ELECTRICAL MACHINES

DC Machine

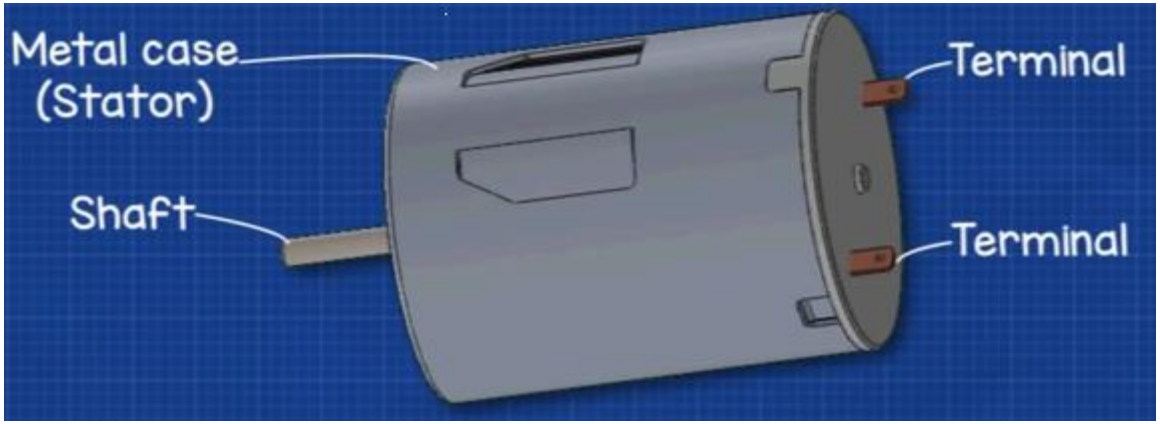
A DC machine is an electromechanical energy alteration device. The DC machines are classified into two types such as DC generator as well as DC motor.

The main function of the DC generator is to convert mechanical power to DC electrical power, whereas a DC motor converts DC power to mechanical power.

DC generators are used for general lighting, charge battery because they can be made to give constant output voltage and can also be used for small power supply (such as a portable generator).

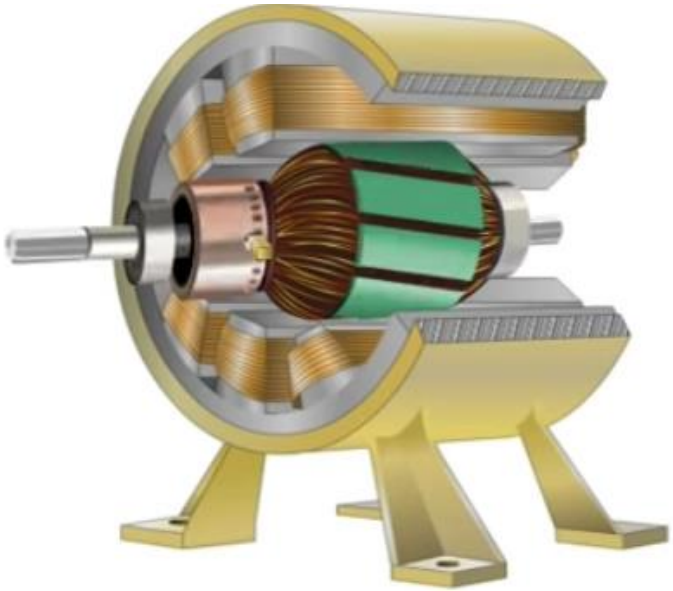
The applications of the DC machine is limited to trains, mills, and mines. For example, underground subway cars, as well as trolleys, may utilize DC motors.

