JNIT College

Sub: EHV AC/DC transmission

I- Mid term

Ans 1) Bundled conductors :-

It is made up of 2 or more than two conductors and is used as one phase conductor.

Bundled conductor are preferred to use above 220 KV.

Need of Bundled Conductor :-

1) Overhead Shielding Wire

Protection from bad weather & direct lightening strokes overhead shielding wire are used because they are made up of galvanised steel with angle of protection with reference to vertical phase is 30° to 45°.

2) Conductors material

Conductors should be made of high tensile strength. It should be consist of reinforced & alumunium with lower weight ACSR.

3) Reactance

It reduced reactance in the transmission line.

4) Reduction of Corona loss & Surge Impedance

Bundled conductor reduces corona losses & Surge Impedance.

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2) Ans → Corona:-

The phenomenon of corona is accompanied by hissing noise & production of Ozone, power loss & radio interference

factors affecting the corona:-

1) Atmosphere:
An corona is formed due to ionization of air surrounding the conditions of the conductor, it is affected by physical state of atmosphere.

2) Conductor Size
The corona effect depends upon the shape & condition of the conductor.

3) Spacing between Conductor
If the spacing between the conductor is made very large compared their diameter, there may not be corona effect.

4) Line Voltage
The line voltage greatly affected by corona. If it is low there is no change in condition of air surrounding the conductors & hence no corona is formed.

Ans 3) Advantages of Series Compensation in EHV System:-

i) Increase in power transfer capability

$$P_1 = \frac{V_S V_R}{X_L} \sin\delta$$

$$P_2 = \frac{V_S V_R}{X_L - X_C} \sin\delta$$

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$$\therefore \frac{P_1}{P_2} = \frac{X_L}{X_L - X_c} = \frac{1}{1 - \frac{X_c}{X_L}} = \frac{1}{1-k}$$ (3)

where $k = \frac{X_c}{X_L}$ = degree of compensation

ii) Improvement in system stability

The reduced value of δ gives higher stability for same power transfer & for the same value of sending and receiving end voltage

iii) Load division among parallel line

Series compensation are used in transmission system for improving the load division between parallel lines.

~~iv) Load division among parallel lines~~

iv) Voltage regulation

There is an automatic change in reactive power with change in ~~voltage~~ current. Thus, Voltage drops due to sudden load variations can be corrected instantly.

The problems associated with series compensation are-

i) Sub - Synchronous resonance

The series capacitor introduces a sub-synchronous frequency in the system. In some cases, this frequency may interact with steam turbine generator shaft and give rise to high torsional stresses.

ii) Line Protection

Series compensation can lead to false ~~Preparation~~ operation of the distance relays of the line protection if degree of compensation & capacitor location are not proper.

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iii) Ferroresonance

When an unloaded or lightly loaded transformer is energized through a series compensated lines, ferroresonance may occur.

iv) High recovery voltage

Series capacitor produces high recovery voltages across the circuit breaker contacts which may damage circuit breaker.

4) Ans → Speed governing System/speed governor Controller System:

When the steam enters, speed changer setting is raised, A (lower), C (raises), D (lower) and subsequently E goes down. High pressure enters through upper opening of main piston which then moves main piston downwards. This opens main control valves and more steam enters.

Thus, for small increments,

$$\Delta P_e = \Delta P_{SI} - \frac{1}{R} \Delta f \ (MW) \quad \text{——— (1)}$$

where Δf = frequency drop in Hz/MW

$$\%\ \text{Regulation} = \frac{\text{change in frequency}}{\text{change in power}} \times 100$$

