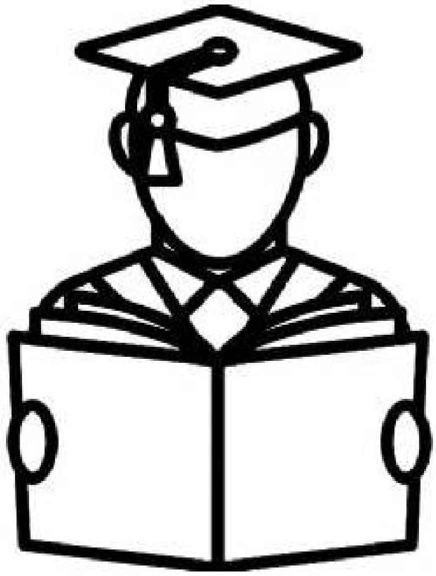
चौधरी **PHOTOSTAT**

"I don't love studying. I hate studying. I like learning. Learning is beautiful."



"An investment in knowledge pays the best interest."

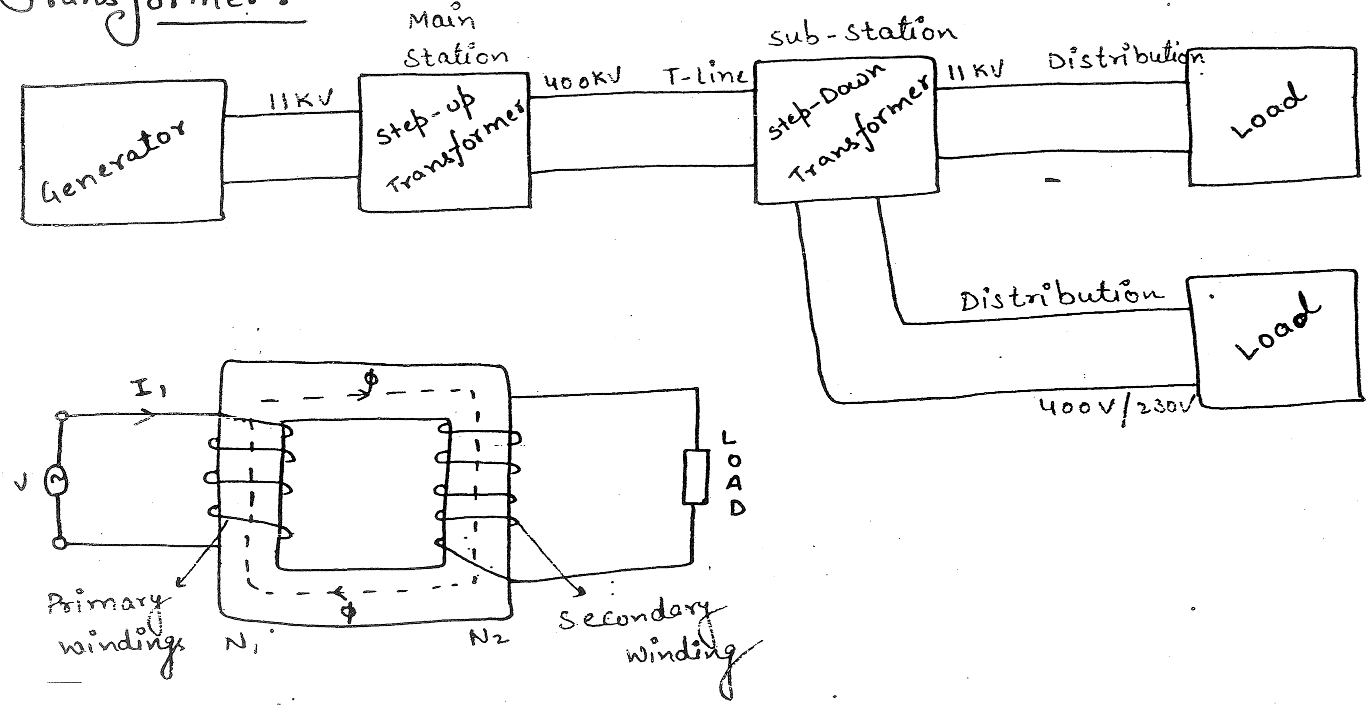
Hi, My Name is

Electronics Engineering for GATE/IES

(*MADE EASY*)

Lectur-1

Transformer :



* Transformer is a static device consist of, two or more than two electric circuits interlinked by common magnetic flux for the purpose of transforming power from one ckt to another circuit without changing any power and frequency.

* In the transformer, primary and secondary winding are electrically isolated and magnetically connected together.

* In the tranfermer wrt external circuit, No energy conversion is present but wrt internal circuit electrical energy into magnetic field. & the magnetic field is converted to electrical energy.

