1) HALL EFFECT

★ Also called Galvanomagnetic Effect Sensor

★ Observed in metals and Semiconductors

★ when a magnetic field is applied at right angles to the current flow in a thin film where an electric field is generated. It is Hall Effect

★ Hall voltage can be given by,

$$V_H \approx B_z I_x$$

★ Lorentz force is the force exerted on a charged particle q moving with velocity v through an electric Field E and magnetic field B

$$f = eE + e[v \times B] \rightarrow (1)$$

e → charge carrier

E → Electric field

B → Magnetic Induction

v → carrier velocity

→ $I = I_0$ and $B = 0$,

$$I = I_0 + \mu_H (I_0 \times B) \rightarrow (2)$$

where I_0 → current density due to Electric field

μ_H → Hall mobility

I → Total current density

$$I_0 = \sigma C - eD\Delta n \longrightarrow (3)$$

where σ = conductivity

D = Diffussion Coefficient

Δn = carrier concentration

★ Hall Mobility μ_H is the product of drift mobility of carrier μ and hall scattering factor r.

$$\mu_H = r\mu$$

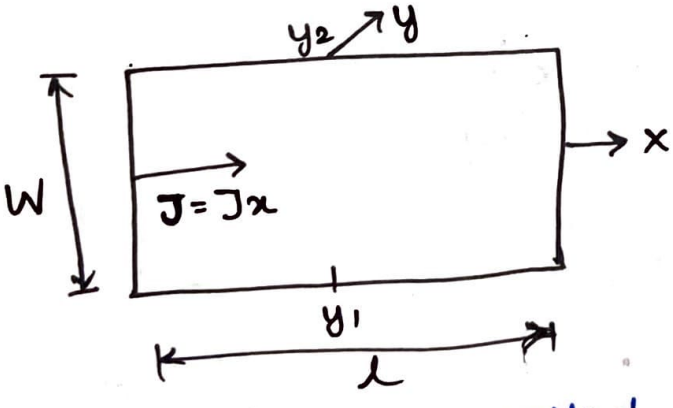
$$r = \frac{[\tau^2]}{[\tau]^2}$$

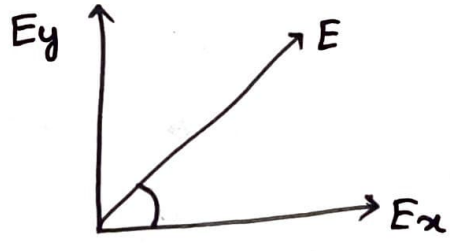
$r = 1$ for semiconductor / metals

$r = 1.93$ for ionized impurities

$r = 1.18$ for phonons

$$E_y = -\mu_H B = E_x$$





Transverse voltage called Hall Voltage V_H is given by,

$$V_H = \int_{y_2}^{y_1} E_H \, dy = -\mu_H B_z E_x W \quad (4)$$

The Effect leading to this phenomena called Hall Effect.

$$\tan\theta_h = \frac{E_y}{E_z} = -\mu_H B_z \longrightarrow (5)$$

Hall Coefficient h_c is defined as,

$$h_c = \frac{-E_H}{I \times B}$$

$$h_c = \frac{-E_y}{I_x \times B_z} = \frac{\mu_n E_x}{I_x}$$

$$I_x = \sigma E_x \quad \text{and} \quad \sigma = e\mu_n$$

$$h = \frac{r}{en}$$

Hall voltage can be expressed in terms of Hall coefficient h_c.

$$V_H = -h_c J_x B_z W$$

$$h_c = \frac{1}{e} \frac{r_p n_p - r_n n_n (\mu_n/\mu_p)^2}{(n_p + n_n (\mu_n/\mu_p)^2)}$$