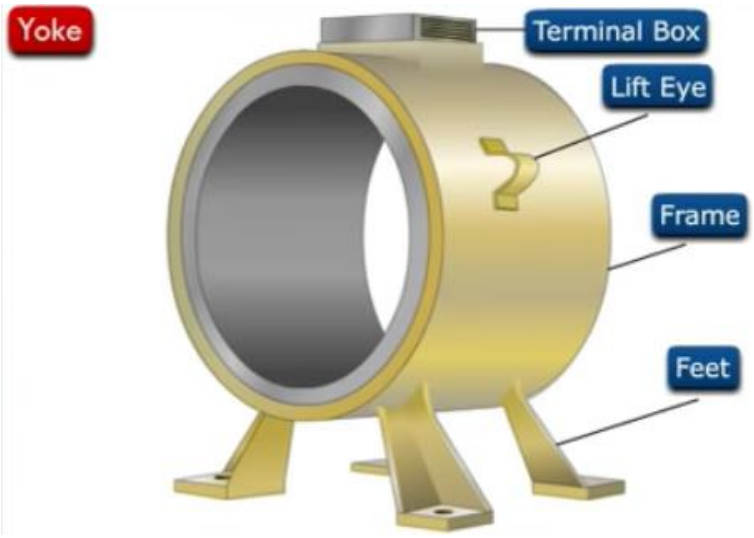
DC Machine



DC Machine - Construction

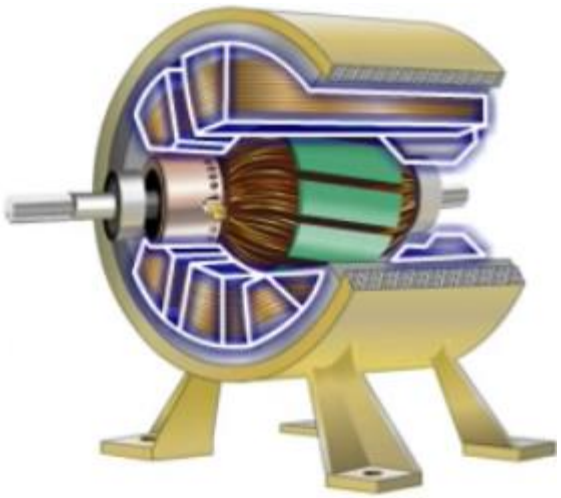
Theoretically, a DC generator can be used as a DC motor without any constructional changes and vice versa is also possible. Thus, a DC generator or a DC motor can be broadly termed as a **DC machine**.

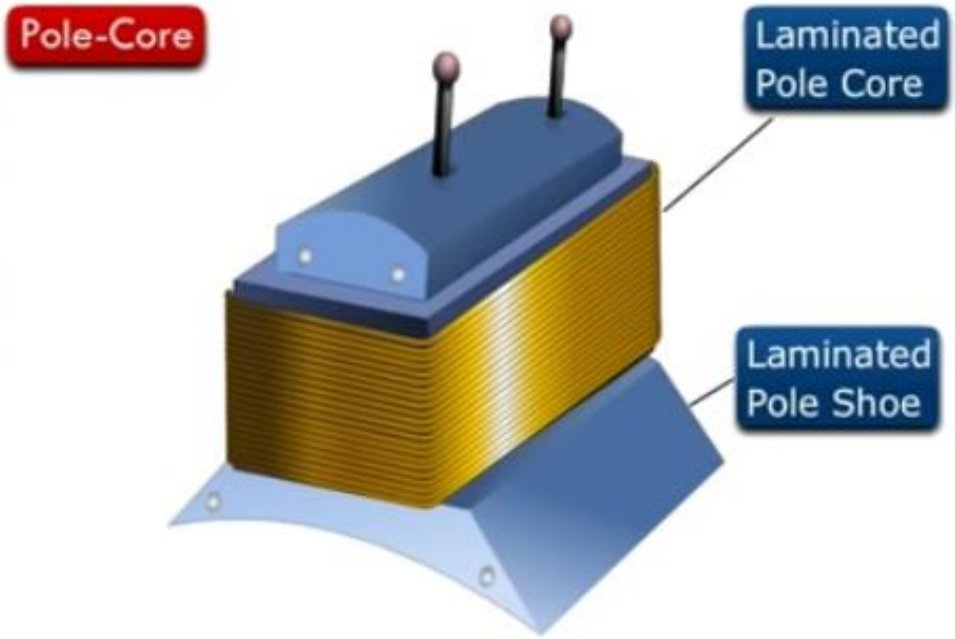




The outer frame of a dc machine is called as **yoke.** It is made up of cast iron or steel. It not only provides mechanical strength to the whole assembly but also carries the magnetic flux produced by the field winding.