* Wrt no. of turns in the primary and secondary winding

Transformers are classified as :

1.) $N_1 > N_2$ → Step down T/F

2.) $N_1 < N_2$ → Step up T/F

3.) $N_1 = N_2$ → Isolation T/F

N_1 = No. of primary turns N_2 = No. of secondary turns

Applications :

1) To change Level of Voltage (Step-up or Step-down)

2) Impedence matching Transformers (to obtain Max. power from source to load).

3) Isolation Transformer (To seperate DC component in AC system)

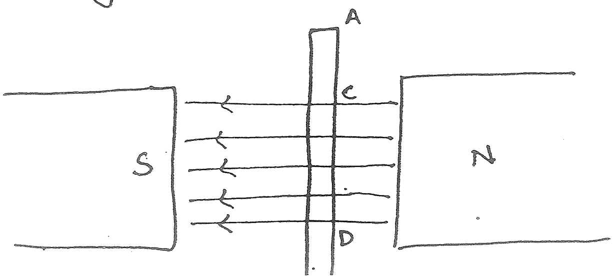
* Transformer works based on the principle of Faraday's Law of electromagnetic Induction.

* Essential requirements to obtain induced voltage are :

1) Conductor
2) Magnetic field
3) Relative speed between conductor and magnetic field. (either wrt space or Time)

Case-I : Dynamically Induced emf

* emf induced in a conductor when it is being rotated in a steady magnetic field is called as Dynamically Induced emf.



Dynamically induced emf = e

$$\boxed{e = B l v \sin\theta}$$

B = Flux density (wb/m^2)

l = Active length of conductor (CD)

v = Linear velocity of the conductor

θ = phase displacement between conductor & magnetic field.

Faraday's First Law :

"When conductor cuts a magnetic lines of force, an in emf induced in the conductor."

Faraday's Second Law :

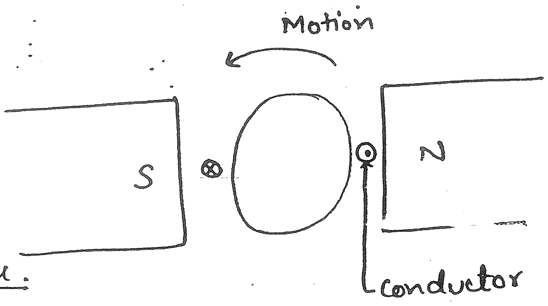
"EMF induced in a conductor is directly proportional to the Rate of change of flux".

* Direction of Dynamically induced emf is obtained by using Flemming's right hand rule.

→ Thumb indicates motion of the Conductor.

→ Forefinger indicates direction of flux.

→ Middle finger indicates direction of induced current (induced voltage).



Case II - ~~Statisticall~~ Statically induced emf

* emf induced in a conductor when it is subjected to time varying flux is called as statically induced emf.

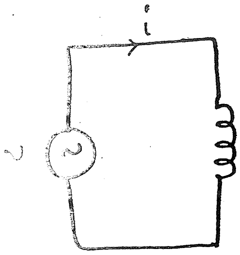
* Direction of statically induced emf is obtained by Lenz's Law.

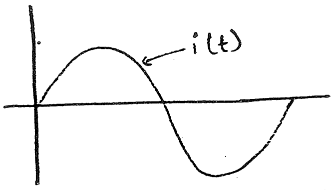
Ex-1

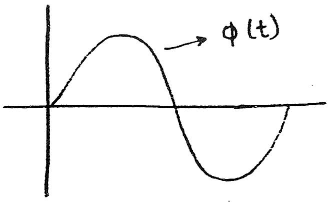
$$e \propto \frac{d\phi}{dt} \qquad \boxed{e = \underset{\substack{\downarrow \\ \text{Lenz's Law}}}{-} N \frac{d\phi}{dt}}$$

v, i, ϕ, e

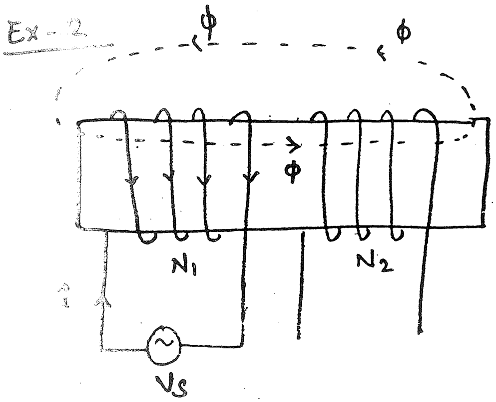
lenz's law







Ex-2



$$e_1 \propto \frac{d\phi}{dt}$$

$$e_1 = -N_1 \frac{d\phi}{dt}$$

$$e_1 = -N_1 \frac{d\phi}{dt} \frac{di}{dt} \qquad \left(L = \frac{N\phi}{i} \right)$$