$$n_i^2 = AT^{3/2} \exp\left[\frac{-E_g}{2kT}\right]$$

A → coefficient

T → Absolute Temperature

K → Boltzman constant

2) a) **BUCKET CONVEYOR :-**

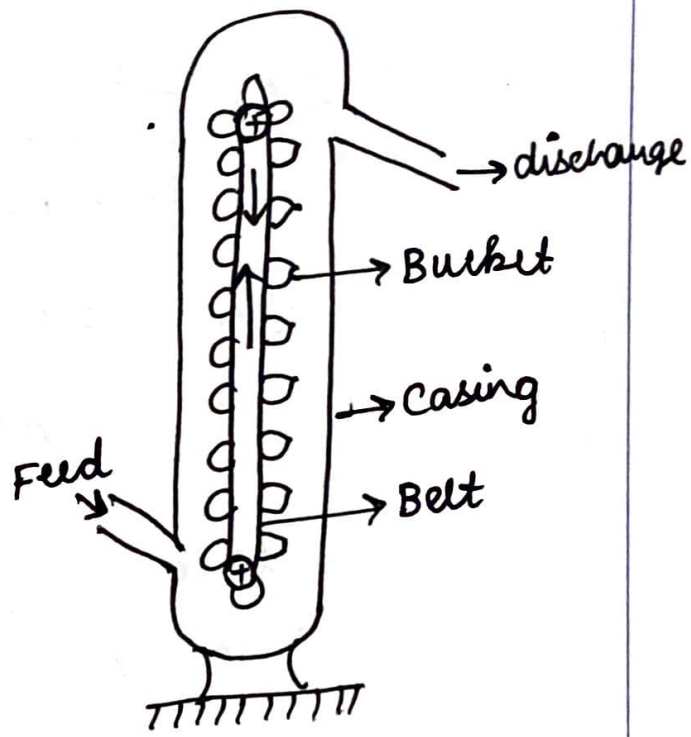
★ BC consist of endless chains or belts to which are attached buckets to convey bulk material in horizontal, inclined and vertical paths

3 types

a) Centrifugal Bucket Conveyor
b) Continuous BC
c) positive discharge BC

working / Construction :-

★ It is used for vertical lifts
★ Buckets are fixed on chain which moves on two wheels
★ Buckets are loaded at the bottom discharged at the top



