DC GENERATOR

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DC Generator

Working principle
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Working
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Application

Working Principle

Faraday’s law of electromagnetic induction

First law

When a conductor moves in a magnetic field it cuts magnetic lines of force, which induces an electromagnetic force (EMF) in the conductor.

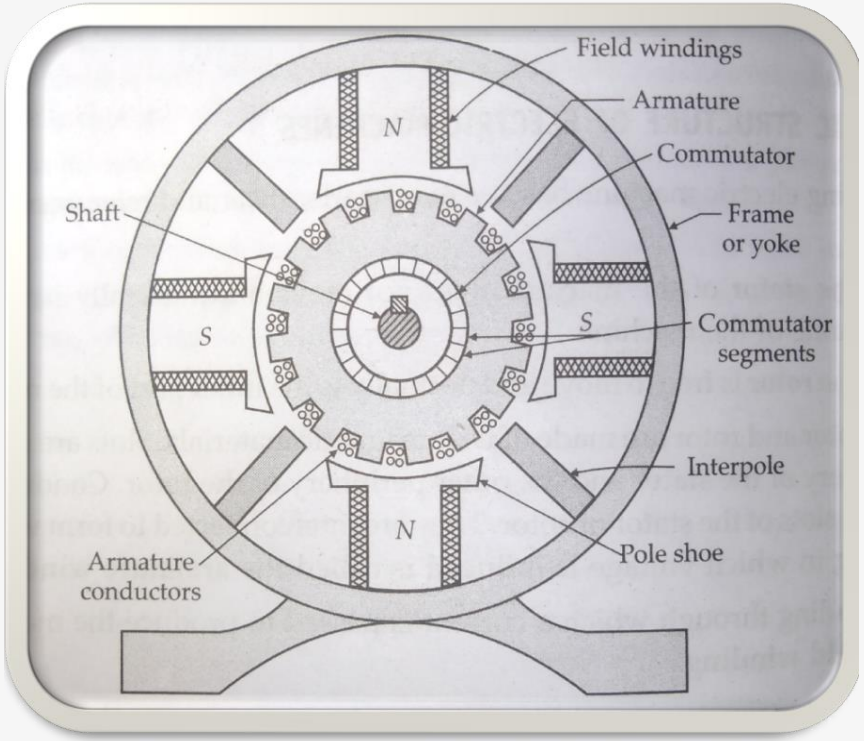
Second Law

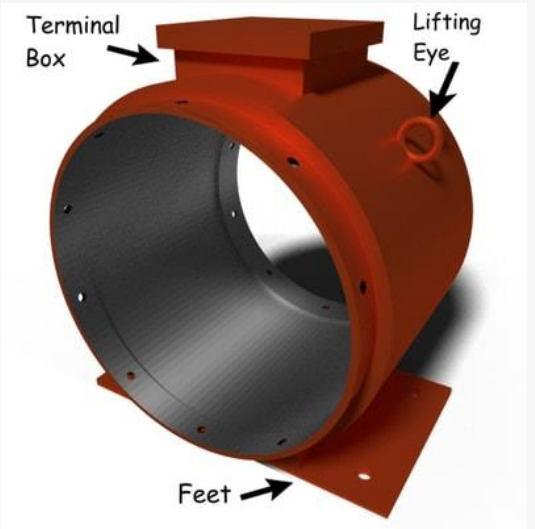
The magnitude of this induced EMF depends upon the rate of change of flux (magnetic line force) linkage with the conductor

Construction

Yoke or Frame

- Made of cast iron (small machine)
- cast steel or rolled steel (large machine)
- Mechanical support
- It carries magnetic flux