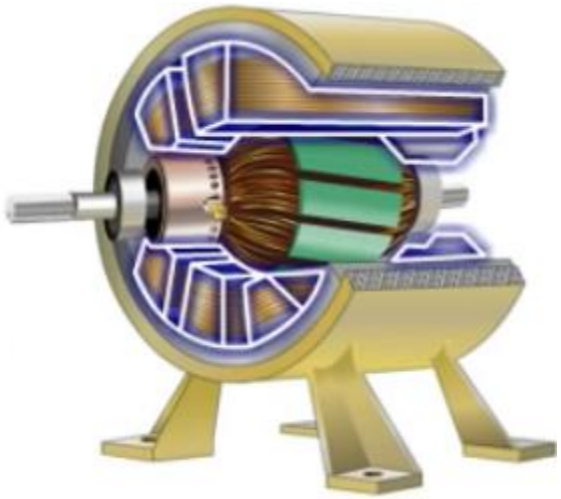
DC Machine - Construction



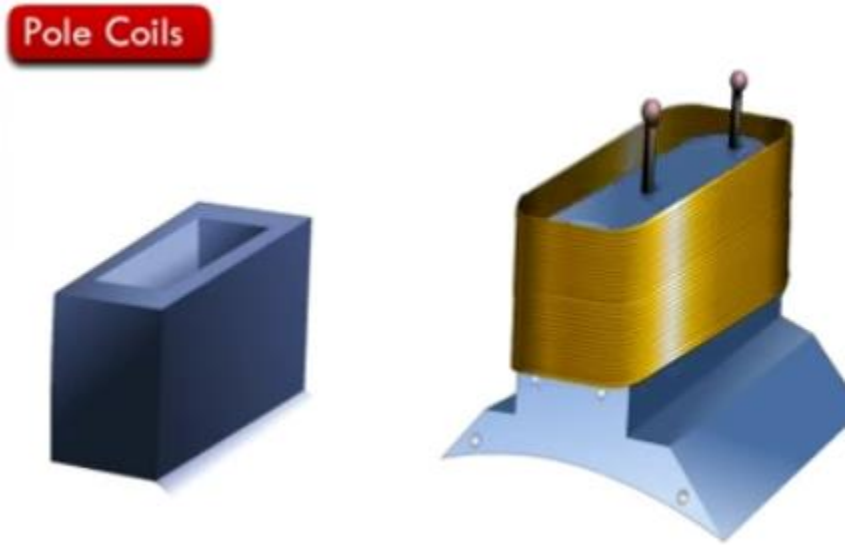


The pole of the DC machine is an electromagnet and the field winding is winding among pole. Poles are joined to the yoke with the help of bolts or welding. They carry field winding and pole shoes are fastened to them. Pole shoes serve two purposes; (i) they support field coils and (ii) spread out the flux in air gap uniformly.

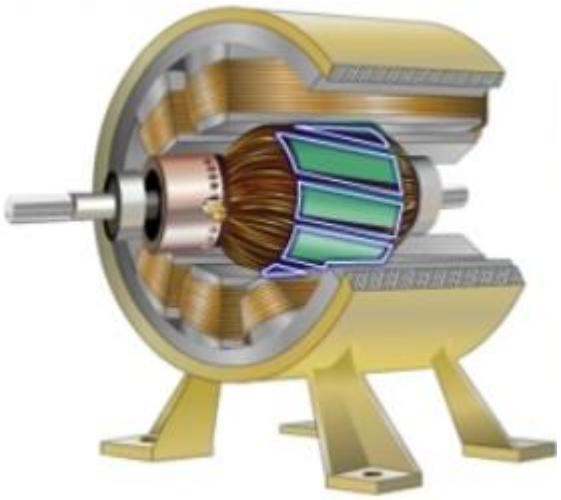
DC Machine - Construction

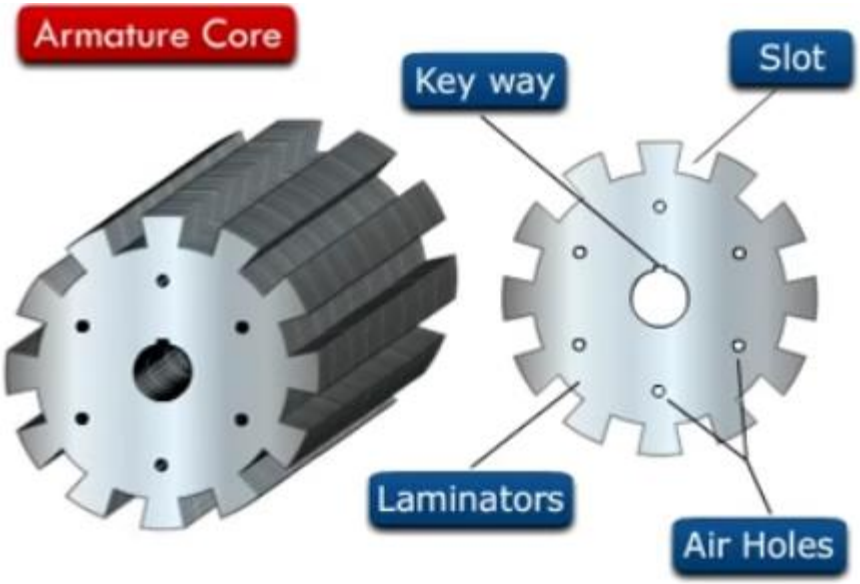


They are usually made of copper. Field coils are former wound and placed on each pole and are connected in series. They are wound in such a way that, when energized, they form alternate North and South poles.