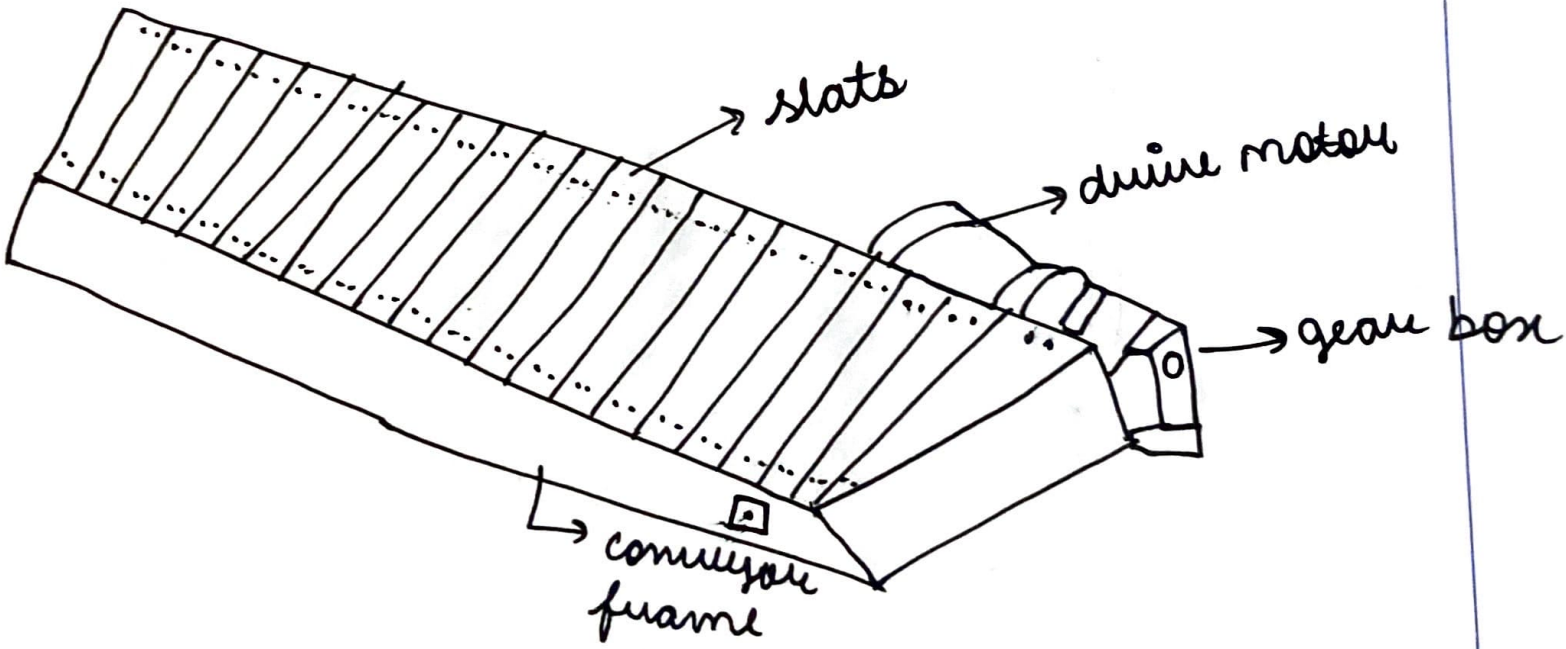
b) **Slat Conveyor :-**

★ SC use a slat and chain system to move components along an assembly line

★ They are often used where production operations are performed with the parts located on the Conveyor

★ Steel panels are attached to the chain with special chain attachments

★ The chain is driven by an electric motor & gearbox



1) CONVEYOR SYSTEMS :-

* Moves materials from one location to another location.
* Mechanical Device
* Involving the transportation of heavy (or) Bulky materials

DESIGNING A CONVEYOR SYSTEM:-

1) Capacity requirement
2) Length of travel
3) Material characteristics
4) Processing requirements
5) Life expectancy
6) Costs

MAIN ELEMENTS OF CONVEYORS:-

1) CONVEYOR DRIVES:-

* Conveyor drives may account for from 10% to 30% of the total cost of the conveyor system, depending on specific job requirements.
* They may be of either fixed-speed or adjustable-speed type.
* Adjustable-speed drives are designed for changing speed either manually or automatically while the conveyor is in operation, to meet variations in processing requirements.

2) CONVEYOR MOTORS:-

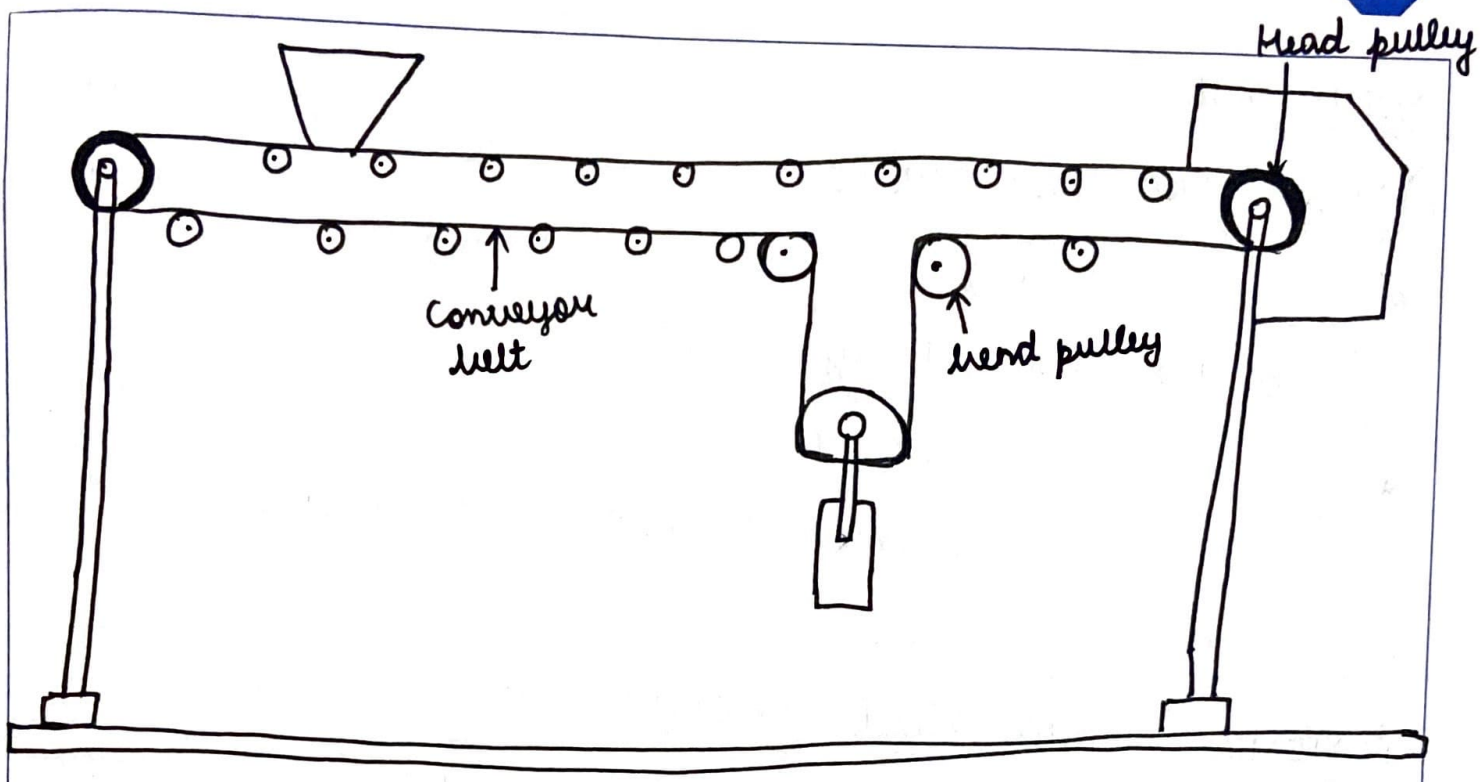
* Conveyor motors for conveyor drives are generally of 240- and 480-V ratings.
* The squirrel-cage motor is most commonly used with belt conveyors and with drives upto 7.457 kW (10 hp).