$$\boxed{e_1 = -L_1 \frac{di}{dt}}$$ self induced emf

$$e_2 \propto \frac{d\phi}{dt}$$

$$e_2 = -N_2 \frac{d\phi}{dt}$$

$$e_2 = -N_2 \frac{d\phi}{di} \frac{di}{dt} \qquad \left(M = \frac{N_2\phi}{i} \right)$$

$$\boxed{e_2 = -M \frac{di}{dt}}$$ Mutual induced emf

Magnetic Coupling :

wrt direction of flux, magnetic Coupling are classified as

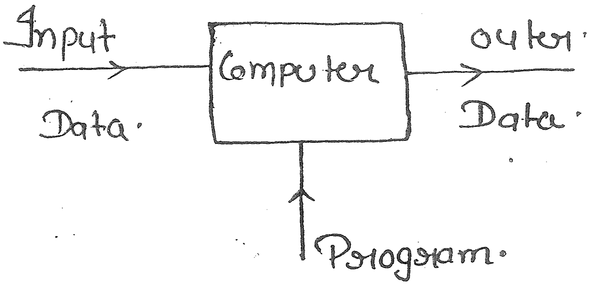
1) positive magnetic Coupling

2) Negetive magnetic Coupling

Computer

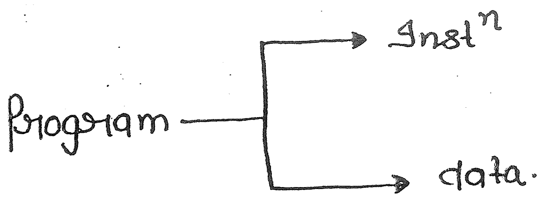
28/11/2017

It is a computation m/c use to process the data under the control of a programe. ∴ The Computer system functionality is program. exeution.



Program:-

is a sequenie of Instruct^n along with a data.

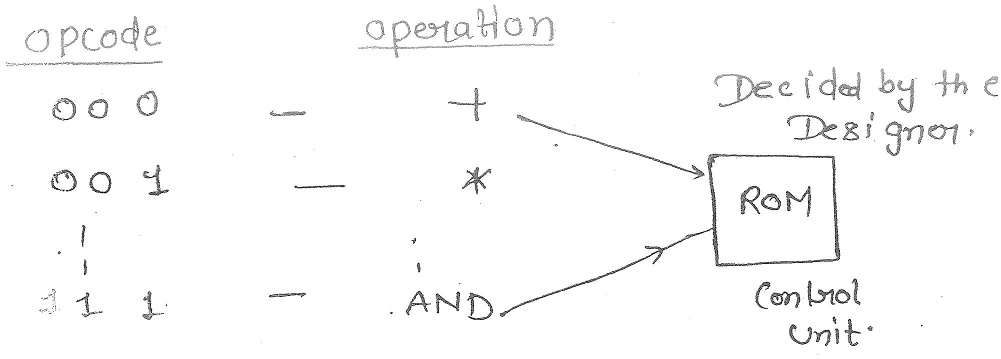


Inst^n:

is a binary code which is designed inside the Processor to performed some task.

Binary code	— Bind with —	operation.

Ex:- If CPU xsupport's 8 operationis then opcode is defind as | $\log_2^8$ = 3 bit { Encoded Format |