Pole cores

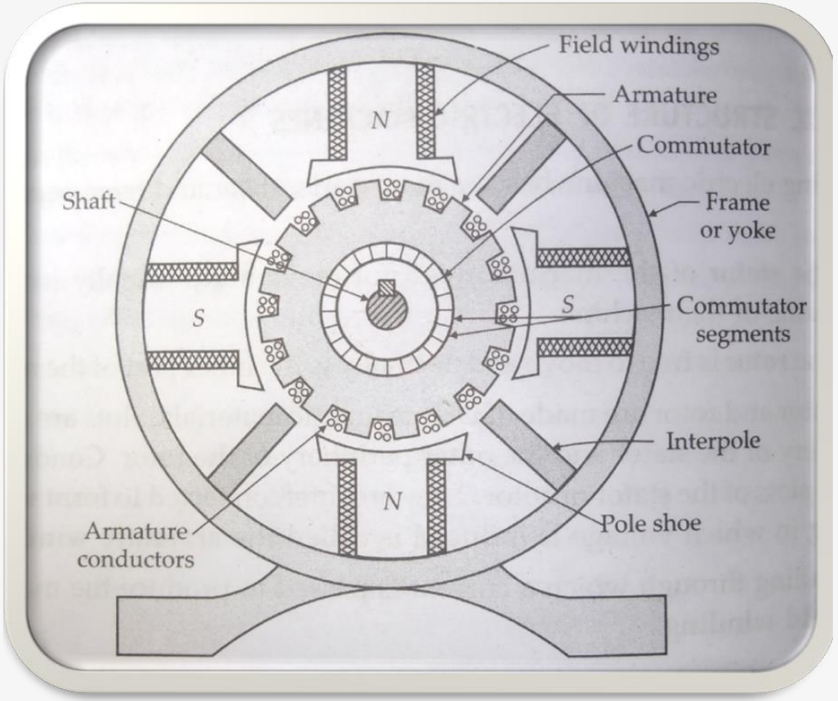
Pole cores

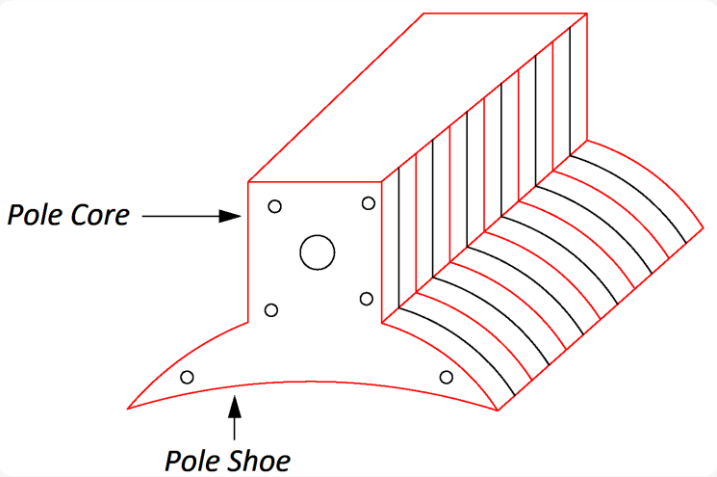
Pole core

- Laminated cast iron or cast steel
- Modern machine : Thin lamination of annealed steel
- Thickness of lamination = 0.25 to 1 mm

