Signals & Systems

①. Introduction to S&S

V_A = pot. @ A w.r.to ground

V_{AB} = pot. diff b/w A and B.

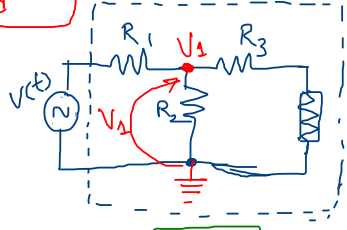
V_A, V_B = pot/voltage w.r.to gnd

$V_{AB} = V_B - V_A$ = pd

① Internal exam schedule
② Units → Internal.
③

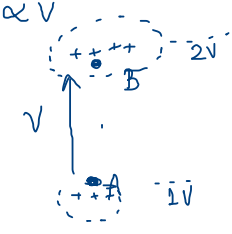
Potential = voltage measured from Gnd to that particular point

pot. diff (pd) = diff of voltages/pot of 2 diff voltages.



System → dependent on physical parameters

$I \propto V$



If A = charges = potential. → V_A

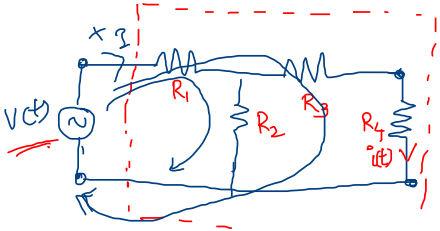
$V = V_B - V_A$ = potential diff.

↓ pot @ B ↓ pot @ A

A = Gnd ⇒ $V_B = V_B$

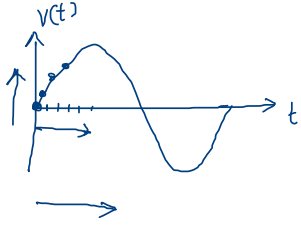
$V_A = 0$

$V = V_B - V_A = V_B$



System ⇒ dependent on physical parameter

$i(t) = ?$



Voltage is dep. on time

↳ V(t)

R, L, C

$I \propto V$

$I = \frac{V}{R}$ → constant.

R indep. of V, I.

R, L, C

Independent of I, V.

$L = \frac{\mu N^2 A}{l}$

$L \propto \frac{A}{l}$

$L \propto \frac{1}{a}$

R, L, & C are dependent on physical parameters

$R = \rho \frac{l}{a}$

$R \propto l$

$R \propto \frac{1}{a}$

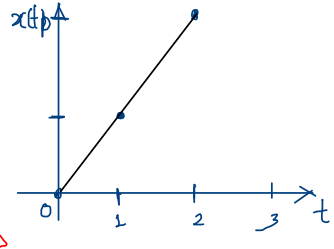
$R \propto \frac{l}{a}$ ⇒ $R = \rho \frac{l}{a}$

$C = \frac{A\varepsilon_0}{d}$

$C \propto \frac{A}{d}$

Signal :- Any physical quantity that varies with time, space or both.

$x(t) = 5t$



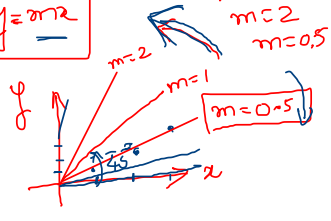
t	x(t)
0	0
1	5
2	10

$x(t)$ — y axis

t — x axis

$y = 5x$ → ① $y = mx$

$m = 1$, $m = 2$, $m = 0.5$



$m \uparrow$ towards y axis

$m \downarrow$ towards x axis.