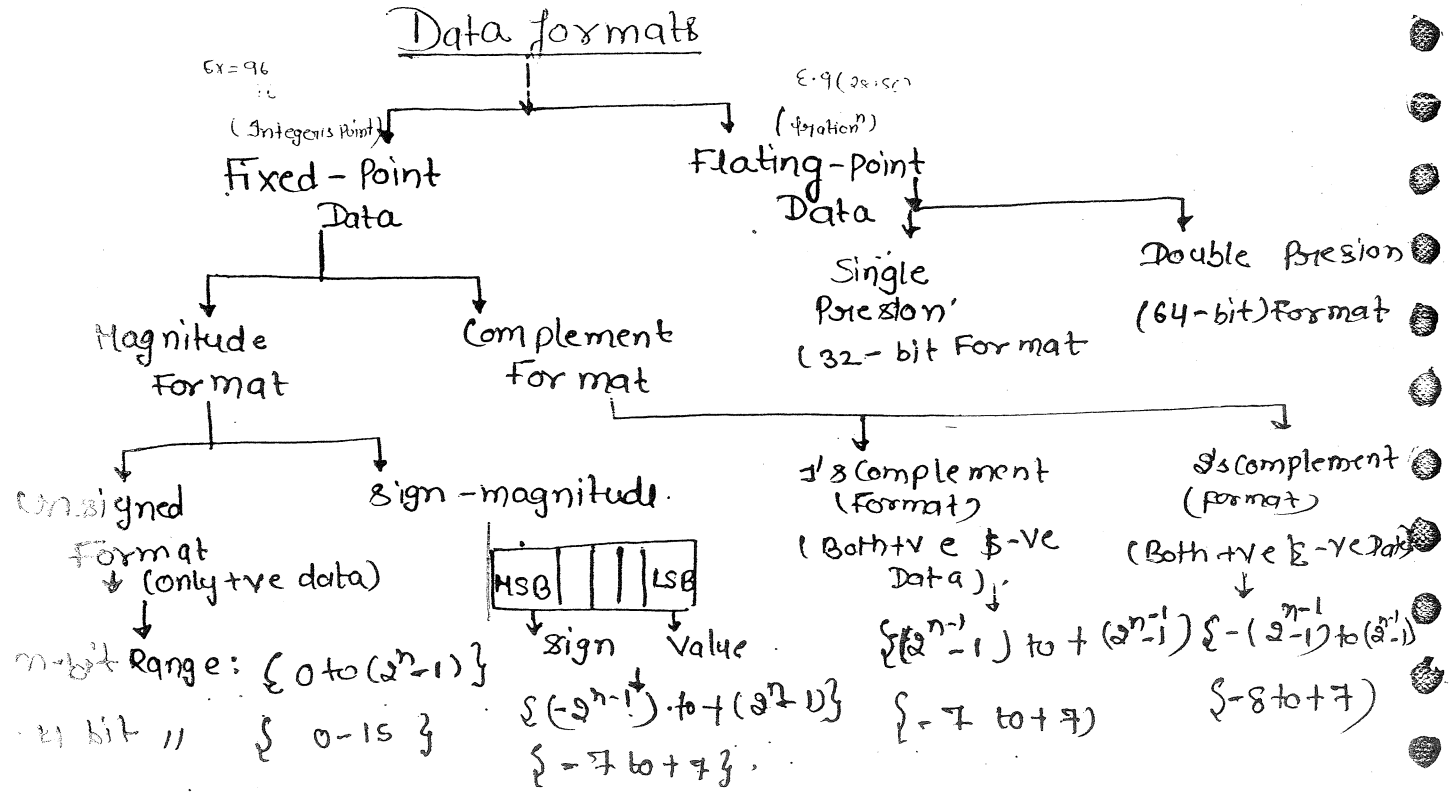
Data :- It is a binary code which is associated with a valueis based on the format.

Binary code - Bind with - Value

$$Ex\ (\overset{2}{1}\overset{1}{0}\overset{0}{1})_2 = 5$$

$$\underbrace{\underset{4}{\underset{\downarrow}{(1*2^2)}} + \underset{0}{\underset{\downarrow}{(0*2)}} + \underset{1}{\underset{\downarrow}{(1*2^{0}]}}}_{⑤}$$

Diflerent Data format :- used in the computer system design to prefer the data is as follow.



$\boxed{+1 \quad -1}$

$\boxed{+0 \quad -0}$ → 0

MSB - 1

4 Bit Binary	Unsigned Data	Sign-magnitude Data	1's compl. Data	2's comp. Data
0000	0	$\boxed{+0}$	+0	+0
0001	1	+1	+1	+1
0010	2	+2	+2	+2
0011	3	+3	+3	+3
0100	4	+4	+4	+4
0101	5	+5	+5	+5
0110	6	+6	+6	+6
0111	7	+7	+7	+7
1000	8	$\boxed{-0}$	-7	-8
1001	9	-1	-6	-7
1010	10	-2	-5	-6
1011	11	-3	-4	-5
1100	12	-4	-3	-4
1101	13	-5	-2	-3
1110	14	-6	-1	-2
1111	15	-7	$\boxed{-0}$	-1
		Not in use	Not in use	

1's compl

1000 = [-7]

1000 → 0111 (7)

1001 = [-6]

1001 → 0110 (6)

2's Complement

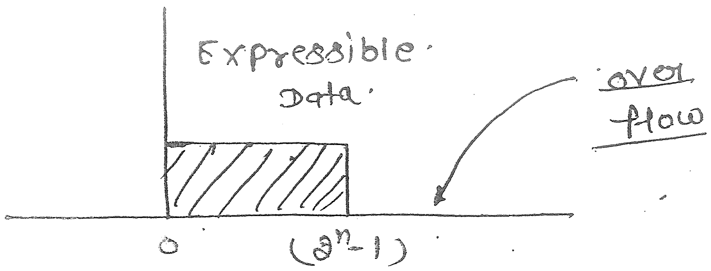
1000 = [-8]

1000 → 0111
+1
1000 =8

1001 = [-7]

1001 → 0110
+1
0111 = 7

Unsigned Data:



4 bit + 4 bit = 5 bit

$$\begin{array}{r} 15 \\ +\ 15 \\ \hline 30 \end{array}$$

4-bit : { 0 to 15 }.