or

$$\%\ R = \frac{\Delta f}{\Delta P} \times 100$$

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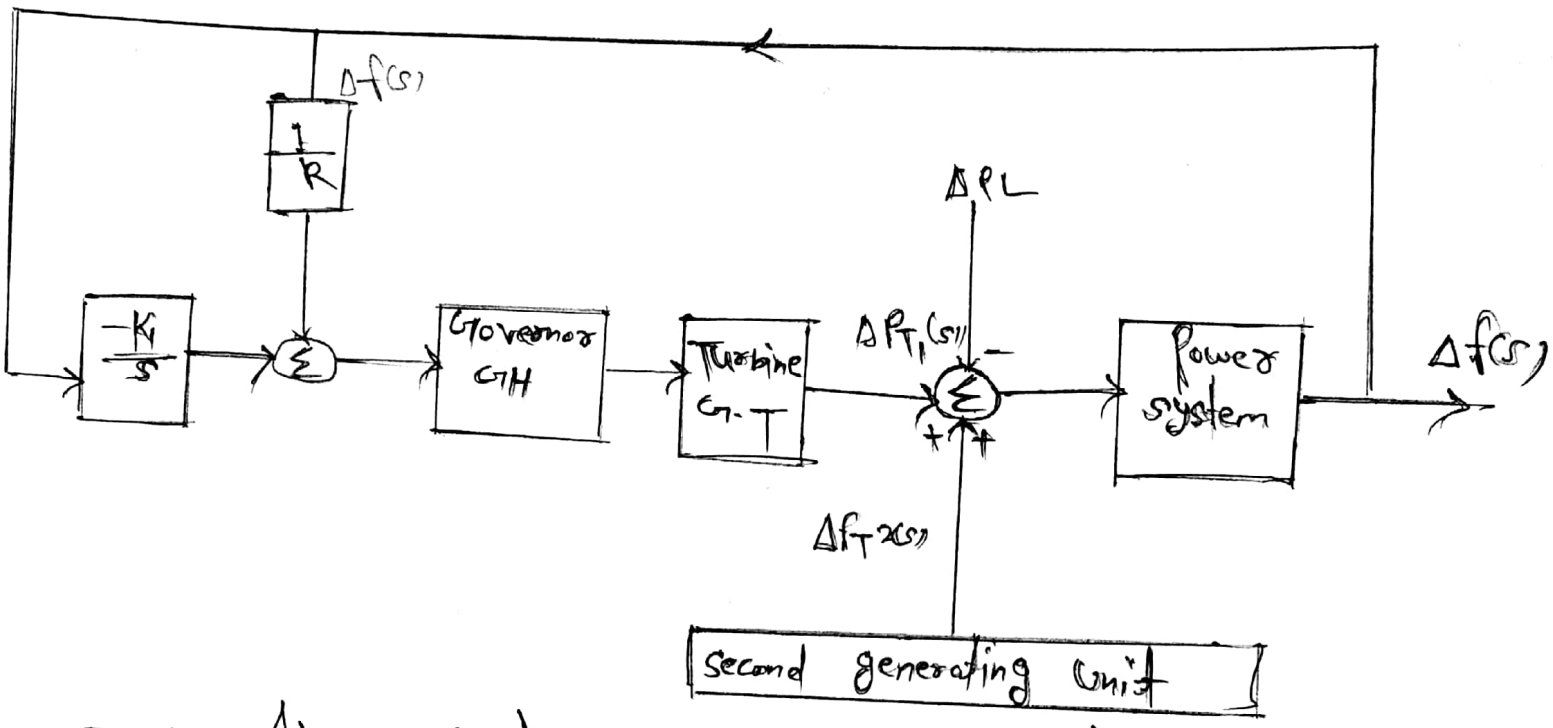

⟹ fig ⇒ speed governor Controller system

5) for unit I,

$P_1 = 500$ MW

Turbine Regulation = 0.05

$\Delta f = 50 \times 0.05 = 2.5$ Hz

$R_1 = \frac{\Delta f}{P_1} = 0.0125$ Hz/MW ——— (1)

For unit II

$P_2 = 400$ MW

Turbine Regulation = 0.05

$\Delta f = 0.05 \times 50 = 2.5$ Hz

$R_2 = \frac{2.5}{400} = 0.00625$ Hz/MW ——— (2)

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From (1) & (2);

$$\frac{\Delta P_1}{\Delta P_2} = \frac{\Delta f}{R_1} \times \frac{R_2}{\Delta f} = \frac{R_2}{R_1}$$

$$\frac{\Delta P_1}{\Delta P_2} = \frac{0.00625}{0.0125} = 0.5$$

Ratio of load sharing = 0.5

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JNIT
JAGANNATH GUPTA INSTITUTE OF ENGINEERING & TECHNOLOGY JAIPUR
II-Mid Term Examination Session 2017-2018
B.Tech …IV… Year …VIII… Semester

Branch: EE **Subject: UEP**
Time: **SubjectCode:7EE**
Date: **Max. Marks: 20**

Note: Attempt any four questions out of five questions.