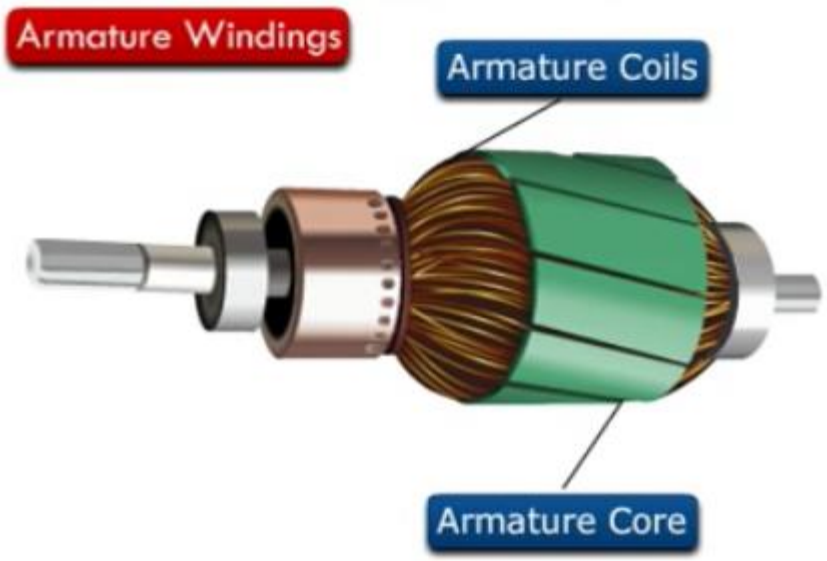
DC Machine - Construction



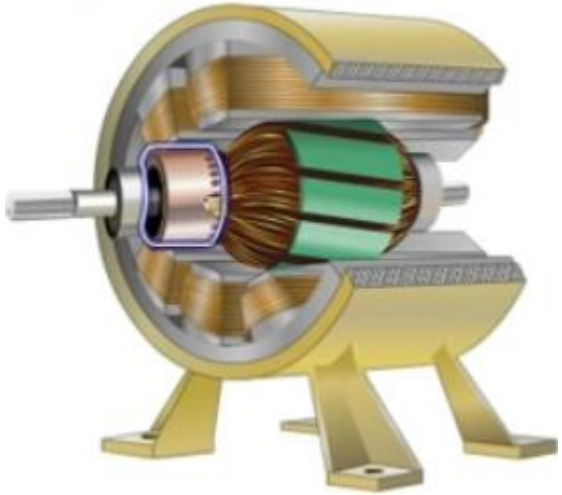


Armature core is the rotor of a dc machine. It is cylindrical in shape with slots to carry armature winding. The armature is built up of thin laminated circular steel disks for reducing eddy current losses. It may be provided with air ducts for the axial air flow for cooling purposes. Armature is keyed to the shaft.

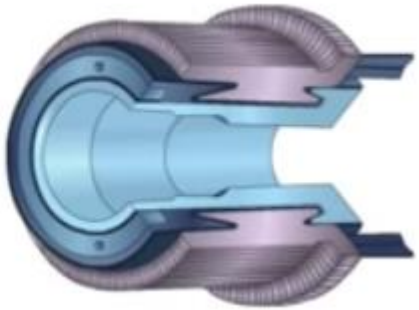
DC Machine- Construction



Armature winding: It is usually a former wound copper coil which rests in armature slots. The armature conductors are insulated from each other and also from the armature core. Armature winding can be wound by one of the two methods; lap winding or wave winding. Double layer lap or wave windings are generally used. A double layer winding means that each armature slot will carry two different coils.