4-bit + 1 bit { 0 to 31 }

↓

Space

⇓

Flip-Flop

⇓

Flag ⟶ carry

→ **Note:-**

Carry flag is used in the CPU designed to Indicate the range excieding cond^n of a unsigned arithmatic

$\boxed{(n\text{-bit}) + (n\text{-bit}) = (n+1)\text{ bit}}$

↓

1 Bit Storage Space

↓

1 Flip-Flop

↓

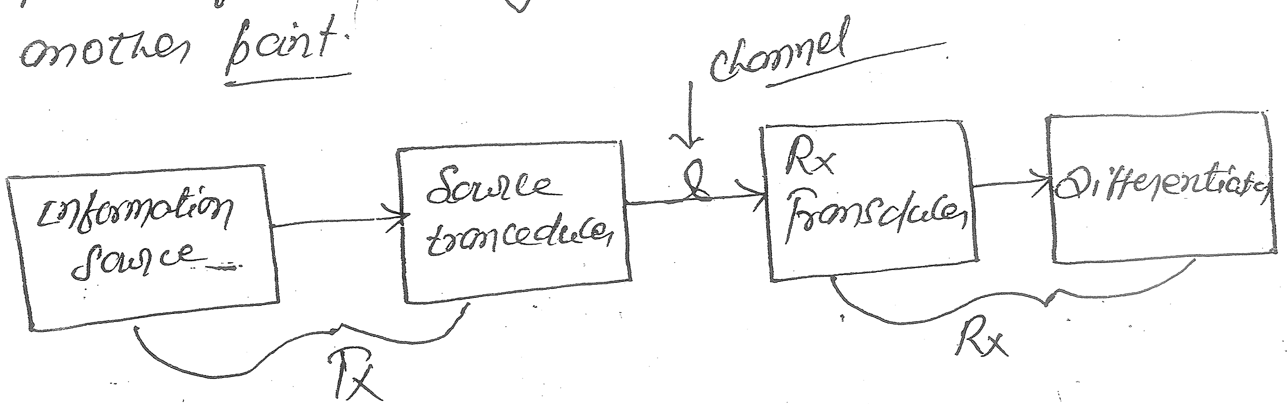
Flag

↓

Carry Flag.

Date 24/7/17

Communication :— Communication is a process of transferring signal from one point to another point.



Voice Signal — 300Hz — 3.5 KHz
Audio " — 20Hz — 20KHz
video " — 0 — 4.5MHz

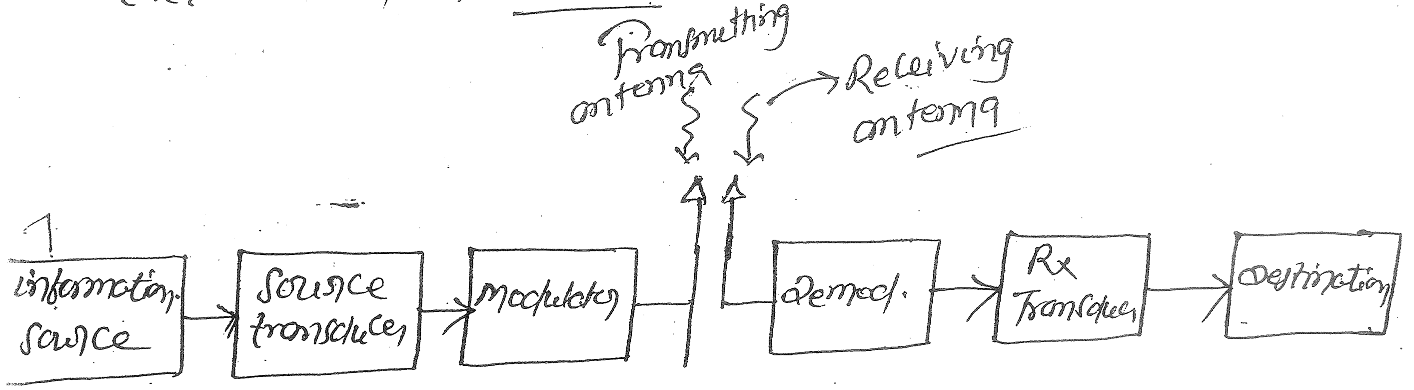
=) (i) Information Source is the Source of information.

=) Source transducer converts physical signal into Electrical Equivalent. Ex:- Mic, microphone.