Pole Shoes

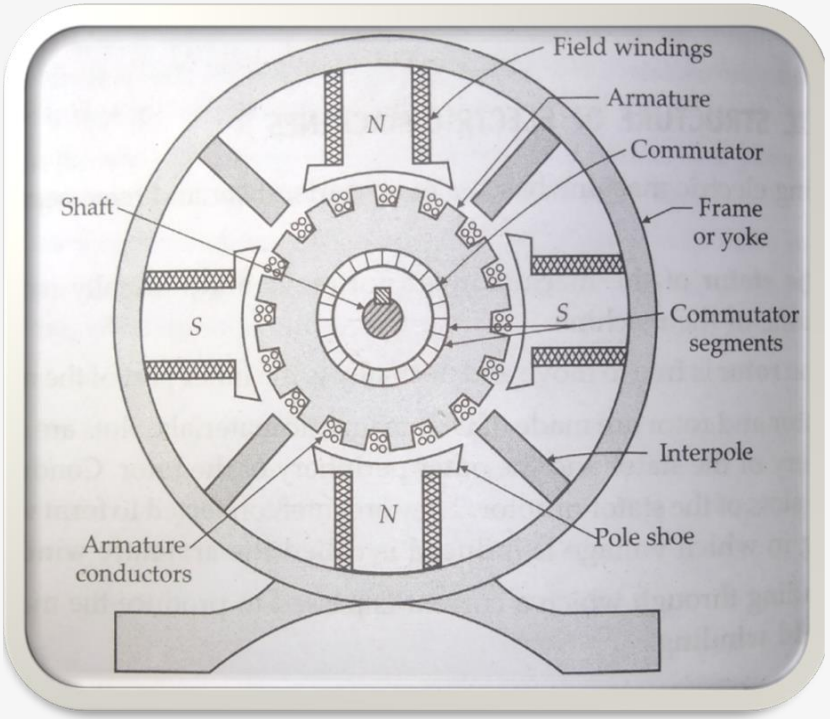
- Spread out the flux in the air gap
- Being large cross section , reduce the reluctance of the magnetic path.
- Support the exciting coil





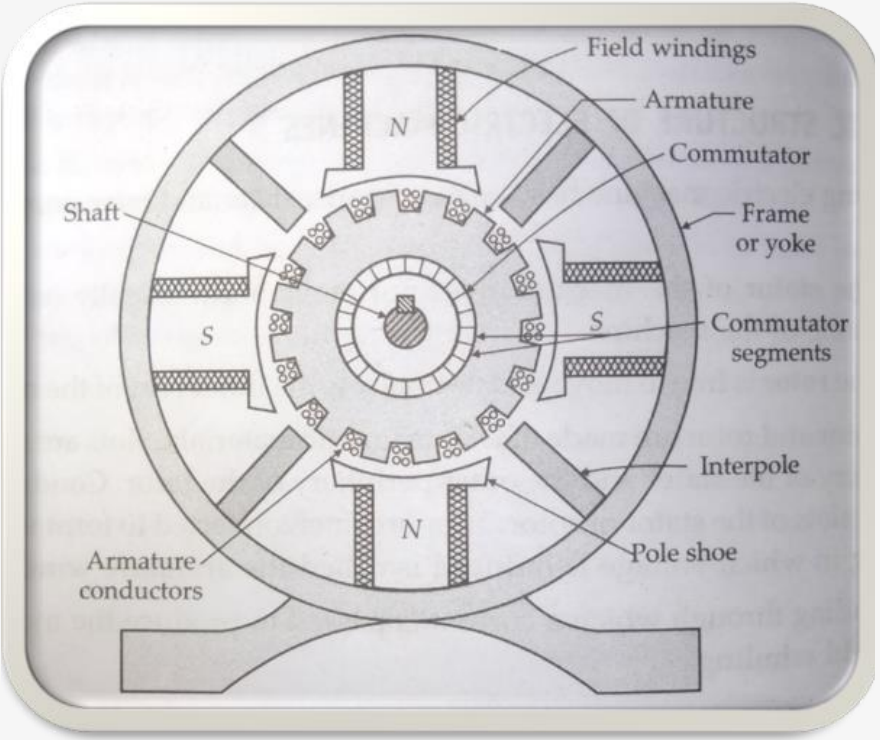
Pole Coil

- Consist of enameled copper coil
- usually finished off with an insulating varnish