Q1. Explain different methods of Electric Heating.

Ans:

Electric heating is a process in which electrical energy is converted to heat. Common applications include space heating, cooking, water heating and industrial processes. An **electric heater** is an electrical device that converts electric current to heat.[1] The heating element inside every electric heater is an electrical resistor, and works on the principle of Joule heating: an electric current passing through a resistor will convert that electrical energy into heat energy. Most modern electric heating devices use nichrome wire as the active element; the heating element, depicted on the right, uses nichrome wire supported by ceramic insulators.

Alternatively, a heat pump uses an electric motor to drive a refrigeration cycle, that draws heat energy from a source such as the ground or outside air and directs that heat into the space to be warmed. Some systems can be reversed so that the interior space is cooled and the warm air is discharged outside or into the ground.

Space heating

Space heating is used to warm the interiors of buildings. Space heaters are useful in places where air-handling is difficult, such as in laboratories. Several methods of electric space heating are used.

Electric radiant heating uses heating elements that reach a high temperature. The element is usually packaged inside a glass envelope resembling a light bulb and with a reflector to direct the energy output away from the body of the heater. The element emits infrared radiation that travels through air or space until it hits an absorbing surface, where it is partially converted to heat and partially reflected. This heat directly warms people and objects in the room, rather than warming the air. This style of heater is particularly useful in areas through which unheated air flows. They are also ideal for basements and garages where spot heating is desired. More generally, they are an excellent choice for task-specific heating.

Radiant heaters operate silently and present the greatest potential danger of ignition of nearby furnishings due to the focused intensity of their output and lack of overheat protection. In the

United Kingdom, these appliances are sometimes called electric fires, because they were originally used to replace open fires.

The active medium of the heater depicted in this section is a coil of nichrome resistance wire inside a fused silica tube, open to the atmosphere at the ends, although models exist where the fused silica is sealed at the ends and the resistance alloy is not nichrome.

Convection heaters

In a convection heater, the heating element heats the air in contact with it by thermal conduction. Hot air is less dense than cool air, so it rises due to buoyancy, allowing more cool air to flow in to take its place. This sets up a convection current of hot air that rises from the heater, heats up the surrounding space, cools and then repeats the cycle. These heaters are sometimes filled with oil. They are ideally suited for heating a closed space. They operate silently and have a lower risk of ignition hazard if they make unintended contact with furnishings compared to radiant electric heaters.

Fan heaters

A fan heater, also called a forced convection heater, is a variety of convection heater that includes an electric fan to speed up the airflow. They operate with considerable noise caused by the fan. They have a moderate risk of ignition hazard if they make unintended contact with furnishings. Their advantage is that they are more compact than heaters that use natural convection and are also cost-efficient for portable and small room heating systems.

Storage heating

A storage heating system takes advantage of cheaper electricity prices, sold during low demand periods such as overnight. In the United Kingdom, this is branded as Economy 7. The storage heater stores heat in clay bricks, then releases it during the day when required. Newer storage heaters are able to be used with various tariffs. Whilst they can still be used with economy 7, they can be used with day-time tariffs. This is due to the modern design features that are added during manufacturing. Alongside new designs the use of a thermostat or sensor has improved the efficiency of the storage heater. A thermostat or sensor is able to read the temperature of the room, and change the output of the heater accordingly.

Water can also be used as a heat-storage medium.

