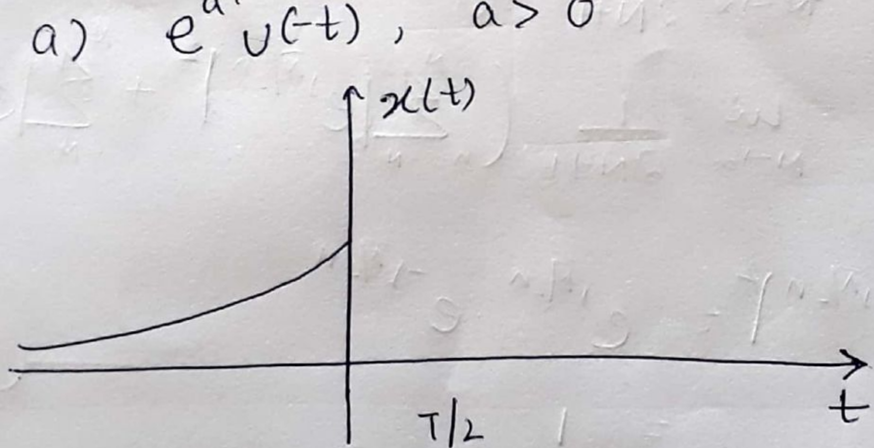


1



2

Q4 a) $e^{at}u(-t)$, $a > 0$



$$E = \lim_{T \to \infty} \int_{-T/2}^{T/2} |x(t)|^2 dt$$ 1

$$= \lim_{T \to \infty} \int_{-\infty}^{0} |e^{at}|^2 dt = \int_{-\infty}^{0} e^{2at} dt$$ 1

$$= \frac{e^{2at}}{2a} \Big|_{-\infty}^{0} = \frac{1-0}{2a}$$

$$= \frac{1}{2a}$$ 1

$\therefore P = 0$

Q4 b) $u[n]$

$$P = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |x(n)|^2$$

$$= \lim_{N\to\infty} \frac{1}{2N+1} \sum_{0}^{N} 1$$

$$= \lim_{N\to\infty} \frac{N}{2N+1} \rightarrow \frac{1}{2} W$$

$\therefore E \rightarrow \infty$

Q4 c)

$$x(n) = j^n + (-j)^n$$

$$= e^{j\pi/2 n} + e^{-j\pi/2 n} \quad \text{—— } 1$$

$$P = \lim_{N\to\infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |x(n)|^2$$

$$= \lim_{N\to\infty} \frac{1}{2N+1} \left(\sum_{n=-N}^{N} |e^{j\pi/2 n}|^2 + \sum_{-N}^{N} |e^{-j\pi/2 n}|^2 \right)$$

$$|e^{j\pi/2 n}|^2 = e^{j\pi/2 n} \cdot e^{-j\pi/2 n} \quad \text{—— } 1$$

$$= 1$$

$$\therefore P = \lim_{N\to\infty} \frac{1}{2N+1} \left(\sum_{n=-N}^{N} 1 + \sum_{n=-N}^{N} 1 \right)$$

$$= \lim_{N\to\infty} \frac{1}{2N+1} \cdot 2 \times (2N+1) \quad \text{—— } 1$$

$$= 2W$$

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Q5

a) Stable
Non-linear
Causal
Memoryless
Time-invariant — 2

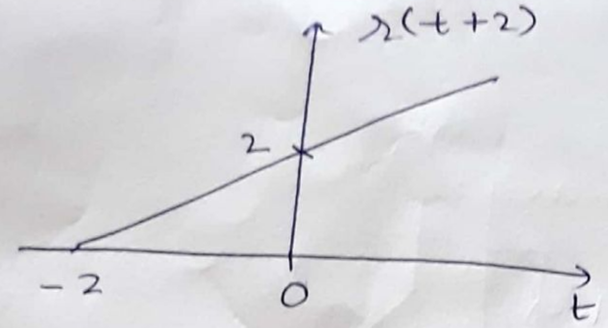
b) Time Variant
Linear
Non-causal
Memory
Stable — 2

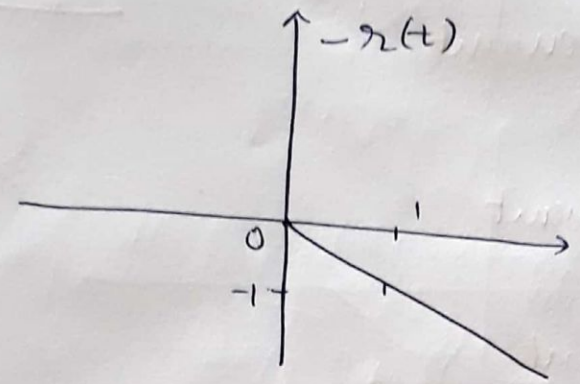
c) Memory
Non-Causal
Time Variant — 2
Linear
Stable