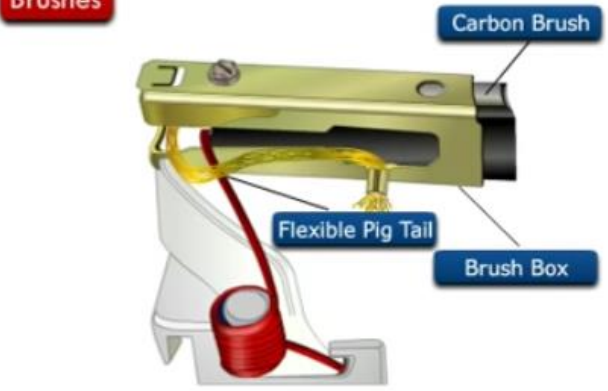
Commutator



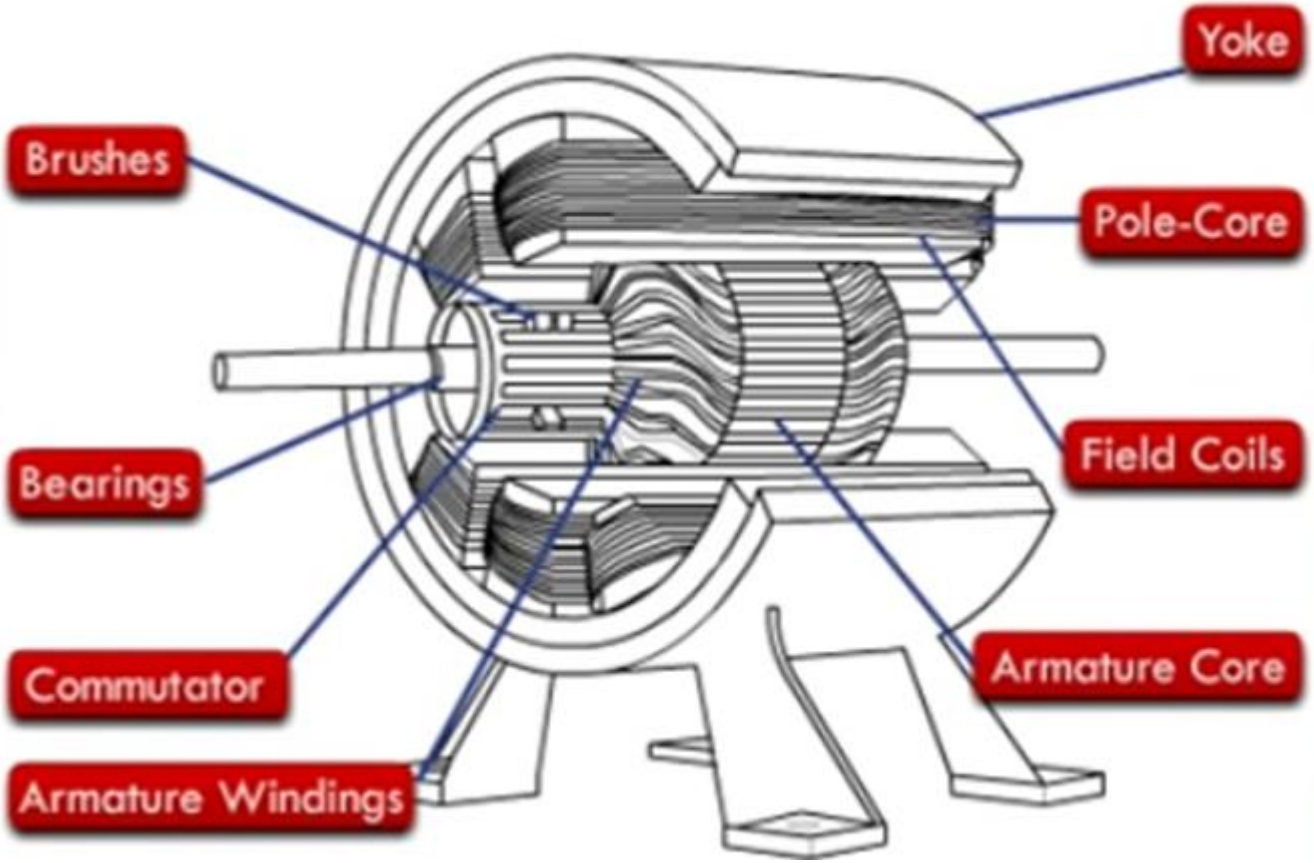
Bearings

Physical connection to the armature winding is made through a commutator-brush arrangement. The function of a commutator, in a dc generator, is to collect the current generated in armature conductors. Whereas, in case of a dc motor, commutator helps in providing current to the armature conductors. A commutator consists of a set of copper segments which are insulated from each other. The number of segments is equal to the number of armature coils. Each segment is connected to an armature coil and the commutator is keyed to the shaft. Brushes are usually made from carbon or graphite. They rest on commutator segments and slide on the segments when the commutator rotates keeping the physical contact to collect or supply the current.