② $y = mx + c$

$y = 0.5x$

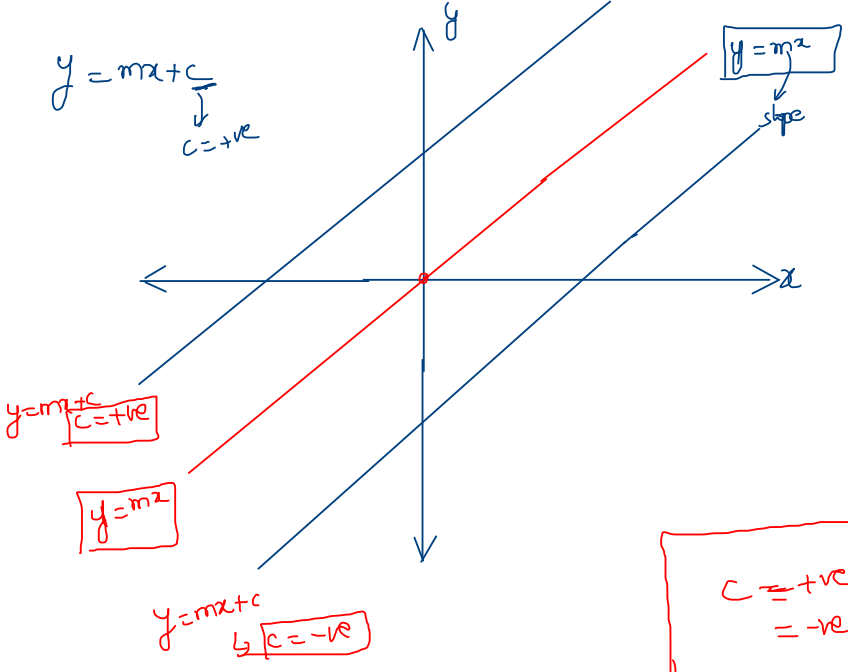
x	y
1	0.5
2	1
3	1.5

Tips & Tricks — Line passing thrush origin

Long Notebook

Tips & Tricks.

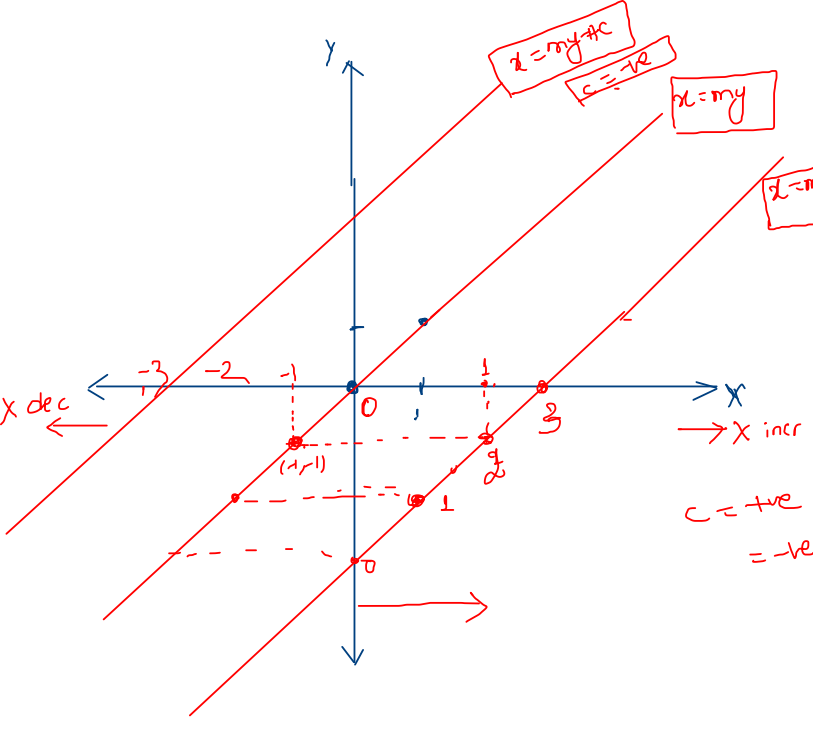
Loopy.



$y = x + 2$

$y = x - 3.$

$c = +ve$	$y\uparrow \Rightarrow$	up shift
$= -ve$	$y\downarrow \Rightarrow$	down shift



$x = my$

y	x
0	0
1	1
2	2

c = +ve

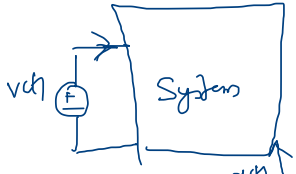
c = +ve ⇒ $x = my + c$

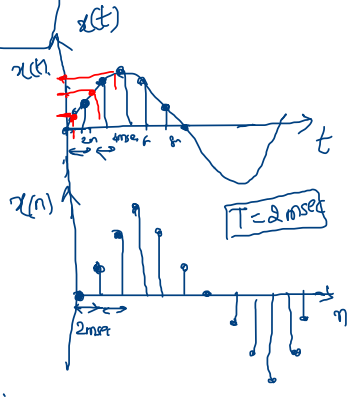
$x \uparrow$ ⇒ Right shift

c = -ve ⇒ $x = my - c$

$x \downarrow$ ⇒ Left shift.

Signal → phys. quantity that varies with t, space (or) both
→ A variable parameter by which the information is conveyed to an electronic ckt.



