Hand Written Notes

UEET Sem:- 6th

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Unit - 1

Electrolysis

1. **ElectroDeposition** :- It is the process of cutting a thin layer of one metal on top of different metal to modify its surface properties.

2. **Faraday's Laws of Electrolysis**

(i) **First Law** :- The first law states that the mass of ions liberated at an electrode is directly proportional to the quantity of electricity.

(ii) **Second Law** :- The masses of ions of different substances liberated by the same quantity of electricity are proportional to their chemical Equivalent weights.

3. **Current Efficiency and Energy Efficiency**

(i) **Current Efficiency** :- It is the ratio of the actual mass of a substance liberated from a electrolyte by the passage of current to the theoretical mass liberated according to Faraday's Law.

Energy Efficiency :-

Energy Efficiency is defined as

$$= \frac{\text{theoretical energy}}{\text{actual energy realised}}$$

4. Factors which affect the electro-deposition of metals are

(i) current Density.
(ii) Electrolyte Concentration.
(iii) Temperature.
(iv) Additional agents.
(v) Nature of electrolyte.
(vi) Nature of the metal on which the deposit is to be made.
(vii) Throwing power of the electrolyte.

Unit - 2

Electrical Heating

1. Electrical Heating used for Domestic Applications :- It includes

(i) Room Heater.
(ii) Immersion Heaters. of water heating.
(iii) Hot plates for cooking.

(iv) Electric kettles.
(v) Electric irons.

2. Electrical Heating used for Industrial Applications

(i) Melting of metals.
(ii) Moulding of glass.
(iii) Baking of insulator.
(iv) Enamelling of copper wires.

3. Advantage of Electrical Heating

(i) Cleaniness.
(ii) No pollution.
(iii) Economical.
(iv) Ease of control.
(v) Higher Efficiency.

4. Different Methods of Heat Transfer

(i) Conduction.
(ii) Convection.
(iii) Radiation.

(i) Conduction:- In this mode of Heat transfer, one molecule of the body gets heated and transfers some of the heat to the adjacent molecule and so on.

(ii) Convection:- In this process, heat is transferred by the flow of hot and cold air currents. This process is applied in the heating of water by immersion heater or heating of buildings. The quantity of heat absorbed by the body by convection depends on temp of heating element.

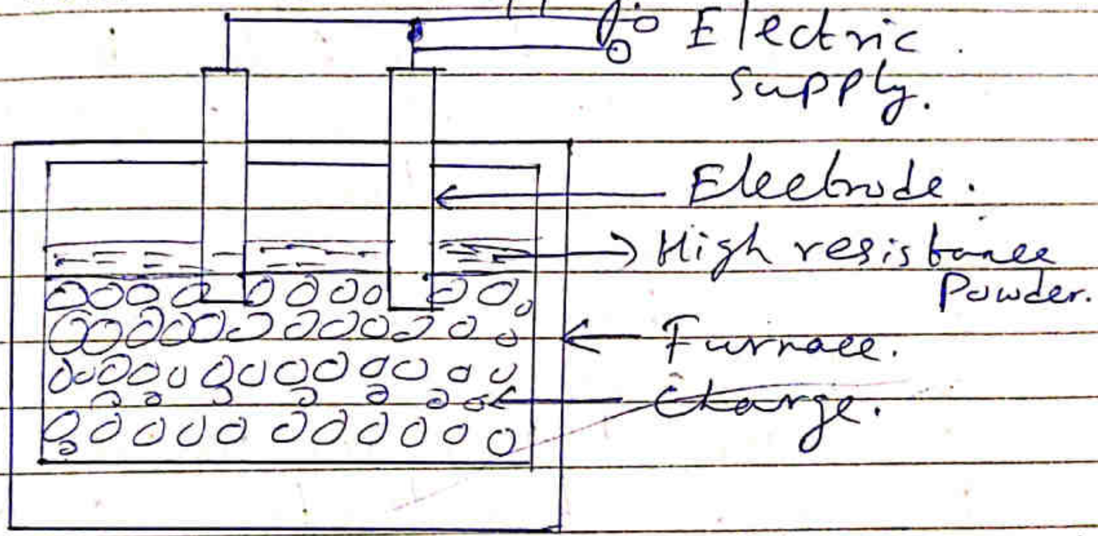
(iii) Radiation:- It is the transfer of heat from a hot body to a cold body in a straight line without affecting the intervening medium.

5. Resistance Heating:- It is based on the Power effect. When current is passed through a resistance element, "I^2R" loss takes place which produces Heat.

6. Direct Resistance Heating:

In this method the material (or charge) to be heated is treated as a resistance and current is passed through it.

The charge may in the form of powder, small solid pieces or liquid. Two electrodes are inserted in this charge and connected either a.c. or d.c supply.