Domestic electrical under-floor heating

An electric underfloor heating system has heating cables embedded in the floor. Current flows through a conductive heating material, supplied either directly from the line voltage (120 or 240 volts) or at low voltage from a transformer. The heated cables warm the flooring by direct conduction and will switch off once it reaches the temperature set by the floor thermostat. A warmer floor surface radiates heat to colder surrounding surfaces (ceiling, walls, furniture.) which absorb heat and reflects all non absorbed heat to yet other still cooler surfaces. The cycle of radiation, absorption and reflection starts slowly and slows down slowly nearing set point temperatures and ceases to take place once equilibrium is reached all-round. A floor thermostat

or a room thermostat or combination controls the floor on/off. In the process of radiant heating a thin layer of air which is in touch with the warmed surfaces also absorbs some heat and this creates a little convection (air circulation). Contrary to believe people are not heated by this warmed circulating air or convection (convection has a cooling effect) but are heated by the direct radiation of the source and reflection of its surrounds. Comfort is reached at lower air temperature due to eliminating circulating air. Radiant heating experiences highest comfort levels as people's own energy (± 70 Watt for an adult) (must radiate out in heating season) is in balance with its surrounds. Compared to convection heating system based on academic research the air temperatures may be lowered by up to 3 degrees. One variation is using tubes filled with circulating hot water as heat source for warming the floor. The heating principle remains the same. Both old style electric and warm water (hydronic) underfloor heating systems embedded in the floor construction are slow and cannot respond to external weather changes or internal demand/lifestyle requirements. The latest variant places specialized electric heating systems and blankets directly under the floor-decor and on top of additional insulation all placed on top of construction floors. Construction floors stay cold. The principle change of heat source positioning allows it to respond within minutes to changing weather and internal demand requirements such as life style being in/out, at work, rest, sleep, more people present/cooking, etc.

Lighting system

In large office towers, the lighting system is integrated with the heating and ventilation system. Waste heat from fluorescent lamps is captured in the return air of the heating system; in large buildings a substantial part of the annual heating energy is supplied by the lighting system. However, this waste heat becomes a liability when using air conditioning. Such expenses can be avoided by integrating an energy efficient lighting system that also creates an electric heat source

Heat pumps

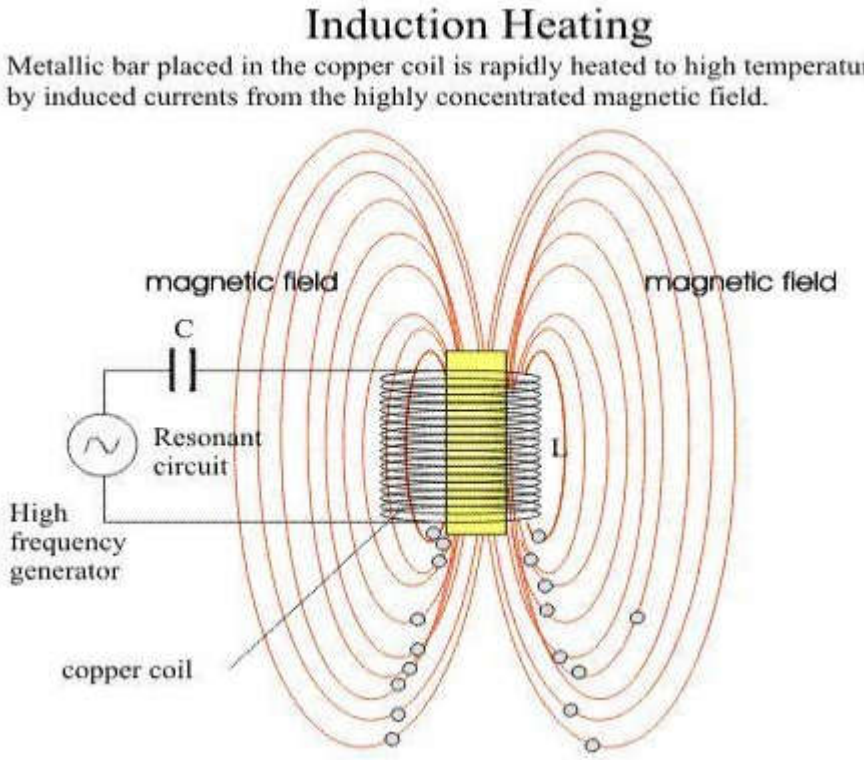
A heat pump uses an electrically driven compressor to operate a refrigeration cycle that extracts heat energy from outdoor air, the ground or ground water, and moves that heat to the space to be warmed. A liquid contained within the evaporator section of the heat pump boils at low pressure, absorbing heat energy from the outdoor air or the ground. The vapor is then compressed by a compressor and piped into a condenser coil within the building to be heated. The heat from the hot dense gas is absorbed by the air in the building (and sometimes also used for domestic hot water) causing the hot working fluid to condense back into a liquid. From there the high pressure fluid is passed back to the evaporator section where it expands through an orifice and into the evaporator section, completing the cycle. In the summer months, the cycle can be reversed to move heat out of the conditioned space and to the outside air.