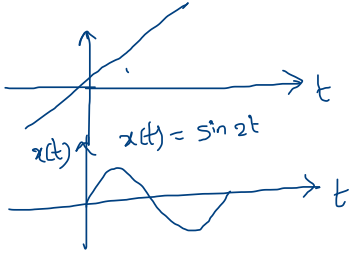


Signal

Signal is defined @ every instant of time ⇐ **Continuous – time**

$x(t) = 5t + 2$

$x(t)$ $y(t)$



Discrete – time

$x(n) = x[n]$

$x(n)$ $y(n)$

Signal is defined only @ fixed discrete instants of time.

$x(t) \xrightarrow{(nT)} x(nT) \xrightarrow{T=\text{fixed}} x(n)$.

$T = 2\text{msec}$ = fixed → sampling rate

Cutting ⇒ Sampling

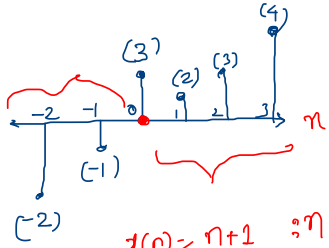
$x(1\text{ msec}) = ?$

Representation of a discrete time signal

- Functional Representation
- Sequence representation
- Tabular
- Graphical

$$x(n) = \begin{cases} n+1 & : n > 0 \\ 3 & : n = 0 \\ n & : n < 0 \end{cases}$$

n	-2	-1	0	1	2	3
x(n)	-2	-1	3	2	3	4



$$x(n) = \begin{cases} n+1 & : n > 0 \\ 3 & : n = 0 \\ n & : n < 0 \end{cases}$$

$$x[n] = \{-2, -1, \underset{\uparrow}{3}, 2, 3, 4\}$$

$-2, -1, 0, 1, 2, 3$

"zero index"

① .

$$x[n] = \begin{cases} \frac{n^2}{2} + |n| & : -2 \le n \le 2 \\ 0 & : \text{elsewhere} \end{cases}$$

plot $x[n]$

↳ Graphical represe

Tabular :-

n	-4	-3	-2	-1	0	1	2	3	4
$x[n]$	0	0	4	1.5	0	1.5	4	0	0

$n = -2$

$$\frac{n^2}{2} + |n|$$

$$= \frac{4}{2} + |-2| = 2 + 2 = 4$$

$x[n] = |n|$

$-1 \quad 1$

$1 \quad 1.$

H/w ②

$x[n] = e^{-n/2}$. Find $x[2n]$, $x[n^2]$

a) functional form

b) sequence form

(2) a) Sketch the Signal $x(t) = \sin 7t + \sin 10t$ for an interval $0 \le t \le 2$. b) Sample the signal with a sampling period $T = 0.2$ sec and sketch the discrete time signal.

b) $x(t) = \sin 7t + \sin 10t$

$T = 0.2$ sec

$x[n]$ → Graphical representation.

$x(t) \xrightarrow{t = nT} x(nT) \xrightarrow{T=0.2} x[n]$

CT $x(t) \xrightarrow{t = nT} x(nT) \xrightarrow{T = \text{fixed}} x[n]$ DT

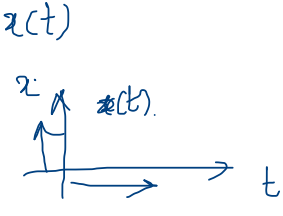
$x(t) \rightarrow x[n]$

$x(t) = \sin 7t + \sin 10t$

$x[nT] = \sin 7(nT) + \sin 10(nT)$

$T = 0.2$

$x[n] = \sin(7(0.2)n) + \sin 10(0.2)n = \sin 1.4n + \sin 2n.$

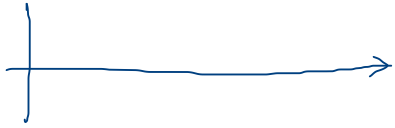


Radian mode

$x[n] = \sin 1.4n + \sin 2n$

n 0 → 10

10 samples



t 0 to 2

↓

nT 0 to 2

$T = 0.2$

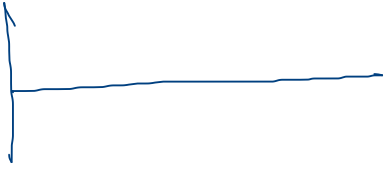
n 0 to 10

t 0 to 2

$x(t)$ 0 → 2 sec.

0 0.2 0.4 0.6 . . . . .

$x[n]$



$t = 2$ sec

↓

nT

$n \times 0.2 = 2$

$n = 10$ samples