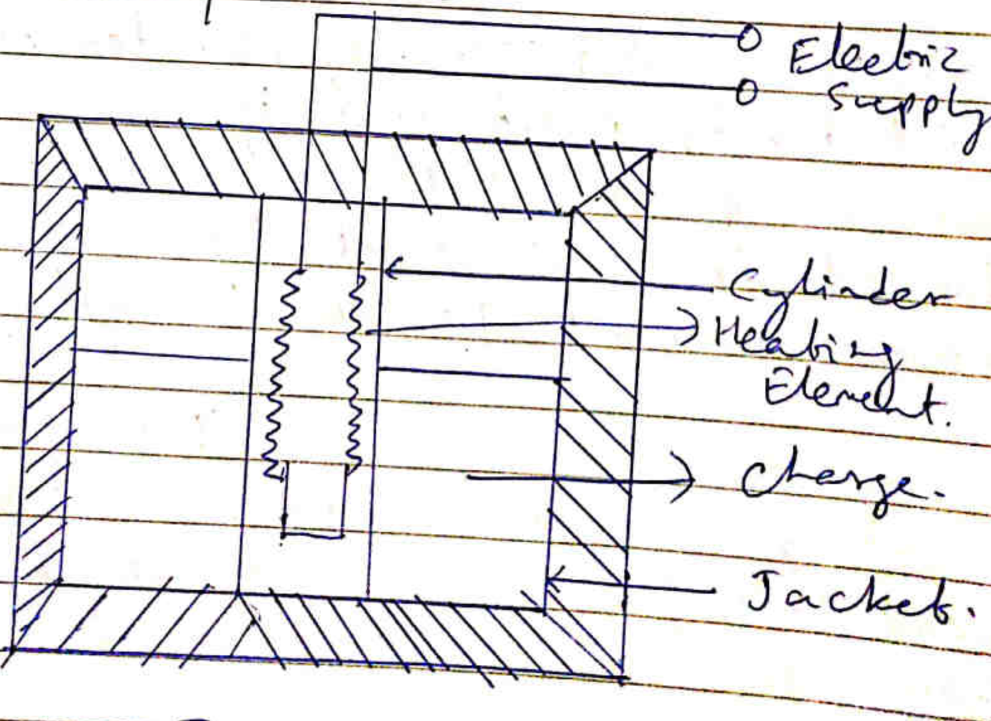
When the charge in the form of small pieces; a powder of high ~~resti~~ resistivity material is sprinkled over the surface of the charge to avoid direct short circuit. Heat is produced when current passes through it.

This method of heating has high efficiency because the heat is produced in the charge itself.

7. Indirect Resistance Heating

In this method of heating, electric current is passed through a resistive element which is placed in an electric oven. Heat produced ~~in the~~ is proportional to I^2R losses in the heating element.

The heat so produced is delivered to the charge either by radiation or convection or by a combination of the two. Sometimes, resistance is placed in a cylinder which is surrounded by the charge placed in the jacket as shown in fig below. This arrangement provides uniform temp. Moreover, automatic temp control can also be provided.



Figure

8. Temp Control of Resistance Furnaces

The temp of a resistance furnace can be changed by controlling power losses.

Two Methods used for temp Control:-

(1) Intermittent Switching.
(2) By changing the Number of Heating Elements.

1. "Intermittent Switching":- In this case, the furnace voltage is switched ON and OFF intermittently. When the voltage supply is switched off. Heat production within the surface is installed and hence its temp is reduced.

When the supply is restored, heat production starts and furnace temp begin to increase. Hence, by this simple method, the furnace temp can be limited between two limits.

(2) "By changing the Number of Heating Elements":- In this case, the number of heating elements is changed without cutting off the supply to the entire furnace.

Smaller the no of Heating Elements	→	Lesser the heat produced.

In the case of a 3-Phase circuit,

Equal number of heating elements is switched off from each phase in order to maintain a balanced load condition.

9. Arc Furnace

If a sufficiently high voltage is applied across an air-gap, the air becomes ionized and starts conducting in the form of a continious "spark" or "Arc" thereby producing intense heat.

When electrodes are made of carbon/graphite, the temp obtained is in the range of 3000°C to 3500°C. The high voltage required for striking the Arc can be obtained by using a step-up transformer fed from a variable a.c. supply as shown in figure.

A.C. Potential Divider

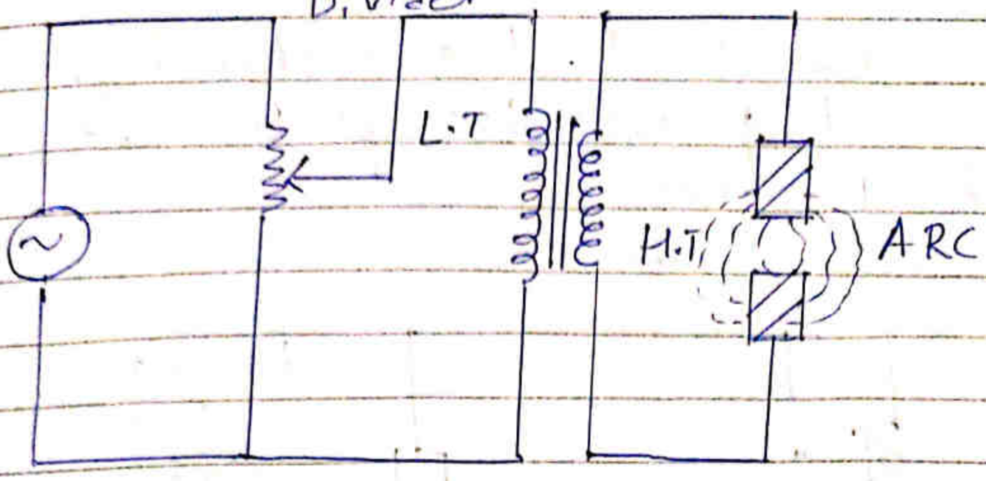


Fig.