3) CONTROL OF CONVEYORS:-

* Control has been enhanced considerably
* with the introduction of process-control computers and programmable controllers which can be used to maintain rated capacities.
* Through variable-speed drives, outputs can be adjusted automatically for changes in processing conditions.

WORKING OF BELT CONVEYOR:-

* Belt conveyor is composed by two pulleys and a closed conveyor belt.
* The pulley that pulls conveyor belt is called drive pulley.
* The other-one is only used to change conveyor belt movement direction called the bend pulley.
* Drive pulley is driven by the motor.
* Drive pully is installed at the discharge end.
* Material is fed on the feed-side and landed on the rotating conveyor belt.



TYPES :-

1) Chale Conveyor
2) wheel Conveyor
3) Roller Conveyor
4) Gravity Conveyor
5) Chain Conveyor
6) Flight Conveyor
7) Apron Conveyor
8) Closed Conveyor
9) Slot Conveyor
10) Continuous flow Conveyor

2) **MEMS :-**

★ Micro Electro Mechanical System

★ Any engineering system that performs electrical and mechanical functions with components in micrometers is a MEMS (1 μm = 1/10 of human air)

Available MEMS products :-

1. Micro Sensors
2. Micro Actuators
3. Read / Write Heads
4. Inkjet printer heads
5. Microdevice components

MINIATURIZATION :-

★ Principle driving force for 21st industrial technology.

★ It has strong demand for

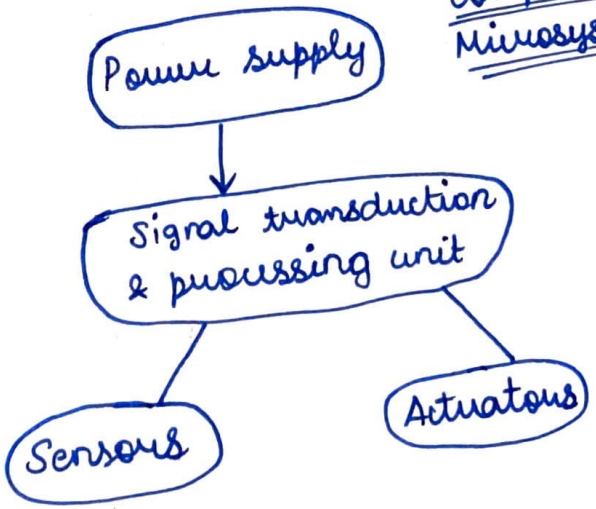
i) Intelligent

ii) Robust

iii) Multifunctional

iv) Low cost

Components of Microsystem



Scaling laws in Miniaturization :-

1. Scaling in geometry
2. Scaling in Rigid body dynamics
3. Scaling in Electro Static force
4. Scaling in Electro magneto force
5. Scaling in Electricity
6. Scaling in fluid mechanics
7. Scaling in Heat Transfer

TYPES:-

1) **MEMS ACCELEROMETER:-**

★ It's a micro Electrochemical device that is used to measure acceleration and force.