Heat pumps may obtain low-grade heat from the outdoor air in mild climates. In areas with average winter temperatures well below freezing, ground source heat pumps are more efficient than air-source heat pumps because they can extract residual solar heat stored in the ground at warmer temperatures than is available from cold air.[4] According to the US EPA, geothermal heat pumps can reduce energy consumption up to 44% compared with air source heat pumps and up to 72% compared with electric resistance heating.[5] The high purchase price of a heat pump vs resistance heaters may be offset when air conditioning is also needed.

Q2. Explain the Induction Heating and its types.
Ans:

Induction heating is the process of heating an electrically conducting object (usually a metal) by electromagnetic induction, through heat generated in the object by eddy currents. An induction heater consists of an electromagnet, and an electronic oscillator that passes a high-frequency alternating current (AC) through the electromagnet. The rapidly alternating magnetic field penetrates the object, generating electric currents inside the conductor called eddy currents. The eddy currents flowing through the resistance of the material heat it by Joule heating. In ferromagnetic (and ferrimagnetic) materials like iron, heat may also be generated by magnetic hysteresis losses. The frequency of current used depends on the object size, material type, coupling (between the work coil and the object to be heated) and the penetration depth.

An important feature of the induction heating process is that the heat is generated inside the object itself, instead of by an external heat source via heat conduction. Thus objects can be heated very rapidly. In addition there need not be any external contact, which can be important where contamination is an issue. Induction heating is used in many industrial processes, such as heat treatment in metallurgy, Czochralski crystal growth and zone refining used in the semiconductor industry, and to melt refractory metals which require very high temperatures. It is also used in induction cooktops for heating containers of food; this is called induction cooking



The following are different types of induction furnaces

1. Core type furnaces

a. Direct core type induction furnace
b. Vertical core type induction furnace
c. Indirect core type induction furnace

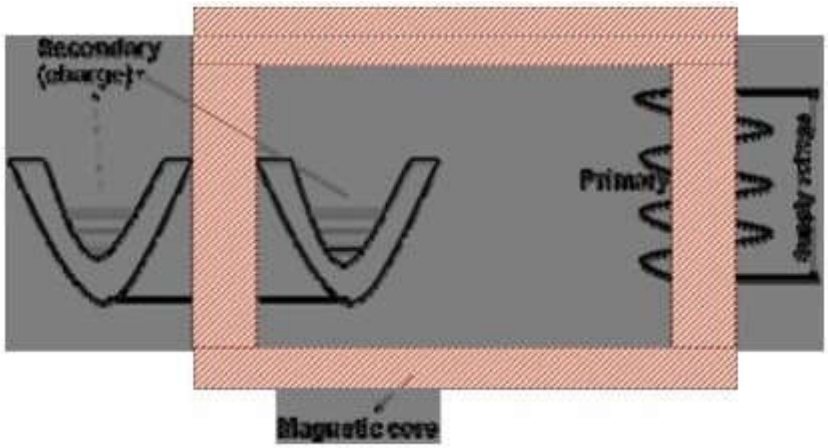
2. Core less type furnaces

Direct core type:

The direct core type induction furnace is shown ion fig.