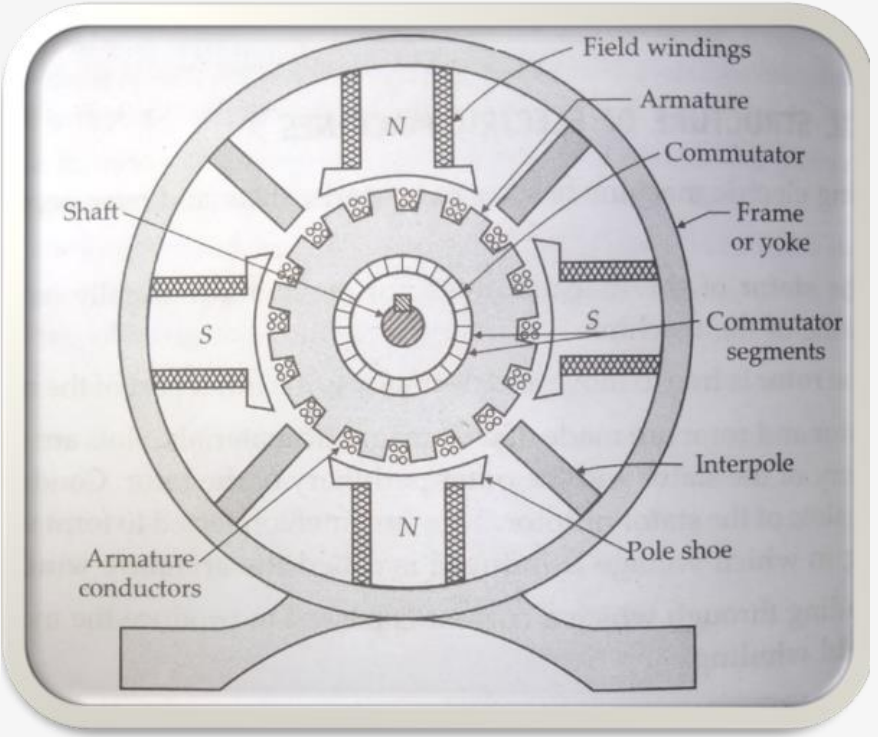
Armature core

- Houses the armature conductor
- It provides an easy path for the magnetic flux.
- silicon steel material is used
- laminated with a stamping of about 0.3 to 0.5 mm thickness
- Each lamination is insulated from the other by a coating of varnish.