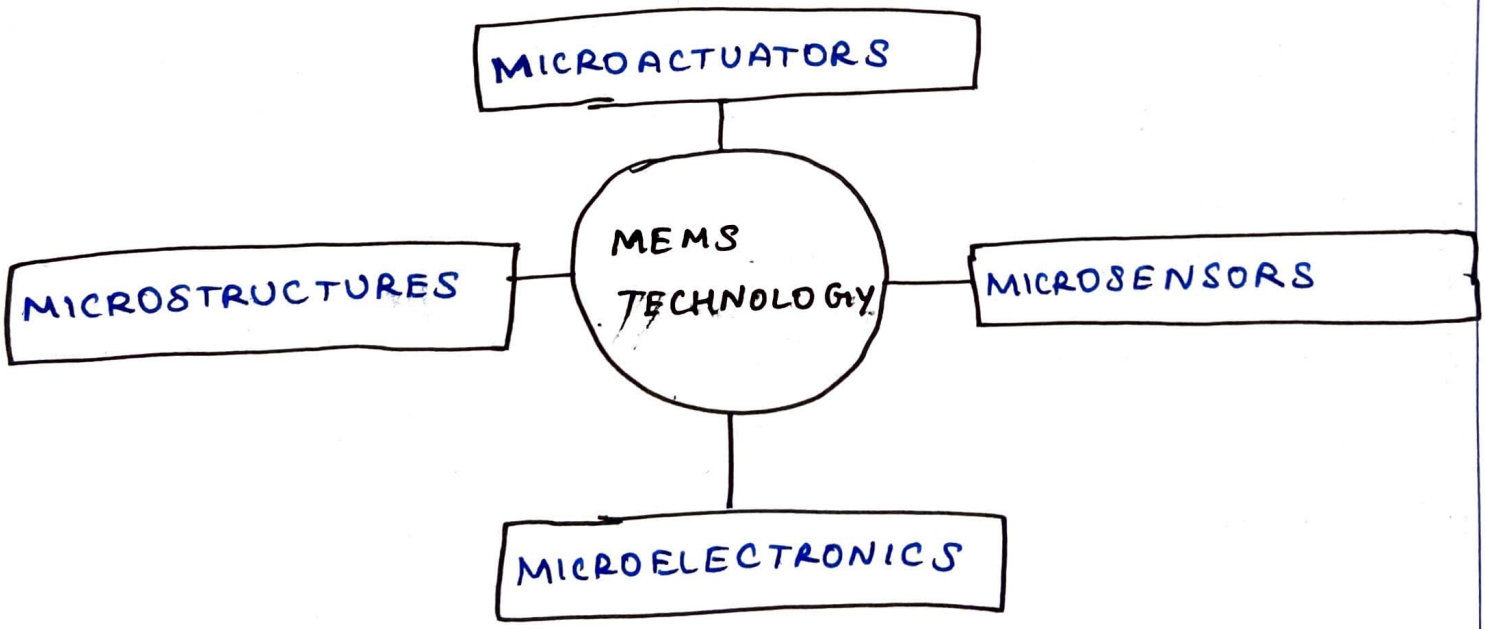
2) **MEMS GYROSCOPES:-**

★ MEMS gyroscopes or MEMS angular rate sensors is a micro Electro mechanical device which is small with inexpensive sensors which are used to measure angular velocity or rotational ~~rotation~~ motion or displacement

3) MEMS PRESSURE SENSORS:-

★ Pressure sensors are a piezo electric resistive pressure sensing die processed by MEMS technology.

★ The sensor is integrated into the tires of the vehicle either internally or externally to measure and monitor the pressure of tires.

4) MEMS Magnetic field Sensors:-

★ MEMS magnetic field sensors are small scale micro-electrochemical systems that help in detecting and measuring magnetic fields.