It consist of an iron core, crucible and primary winding connected to an a.c supply.

The charge is kept in the cruicible, which forms a single turn short circuited secondary circuit.



The current in the charge is very high in the order of several thousand amperes. The charge is magnetically coupled to the primary winding.

The change is melted because of high current induced in it. When there is no molten metal, no current will flow in the secondary.

To start the furnace molten metal is poured in the oven from the previous charge.

This type of furnace has the following drawbacks:

The magnetic coupling between the primary and secondary is very weak, therefore the leakage reactance is very high. This causes low power factor.

Low frequency supply is necessary because normal frequency causes turbulence of the charge.

If current density exceeds about 5 amps/mm2 the electromagnetic force produced by this current density causes interruption of secondary current.

Hence the heating of the metal is interrupted. It is called pinch effect.

The crucible for the charge id of odd shape and inconvenient from the metallurgical point of view.

The furnace cannot function if the secondary circuit is open.

It must be closed. For starting the furnace either molten metal is poured into the crucible or sufficient molten metal is allowed to remain in the crucible from the previous operation.

Such furnace is not suitable for intermittent services.

Indirect core type induction furnace:

In this type of furnace induction principle has been used for heating metals.

In such furnace an inductively heated element is made to transfer its heat to the change

When the primary winding is connected to the supply, current is induced in the secondary of the metal container.

So heat is produced due to induced current. This heat is transmitted to the charge by radiation.

The portion AB of the magnetic circuit is made up of a special alloy and is kept inside the chamber of the furnace.

The special alloy will loose its magnetic properties at a particular temperature and the magnetic properties are regained when the alloy will cooled.

As soon as the furnace attains the critical temperature the reluctance of the magnetic circuit increases many times and the inductive effect correspondingly decreases thereby cutting off the heat supply.

The bar AB is removable type and can be replaced by other, having different critical temperature. Thus the temperature of the furnace can be controlled very effectively.

Coreless induction furnace:

Coreless induction furnace also operates on the principle of transformer. In this furnace there is no core and thus the flux density will be low.

Hence for compensating the low flux density, the current supplied to the primary should have sufficiently high frequency.

The flux set up by the primary winding produces eddy currents in the charge. The heating effect of the eddy currents melts the charge.

Stirring of the metals takes place by the action of the electromagnetic forces. Coreless furnace may be having conducting or non conducting containers.

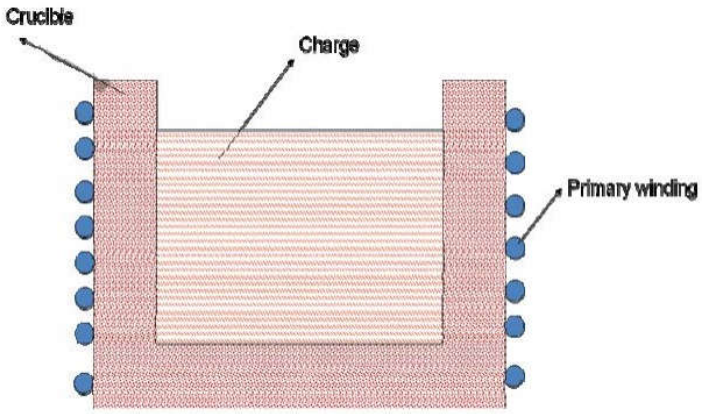
Fig shows a coreless induction furnace in which container is made up of conducting material.

The container acts as secondary winding and the charge can have either conducting or non conducting properties.

Thus the container forms a short circuited single turn secondary. Hence heavy current induced in it and produce heat.

The flux produced by the primary winding produces eddy currents in the charge. The heating effects of the eddy currents melt the charge.

Stirring action in the metals takes place by the action of the electromagnetic forces.



Advantages:

- ✓ Time taken to reach the melting temperature is less.
- ✓ Accurate power control is possible.
- ✓ Any shape of crucible can be used.
- ✓ The eddy currents in the charge results in automatic stirring.
- ✓ Absence of dirt, smoke, noise, etc.
- ✓ Erection cost is less.