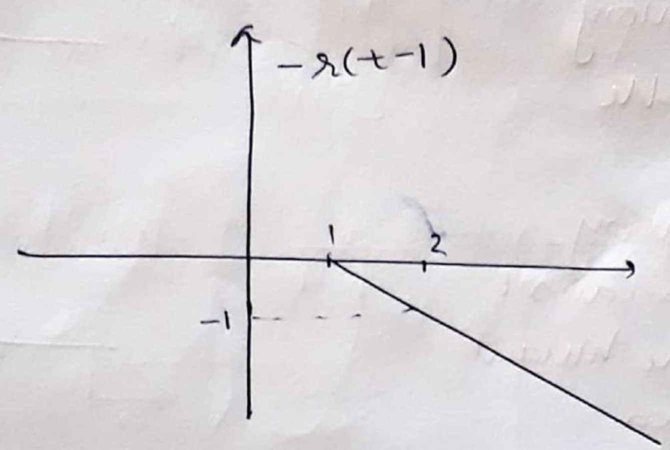
d) Stable
Non.Causal
Memory — 2
Time invariant
Linear

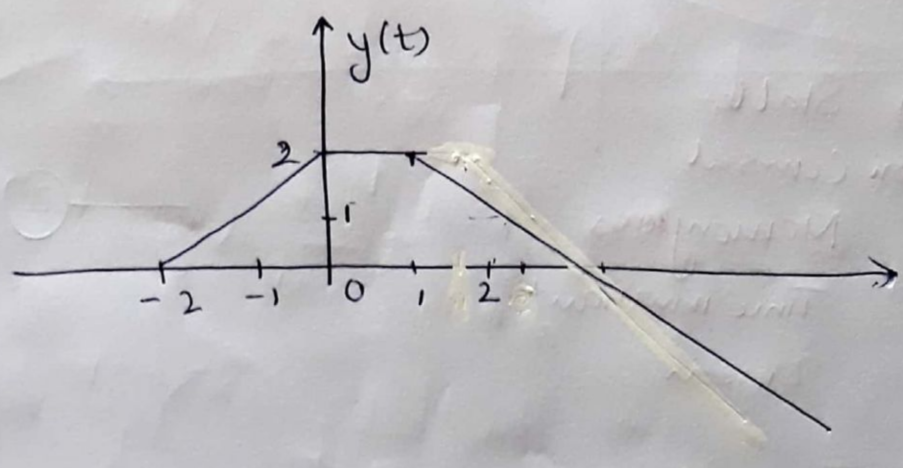
e) Time Variant
Memory
Causal — 2
~~S~~ Not-Stable
Linear

Q6



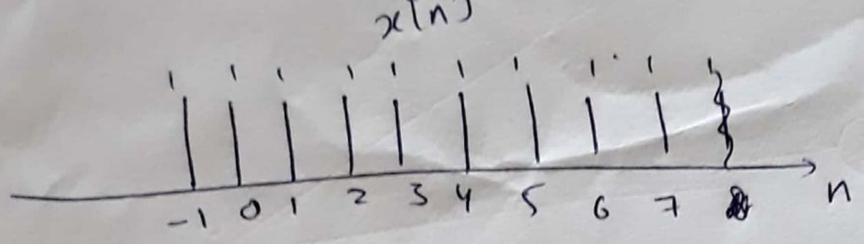






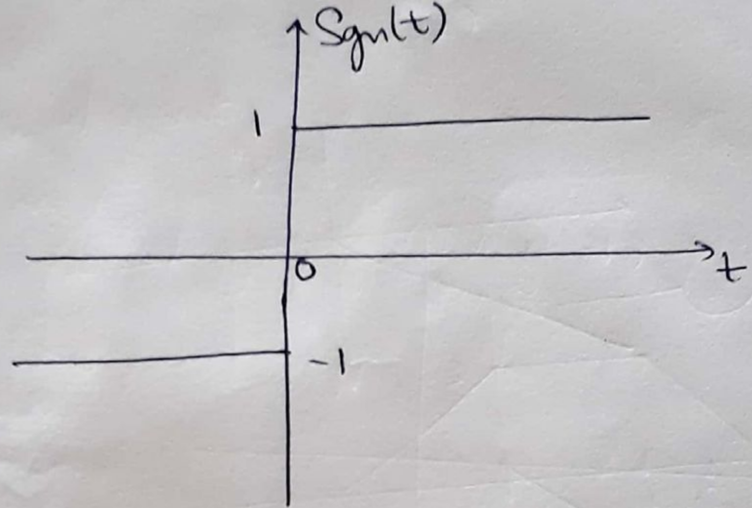
Q 6)

b) $x[n] = u[n+1] - u[n-8]$



3

c)



Q7 Signal is a function of one variable or more than one variable.

2

eg: Speech — 1D Image - 2D

Video — 3D

2