Two Types of Arc Furnace :-

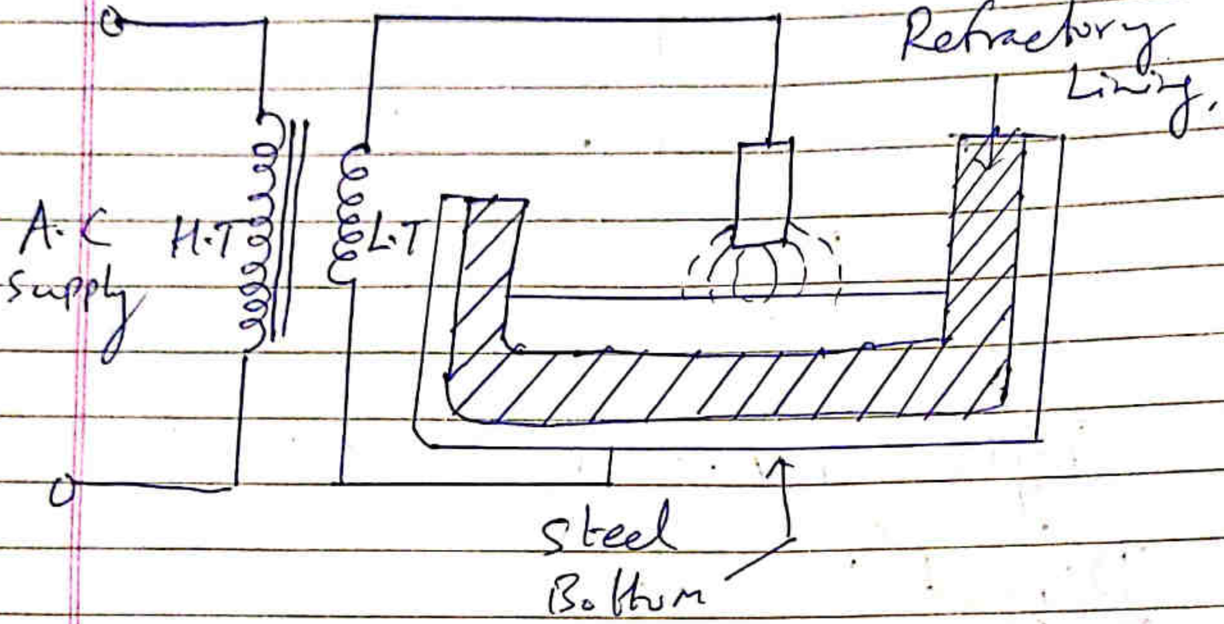
(i) Direct Arc Furnace.
(ii) InDirect Arc Furnace.