Q3 Write short note on Welding Methods in detail.

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing fusion, which is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal. In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that is usually stronger than the base material. Pressure may also be used in conjunction with heat, or by itself, to produce a weld. Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized.

Although less common, there are also solid state welding processes such as friction welding in which metal does not melt.

Some of the best known welding methods include:

- Oxy-fuel welding – also known as oxyacetylene welding or oxy welding, uses fuel gases and oxygen to weld and cut metals.
- Shielded metal arc welding (SMAW) – also known as "stick welding" or "electric welding", uses an electrode that has flux around it to protect the weld puddle. The electrode holder holds the electrode as it slowly melts away. Slag protects the weld puddle from atmospheric contamination.
- Gas tungsten arc welding (GTAW) – also known as TIG (tungsten, inert gas), uses a non-consumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by an inert shielding gas such as argon or helium.
- Gas metal arc welding (GMAW) – commonly termed MIG (metal, inert gas), uses a wire feeding gun that feeds wire at an adjustable speed and flows an argon-based shielding gas or a mix of argon and carbon dioxide (CO_2) over the weld puddle to protect it from atmospheric contamination.
- Flux-cored arc welding (FCAW) – almost identical to MIG welding except it uses a special tubular wire filled with flux; it can be used with or without shielding gas, depending on the filler.
- Submerged arc welding (SAW) – uses an automatically fed consumable electrode and a blanket of granular fusible flux. The molten weld and the arc zone are protected from atmospheric contamination by being "submerged" under the flux blanket.
- Electroslag welding (ESW) – a highly productive, single pass welding process for thicker materials between 1 inch (25 mm) and 12 inches (300 mm) in a vertical or close to vertical position.

- Electric resistance welding (ERW) – a welding process that produces coalescence of laying surfaces where heat to form the weld is generated by the electrical resistance of the material. In general, an efficient method, but limited to relatively thin material.

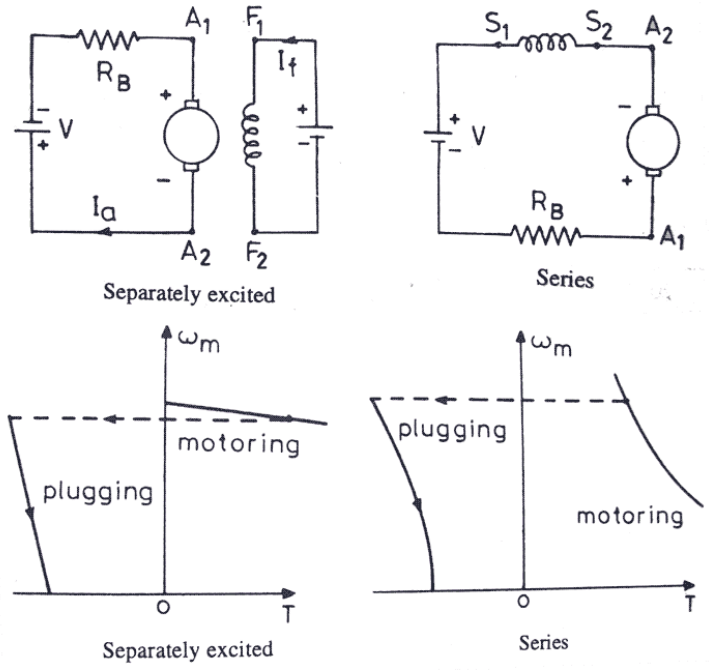
Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding may be performed in many different environments, including in open air, under water, and in outer space. Welding is a hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to intense ultraviolet radiation.

Until the end of the 19th century, the only welding process was forge welding, which blacksmiths had used for millennia to join iron and steel by heating and hammering. Arc welding and oxyfuel welding were among the first processes to develop late in the century, and electric resistance welding followed soon after. Welding technology advanced quickly during the early 20th century as the world wars drove the demand for reliable and inexpensive joining methods. Following the wars, several modern welding techniques were developed, including manual methods like SMAW, now one of the most popular welding methods, as well as semi-automatic and automatic processes such as GMAW, SAW, FCAW and ESW. Developments continued with the invention of laser beam welding, electron beam welding, magnetic pulse welding (MPW), and friction stir welding in the latter half of the century. Today, the science continues to advance. Robot welding is commonplace in industrial settings, and researchers continue to develop new welding methods and gain greater understanding of weld quality.