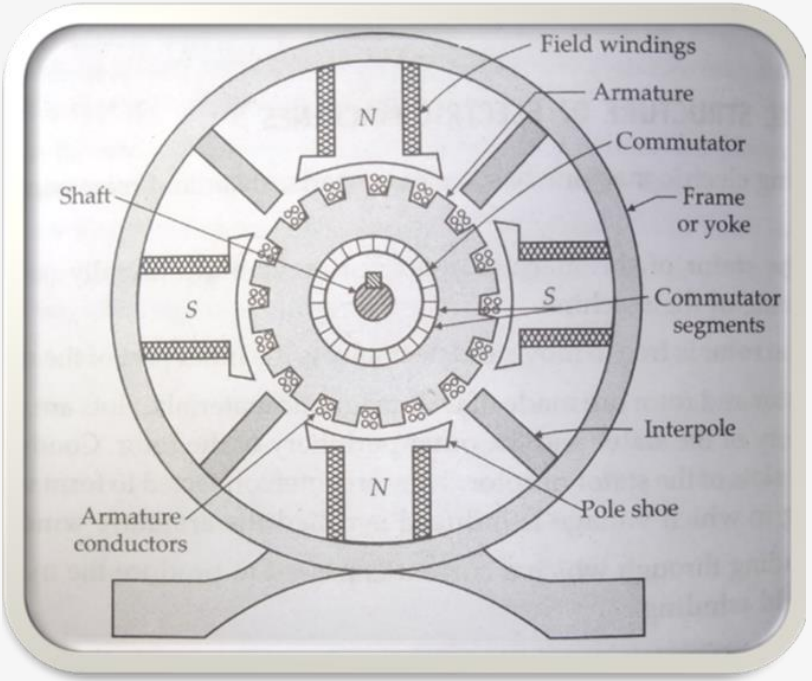
Armature winding

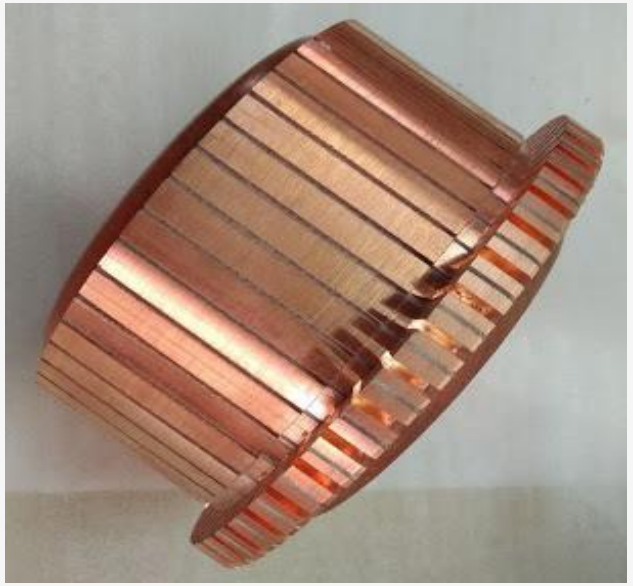
Consist of enameled copper coil



Commutator

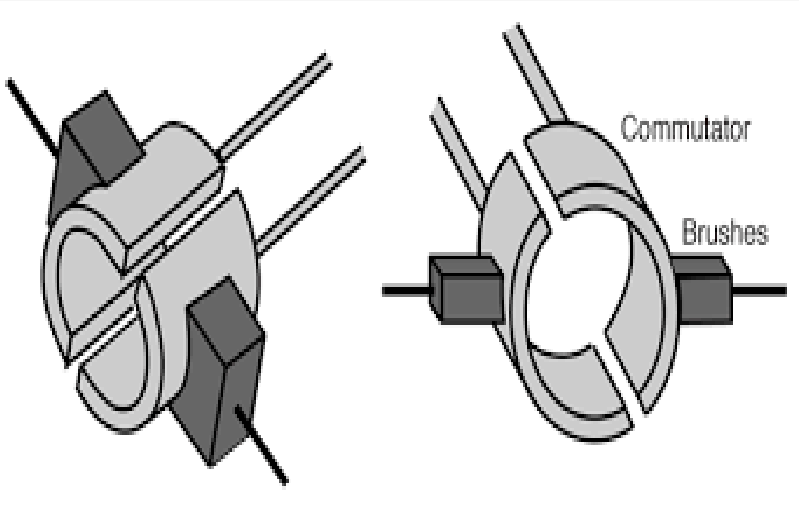
- Cylindrical in shape
- made from number of wedge-shaped hard drawn copper bars or segments insulated from each other and from the shaft.
- Each commutator segment is connected to the ends of the armature coils.
- It connects the rotating armature conductors to the stationary external circuit through brushes.
- It converts the induced alternating current in the armature conductor into the unidirectional current