(i) Direct Arc Furnace :-

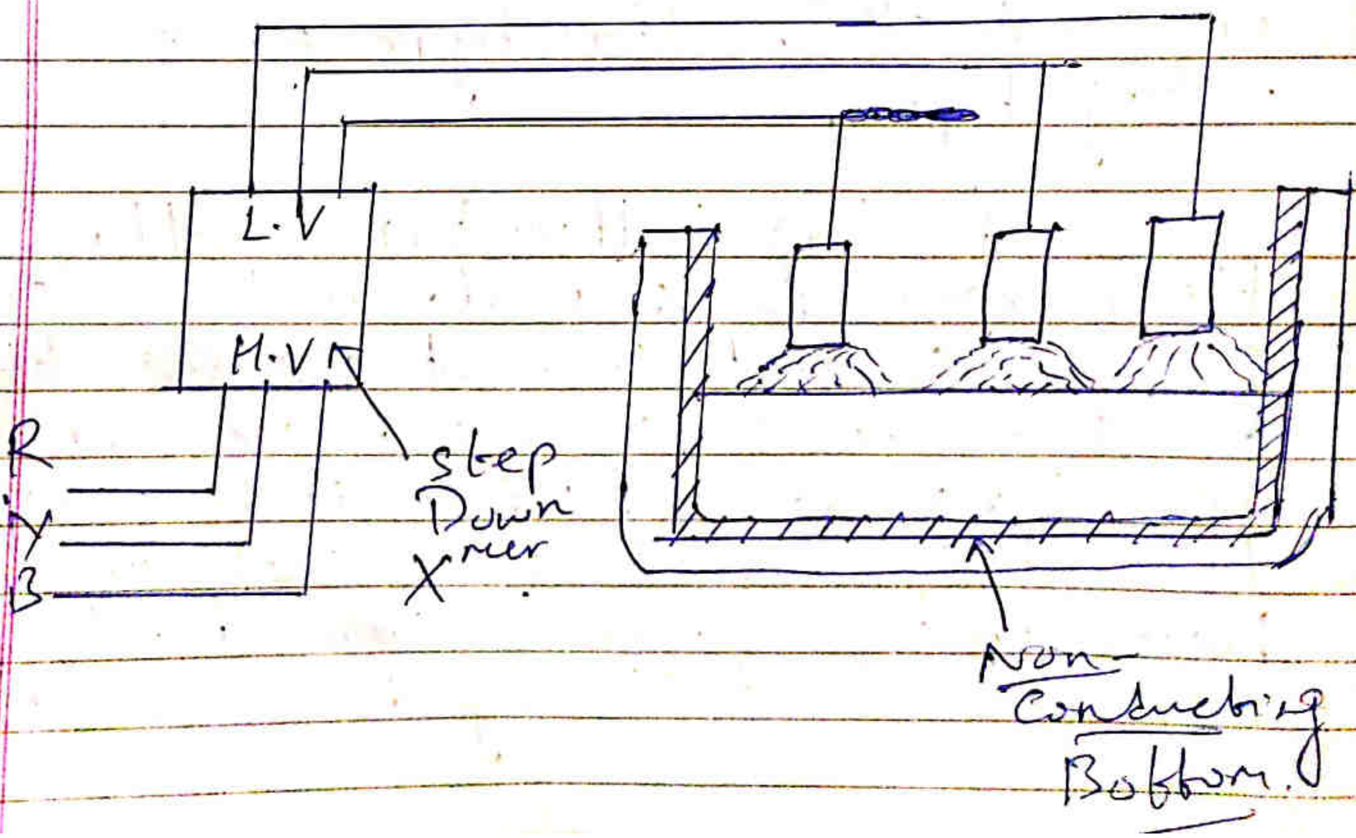
It could be either of conducting-bottom type or non-conducting type.

In conducting-bottom type, bottom of the furnace forms part of the electric circuit so that current passes through the body of the charge which offers very low resistances. Hence, it is possible to obtain high temp in such furnaces. Moreover, it produces uniform heating of charge without stirring it mechanically.

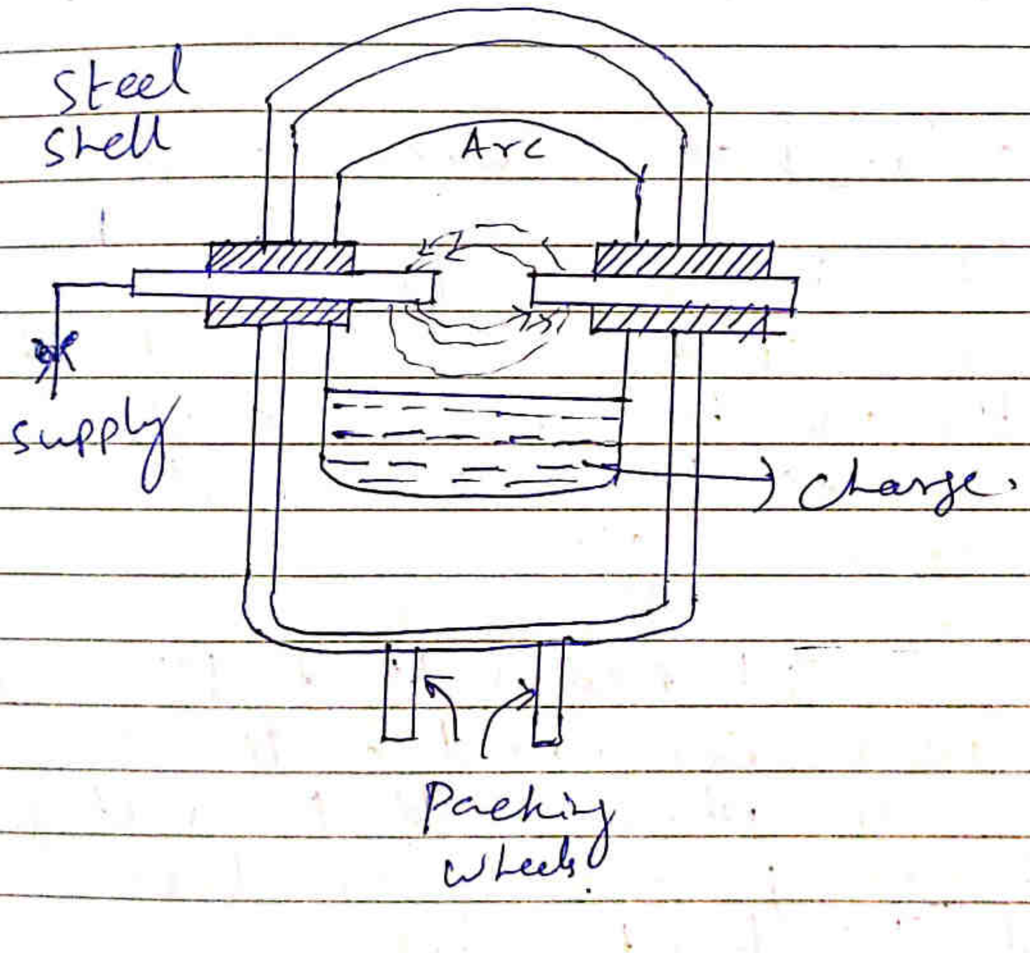
In nonconducting bottom type, no current passes through the body of the furnace.