Q4 What are Plugging Electric Barking in detail.

Another type of braking is **Plugging type braking**. In this method the terminals of supply are reversed, as a result the generator torque also reverses which resists the normal rotation of the motor and as a result the speed decreases. During plugging external resistance is also introduced

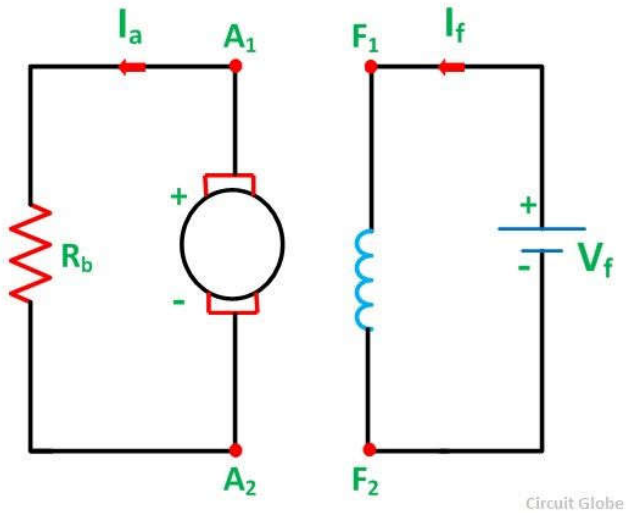
into the circuit to limit the flowing current. The main disadvantage of this method is that here power is wasted.



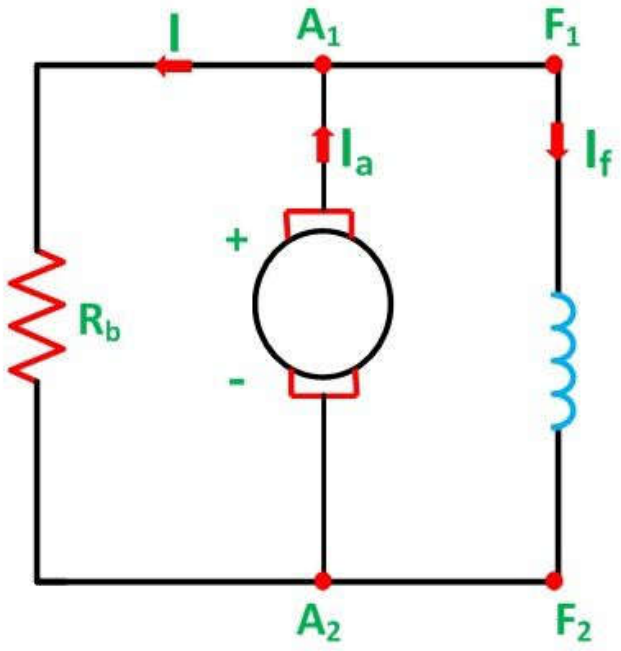
Q5. Explain Rheostatic Braking in detail.

Ans: Braking resistor Rb is connected across the armature as soon as the DC motor is disconnected from the supply mains. The motor now works as a generator, producing the braking torque.For the braking operation in Dynamic Braking, the motor is connected in two ways.

Firstly the separately excited or shunt motor can be connected either as a separately excited generator, where the flux is kept constant. The second way is that it can be connected to a self-excited shunt generator, with the field winding in parallel with the armature.



The connection diagram is shown below when braking with self-excitation is performed.



This method is also known as **Rheostatic Braking** because an external braking resistance R_b is connected across the armature terminals for electric braking. During an electric braking, the kinetic energy stored in the rotating parts of the machine and the connected load is converted into electric energy, when the motor is working as a generator. The energy is dissipated as heat in the braking resistance R_b and armature circuit resistance R_a.