=) Wired Communication System is preffered for short distance Communication only. For long distance Communication wireless transmission is preffered, in which signal propagates through free space.

⇒ Receiving transducer converts Electrical signal into physical Equivalents.

Ex:- Loud speaker.

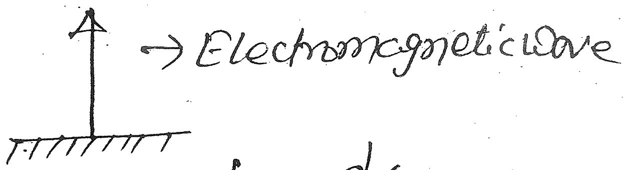


⇒ Generally ~~We, Know that~~ without modulation. long distance communication through free space is not possible.

* Need for Modulation:—

① Reducing antenna height requirment:—

for faithful radiation of signal



$$ht = \lambda/4$$

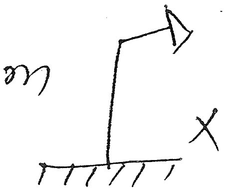
$$\lambda = \frac{v}{f}$$

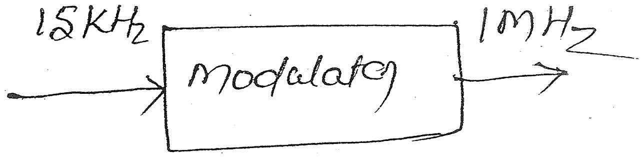
$$\boxed{\lambda = \frac{c}{f}}$$

$$\downarrow ht = \frac{c}{4f} \uparrow$$

$$ht = \frac{3\times10^8}{4\times(15\times10^3)}$$

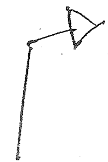
$$= 5km$$





$$ht = \frac{3\times10^8}{4\times(10^6)}$$

$$= 75 m$$



=) For faithful radiation of antenna height should be atleast of $\frac{\lambda}{4}$.

=) Transmitting antenna convert electrical signal into electromagnetic ~~expressing~~ and resulting progates with light velocity.

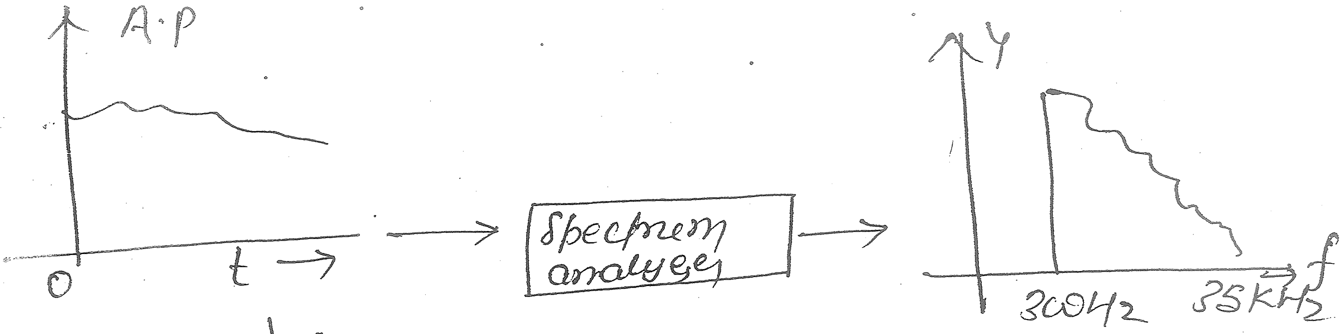
Note:- modulation is the process of increasing of the signal into reduce antenna height requirement.

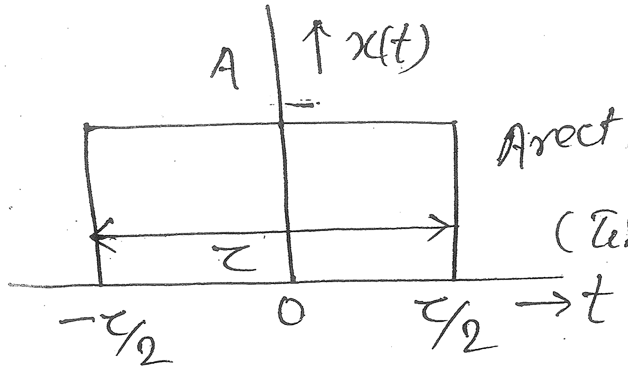
② Multiplexing:— It is the process of transmitting multiple no. of signals through a single channel. Generally without modulation, multiplexing is not possible.