(a)



(ii) Indirect Arc Furnace :- The arc is struck by short circuiting the electrodes manually or automatically for a moment and then, withdrawing them apart. The heat from the hot top layer of the charge is transferred to other parts of the charge by conduction.



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10. **Dielectric Heating:-** It is also called High frequency capacitive heating.

The supply frequency required for dielectric heating is between 10-50 MHz and applied voltage is upto 20kV.

Overall Efficiency of Dielectric Heating ≃ 50%

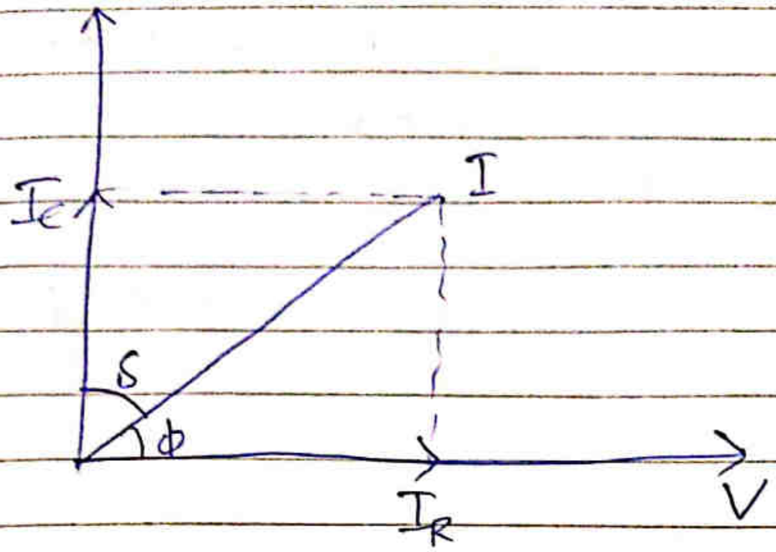
11. **Dielectric Loss:-** when a practical capacitor is connected across an a.c supply, it draws a current which leads the voltage by an angle ϕ, which is less than "90°" or falls short of 90° by an angle "δ".

It means that there is a certain component of the current which is in phase with the voltage and hence produces some loss called "Dielectric loss."

At normal supply frequency of "50Hz", loss is small.

At higher frequency, loss becomes large.

Vector diagram of Capacitor



Power drawn from supply $= VI\cos\phi$. ---(i)

Now, $I_C = I = \dfrac{V}{X_C} = 2\pi fCV$. ---(ii)

$\therefore P = V(2\pi fCV)\cos\phi$.

$= 2\pi fCV^2 \cos\phi$. --- (iii)

Now, $\phi = (90° - \delta)$

$\cos\phi = \cos(90° - \delta)$

$= \sin\delta = \tan\delta = \delta$ ---(iv)

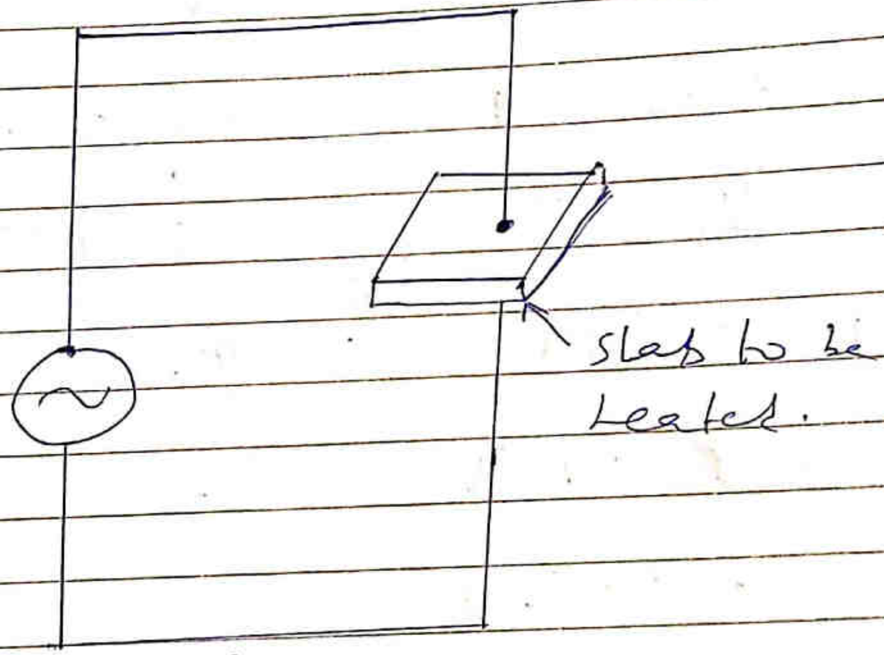
where δ is very small and is expressed radians.