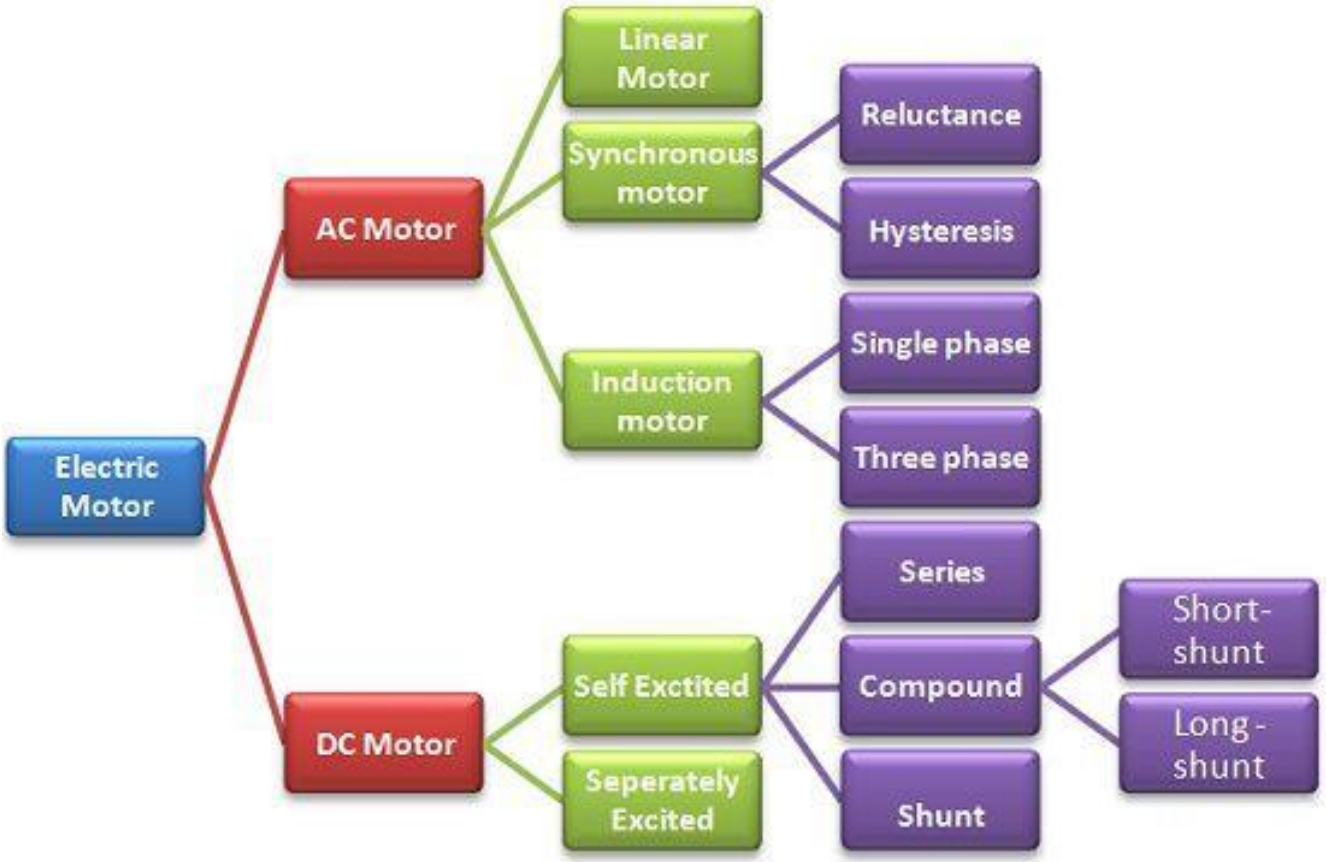
Brushes



DC Motor - Schematic

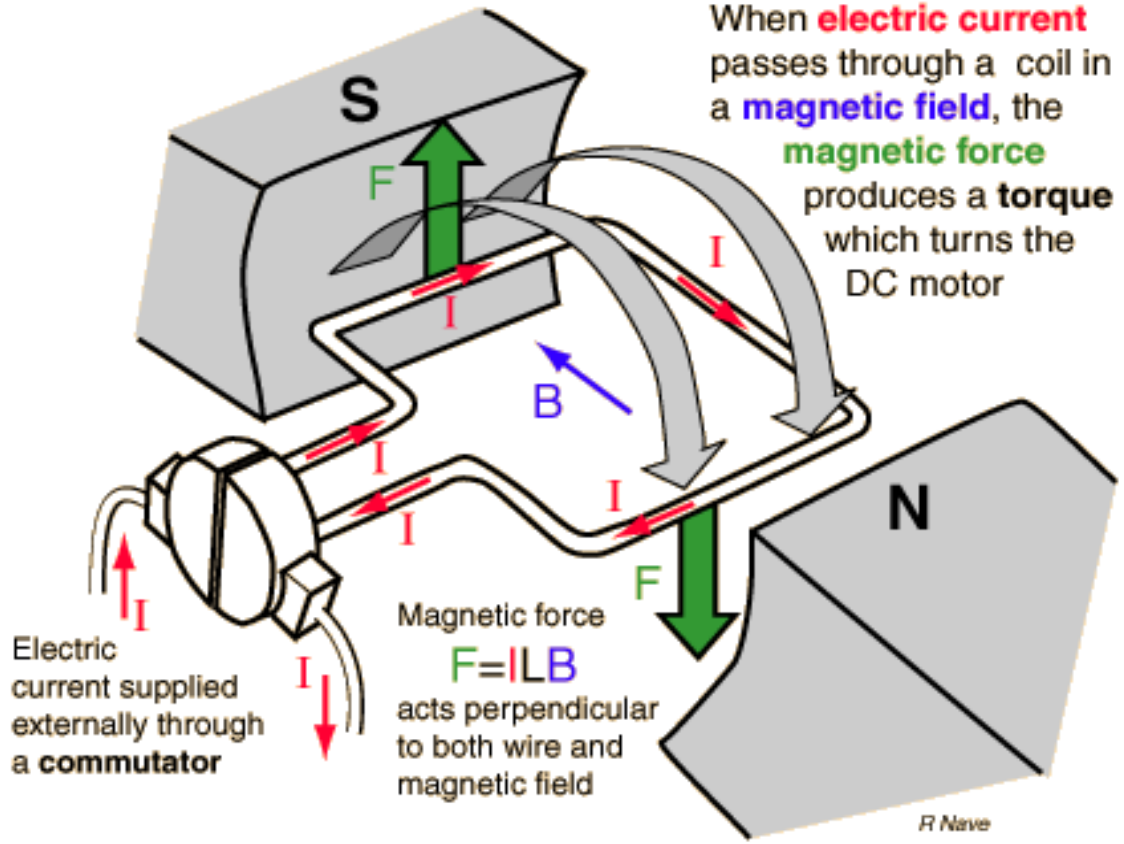


MOTORS

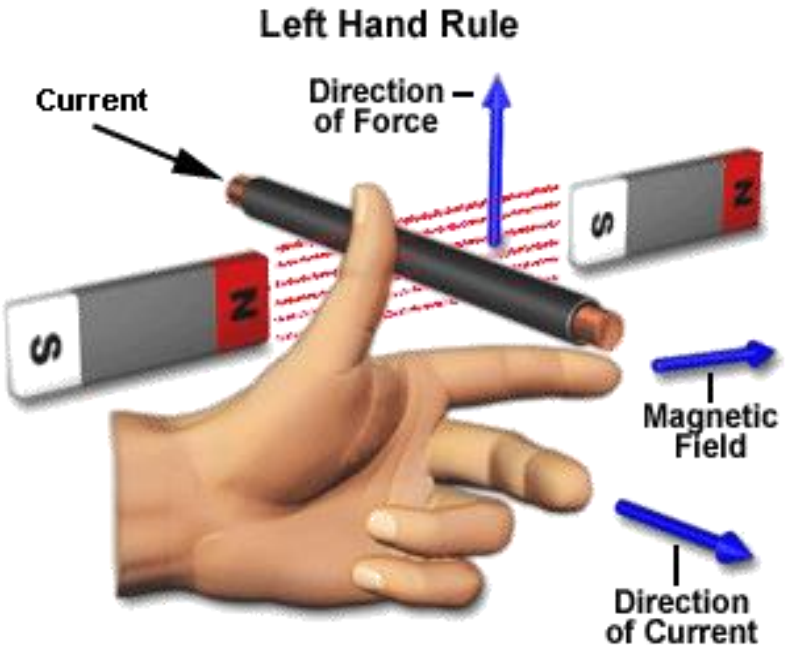

Electric Motor
AC Motor
DC Motor
Linear Motor
Synchronous motor
Induction motor
Reluctance
Hysteresis
Single phase
Three phase
Self Exctited
Seperately Excited
Series
Compound
Shunt
Short-shunt
Long-shunt

DC MOTOR

- When a Current carrying conductor is kept in a magnetic field; it experiences a mechanical force.