*③ Fourier Transform:— $x(t) \rightarrow f(t)$

$$\boxed{X(f) = \int_{-\infty}^{\infty} x(t) \cdot e^{-j2\pi ft} dt}$$

=) Fourier transform is mainly used in to find frequencies presented in the given time, domain signals.





$A\,\mathrm{rect}\left(\frac{t}{\tau}\right)$

(Time domain representation of signal)

$$X(f) = \int_{-\infty}^{\infty} x(t)\cdot e^{-j2\pi ft}\,dt$$

$$= \int_{-\tau/2}^{\tau/2} A\cdot e^{-j2\pi ft}\,dt$$

$$= A\int_{-\tau/2}^{\tau/2} e^{-j2\pi ft}\,dt$$

$$= \frac{-A}{j2\pi ft}\left[e^{-j2\pi ft}\right]_{-\tau/2}^{\tau/2}$$

$$= \frac{-A}{j2\pi f}\left[e^{-j2\pi f\tau/2} - e^{-j2\pi f\tau/2}\right]$$

$$= \frac{A}{\pi f}\left[\frac{e^{j\pi f\tau - j\pi\tau}}{2j}\right]$$

$$= \frac{A}{\pi f}\sin(\pi f\tau)$$

25th May 019

EDC

Properties of all semiconductor maximum at this temp

1. SEMI-CONDUCTOR PHYSICS

* Classification of temperature :- [T]

① Absolute Temp. 0°K = -273 °c (Practically not possible)

② Room temp. 300 K = 27 °c

③ Ambient temp (T_A):290 K = 17 °c

K = °K

new notation — same — old notation

→ $\boxed{\text{Temp in Kelvin} = \text{Temp. in } ^\circ C + 273}$

* Thermal Voltage :- (V_T)

→ volt-equivalent of temperature

$$\boxed{V_T = \frac{\bar{K}T}{q} \text{ volt}}$$

— convert voltage into temperature & v/c-versa

محمد مہتاب خان

where, T = temperature in Kelvin

q = magnitude of charge

= 1.6×10^{-19} C

$\bar{K}$ = 1.381×10^{-23} J/°K

→ After substituting values of q and $\bar{K}$ we get:

$$\boxed{V_T = \frac{T}{11,600} \text{ volt}}$$

$\boxed{V_T \propto \text{Temp}}$

→ If T = 0K, $V_T = 0$

If T = 300 K, $V_T = \frac{300}{11,600} = 0.02568$ V

$\boxed{V_T = 26 mv}$

The standard room temp. corresponds to a voltage of 26 mv.

For a large variation in temp., we get a minute variation in thermal voltage two different types of

→ Boltzmon's constant :-

$\bar{K} = 1.381 \times 10^{-23}$ J/K

$K = 8.62 \times 10^{-5}$ eV/K

$\boxed{\bar{K} = 1.6 \times 10^{-19} K}$ — relation

$V_T = \frac{\bar{K}T}{q} = \frac{1.6 \cancel{\times 10^{-19}} K.T}{\cancel{q}} \Rightarrow \boxed{V_T = K.T} = 26$ mV.

$\boxed{KT \rightarrow 26 mV}$

* Electron Volt :- (eV)

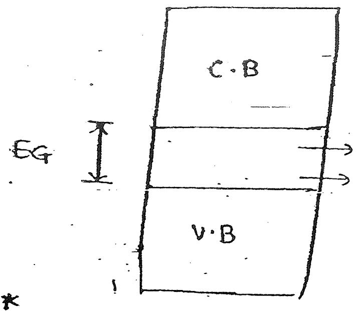
→ It is the practical unit of energy in electronics. — Joule is bigger unit

** $\boxed{1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}}$

⇒ 1eV is defined as the energy (Kinetic) gained by the electron in moving through a potential difference of 1Volt.

* Energy Gap (E_g or E_G) :-

-: Energy band diagram of semiconductor



$\boxed{E_G \propto \frac{1}{\text{Temp}}}$

***

	Germanium	Silicon
EGO	0.785 eV	1.21 eV
EG300	0.72 eV	1.1 eV

EGO = band gap at 0 kelvin.

EG300 = band gap at 300K.

→ In semiconductor, energy gap decreases with temperature

→ EG at any temp T(K) is given by,

$\boxed{E_G(T) = E_{G0} - \beta_0 T}$ eV

or

$E_G \propto \frac{1}{\text{Temp}}$

β_0 → material constant (eV/°K)

For Ge :- **

$$\boxed{E_G(T) = 0.785 - \boxed{2.33} \times 10^{-4}\ T}$$ ev → put T = 0 = 0.785

For Si :- **

$$\boxed{E_G(T) = 1.21 - \boxed{3.6} \times 10^{-4}\ T}$$ eV → put T = 300 = 0.72 eV

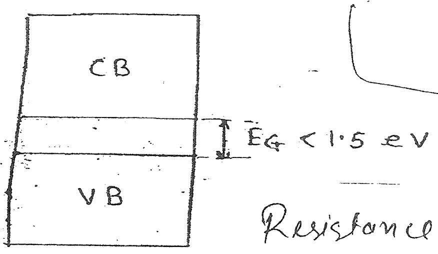
→ material constant varying from material to material

NOTE :
For GaAs $E_{G300} = 1.42$ ev.