$$\boxed{P = 2\pi fCV^2\delta \text{ Watts}} \quad \text{---(v)}$$

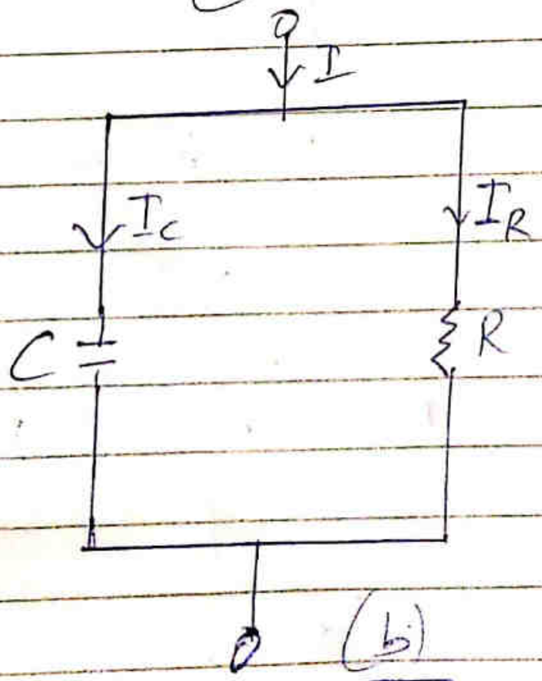
Here, $\boxed{C = \varepsilon_0 \varepsilon_r \dfrac{A}{d}}$ ——— (vi) where, 'd' is the thickness.

'A' is the surface area of the dielectric slab.

This power is converted into heat.



(a)



(b)

Unit - 3

Welding

1. **Definition**:- It is the Process of joining two Pieces of metal or non-metal at faces rendered plastic or liquid by the application of heat or pressure or Both.

Filler material may be used to effect the Union.

2. **Welding Processes**

(A) Fusion Welding:- It involves melting of the Parent Metal.

Example:- (i) Carbon Arc welding.
(ii) Thermal welding.

(B) Non-Fusion Welding:- It does not involves melting of the Parent metal.

Example:-

(i) Forge welding.
(ii) Explosive welding.
(iii) Resistance welding.

3. **Proper selection of welding Process**:- depends on

(a) Kind of metals to be joined.

(b) Cost involved.

(c) nature of Products to be fabricated.

(d) Production techniques adopted.

4. **Formation of Electric Arc**:- An electric Arc is formed whenever electric current is passed between two metallic electrodes which are separated by a short distance from eachother.

The arc is started by momentarily touching the positive electrode (anode) to the negative metal (or plate) and then withdrawing it to about 3 to 6 mm from the plate.

When electrode first touches the plate, a large short circuits current flows and as it is later withdrawn from the plate.

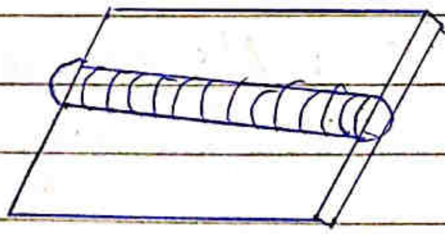
when electrode first touches the plate a large short circuit current flows and as it is later withdrawn from the plate, current continues to flow in the form of a spark across the airgap so formed.

Due to this spark, the air in the gap becomes ionized i.e is split into negative electrons and positive ions.

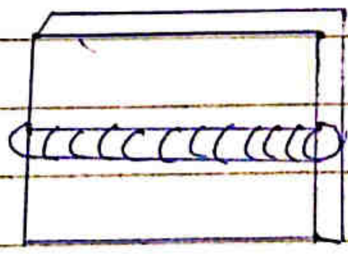
Consequently, air becomes conducting and current is able to flow across the gap in the form of an arc.

Four Positions of Arc Welding

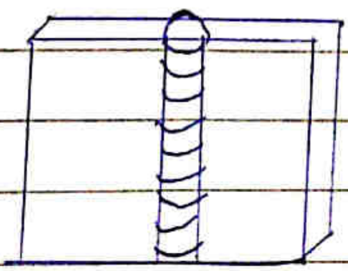
(i) Flat Position.



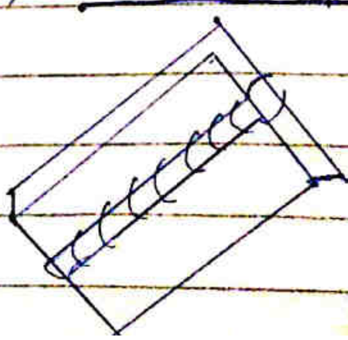
(ii) Horizontal Position.



(iii) Vertical Position.