Fleming's left hand rule



Used to determine the direction of force acting on a current carrying conductor placed in a magnetic field .

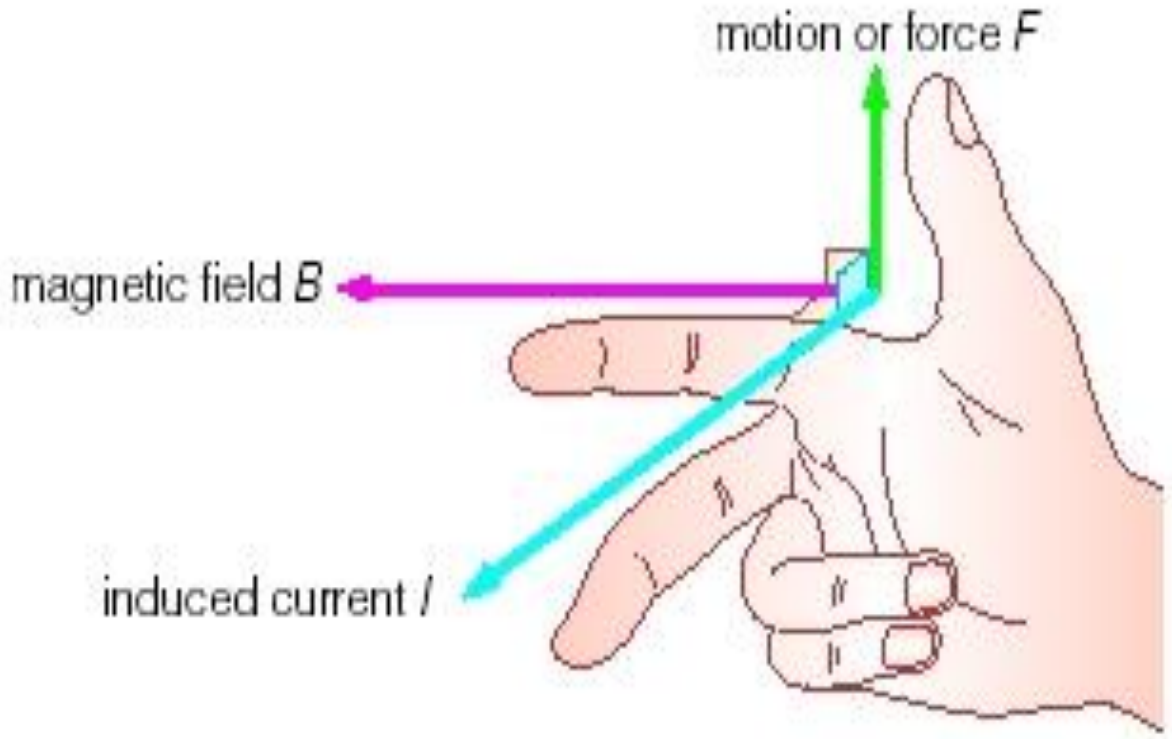
The middle finger , the fore finger and thumb of the left hand are kept at right angles to one ano The middle finger represent the direction of current

The fore finger represent the direction of magnetic field

The thumb will indicate the direction of force acting on the conductor .

This rule is used in motors.

Fleming's Right hand rule



Fleming's Right hand rule

- Used to determine the direction of emf induced in a conductor
- The middle finger , the fore finger and thumb of the left hand are kept at right angles to one another.
- The fore finger represent the direction of magnetic field
- The thumb represent the direction of motion of the conductor
- The middle finger will indicate the direction of the inducted emf .
- This rule is used in DC Generators

Working principle

- A generator works on the principles of Faraday's law of electromagnetic induction

- Whenever a conductor is moved in the magnetic field , an emf is induced and the magnitude of the induced emf is directly proportional to the rate of change of flux linkage.

- This emf causes a current flow if the conductor circuit is closed .