→ For a semiconductors, EG is small i.e. $\boxed{E_G \leq 1.5 \text{ ev}}$

→ bipolar → ~~current~~ carried by both electrons & protons

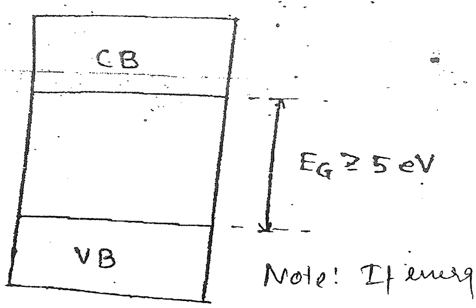
→ diffusion current



Resistance decreases with temperature

(NTCR)
Negative temperature coefficient of Resistance

→ For insulators, EG is large i.e. $\boxed{E_G \geq 5 \text{ eV}}$



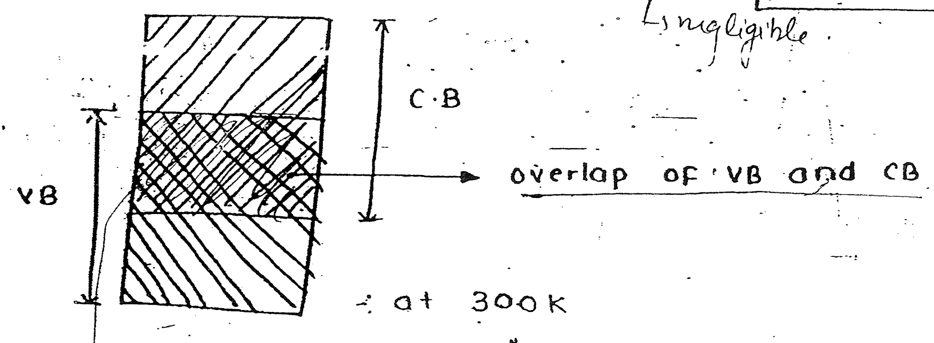
Conductivity negligible

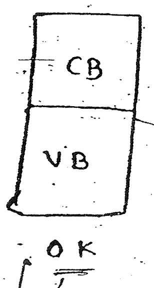
For ideal insulator conductivity is zero.

Note! If energy gap is less, less amount of additional energy is required for electron to jump from valence band to conduction band.

→ For metals / conductors, EG is zero. ⌊ negligible

E_G = non-zero
EG (close to 0) ⌊ Text Books





increase metal

at 0 K ~~one~~ Eg is 0.

overlap increases with ~~temperature~~

200° to 300 K

Metals → Conductivity is very large.

Only drift current flows.

Unipolar. → current is carried only by electrons

*** only metals
PTC of resistance
Positive temperature constant
[when metal is heated its resistance increases]

of insulators and conductivity of a metal.

Electric Field Intensity :- (E or, $\mathcal{E}$) signifies this

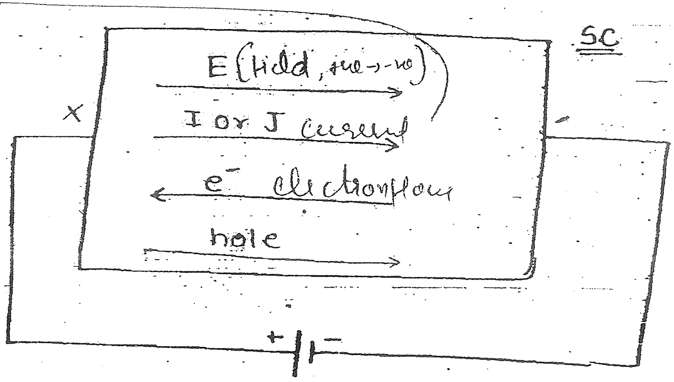
→ ~~Field~~ intensity or; field gradient or, field.

→ By defination,

$$\boxed{E = -\frac{dV}{dx}} \ V/m.$$

$$\boxed{|E| = \frac{\text{Magnitude of voltage existing}}{\text{distance or, spacing.}}}$$ – expressing of semiconductors

→ Field (current) is directed from higher potential to lower potential or, positive terminal to negative terminal.



ex :-

▶ considering a semi-conductor bar → calculate the field at the centre of the bar.