(iv) Overhead Position



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Unit-4

ILLUMINATION

1. **Luminous Intensity:-** Luminous intensity in any given direction is the luminous flux emitted by the source per unit solid angle, measured in the direction in which the intensity is required.

It is denoted by symbol "I" and is measured in candela (cd) or lumens per steradian.

2. **Lumen:-** The Lumen is the unit of luminous flux and is defined as the amount of luminous flux given out in a space represented by one unit of solid angle by a source having an intensity of one candle power in all directions.

i.e. Lumens = Candle power × solid angle

$= CP \times \omega$.

Total lumens given out by Source of one Candela is 4π lumens

3. Illumination:- when the light falls upon any surface, the phenomenon is called the illumination.

It is defined as number of number of lumens, falling on the surface per unit area. It is denoted by "E".

$$E = \frac{F}{A}$$ lumens per meter.

4. Mean Horizontal Candle Power (M.H.C.P):-

It is defined as the mean of candle powers in all directions in horizontal plane containing the source of light.

5. Mean Spherical Candle Power (M.S.C.P):-

It is defined as the mean of candle powers in all directions and in all planes from the source of light.

6. Laws of Illumination

Two laws of illumination

(i) Inverse Square Law.

(ii) Lambert's Cosine Law.

(i) Inverse Square Law:-

"The illumination of a surface is inversely proportional to the square of the distance between surface and light source provided that the distance between the surface and source is sufficiently large so that the source can be regarded as a point of source."

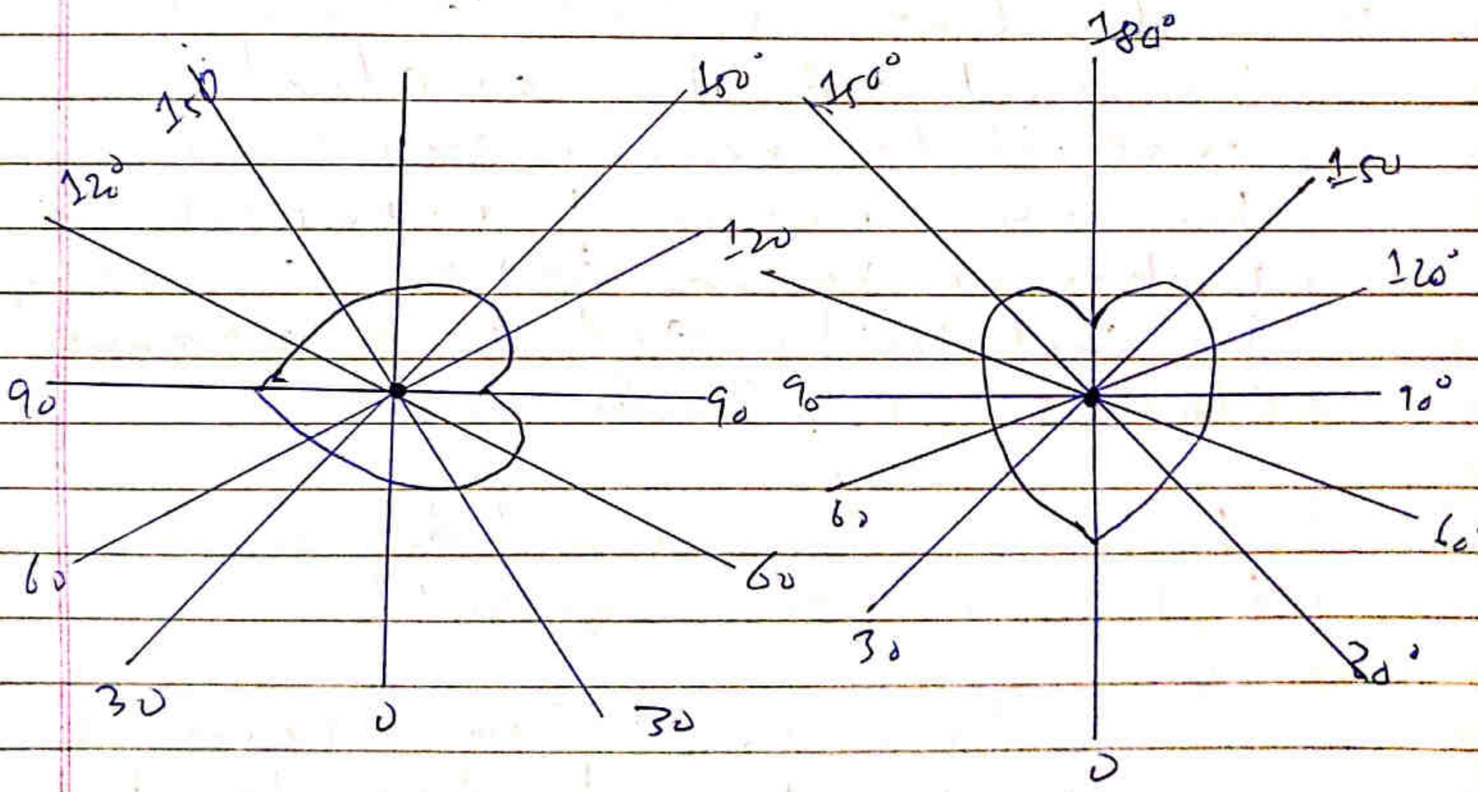
(ii) Lambert's Cosine Law:-

This law states that the illumination at any point on a surface is proportional to the cosine of the angle between normal at that point and direction of luminous flux.

Polar Curve

If the luminous intensity in a horizontal plane passing through the lamp is plotted against angular position, then this curve is known as "Horizontal polar curve." [Fig(a)].

If the luminous intensity in a vertical plane is plotted against angular position, then curve is known as vertical polar curve. [Fig(b)].



(a)   (b)

Unit - 5

Industrial Drive

1. **Group Drive** :- where a no of machines are driven through Belts from a common shaft is known as group drive.

2. **Individual Drive** :- In this case there is a separate driving motor for each machines. such a drive common is very common in most of the industries.

3. **Selection of Motors** :- Due to universal adoption of electric drive, it has become necessary for the manufacturer to manufacture motors of various design according to suitability and use in various classes of Industries.

Following Factors will decide the type of motor required :-

(i) Electrical Characteristics.
(ii) Mechanical Characteristics.
(iii) Size and Rating of Motors.
(iv) Cost.

Starting Torque of D.C. Motors

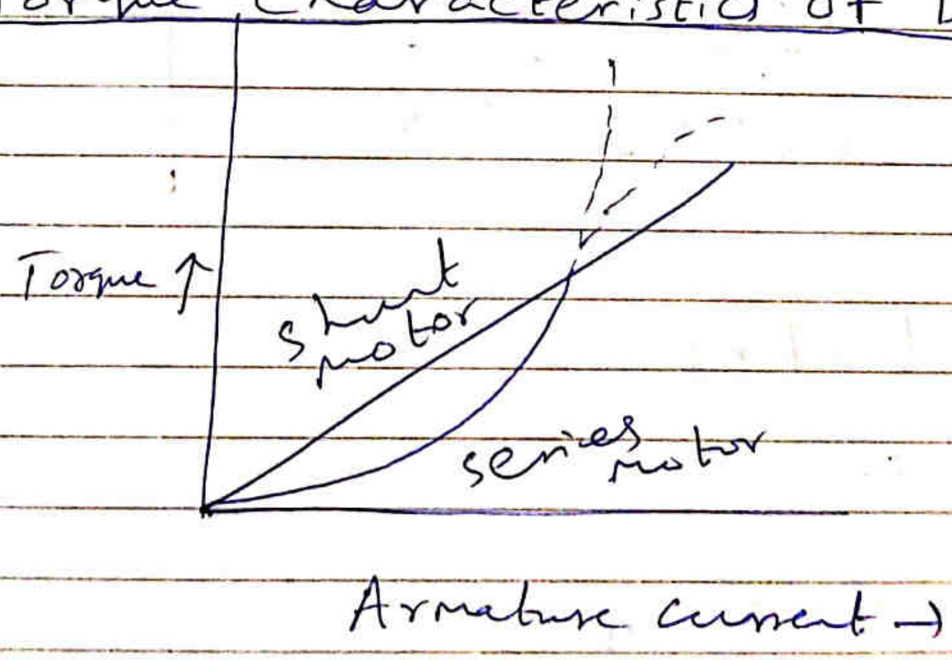
Gross torque T_g is given as:-

$$T_g = \frac{1}{2\pi} \times \frac{\phi Z P I_a}{A} \text{ N. Nw.}$$

$$= 0.159 \times \frac{\phi Z P I_a}{A} \text{ N. Nw.}$$

$$T_g = 0.0162 \frac{\phi Z P I_a}{A} \text{ M Kg.}$$

Torque characteristics of D.C. Motor



Three-Phase Induction Motors

Then, the torque,

T, is given by

$$T = K \frac{V^2 r_2'/s}{\left(r_1 + \frac{r_2}{s}\right)^2 + \left(x_1 + x_2'\right)^2}$$

Stator current per phase is :-

$$I = \frac{V}{\sqrt{\left(r_1 + \frac{r_2}{s}\right)^2 + \left(x_1 + x_2'\right)^2}}$$

At starting,

$s = 1$.

starting Torque,

$$T_s = \frac{V^2 r_2'}{(r_1 + r_2')^2 + (x_1 + x_2')^2}$$

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Unit - 6 :-

Electric Traction

1. Electric Traction :- The system of traction involving the use of electricity is known as Electric Traction.

2. **System of Traction**

    1. Direct steam Engine Drive.
    2. Direct internal combustion engine drive.
    3. steam electric drive.
    4. Petrol electric traction.
    5. Electric Drive.

3. **Braking** :- In traction work both electrical and mechanical braking are employed for bringing the vechile to rest. Electrical braking cannot do away the mechanical brakes, since a vechiles cannot be held stationary by its use.

For D.C. motors,

Three methods employed for electric braking :-

(i) plugging.

(ii) Reostatic Braking.

(iii) Regenerative Braking.