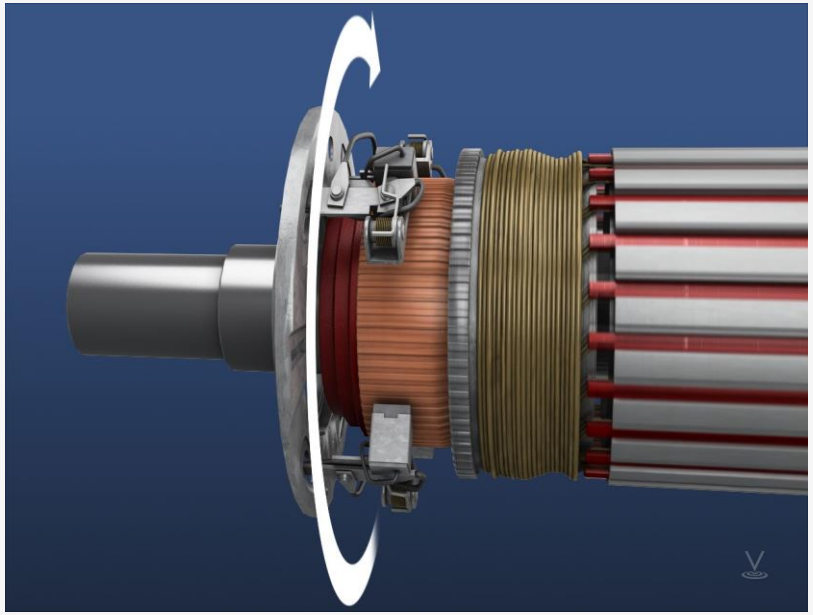




BRUSHES

- Carbon brushes are placed or mounted on the commutator
- They are usually made of high-grade carbon
- With the help of two or more carbon brushes current is collected from the armature winding.
- The brushes are pressed upon the commutator and form the connecting link between the armature winding and the external circuit.
- carbon is conducting material and at the same time in powdered form provides a lubricating effect on the commutator surface.





BEARINGS AND SHAFT

BEARINGS

- The ball or roller bearings are fitted in the end housings
- Mostly high carbon steel is used for the construction of bearings as it is a very hard material.

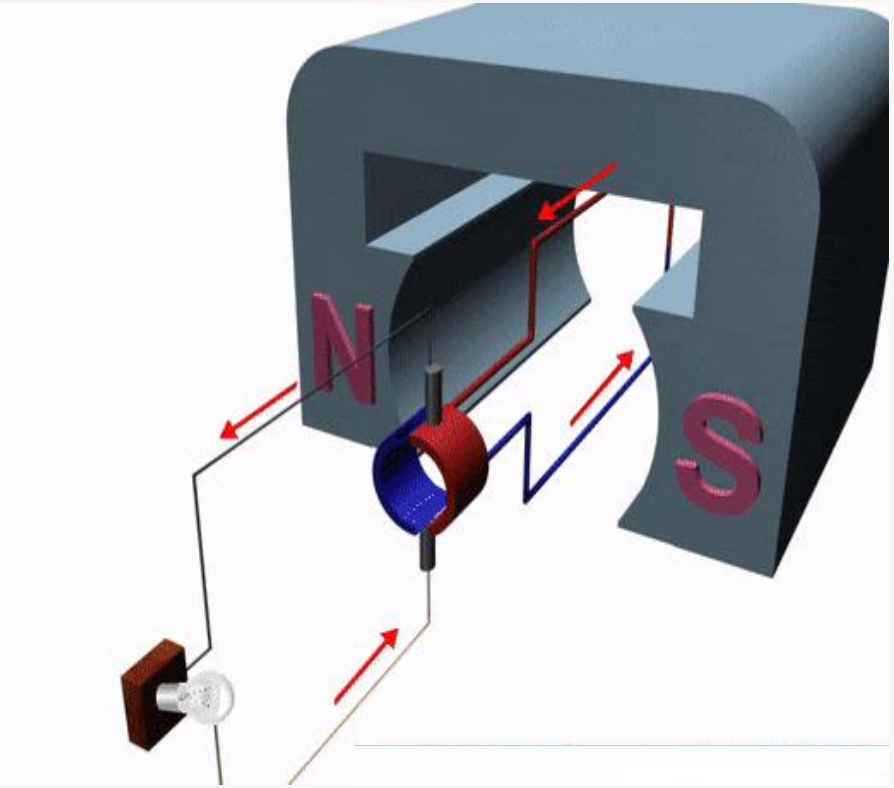
SHAFT

- Shaft is made of mild steel with a maximum breaking strength.

Working

The maximum emf is induced when the coil is perpendicular to the magnetic field.

The minimum emf is induced when the coil is parallel to the magnetic field



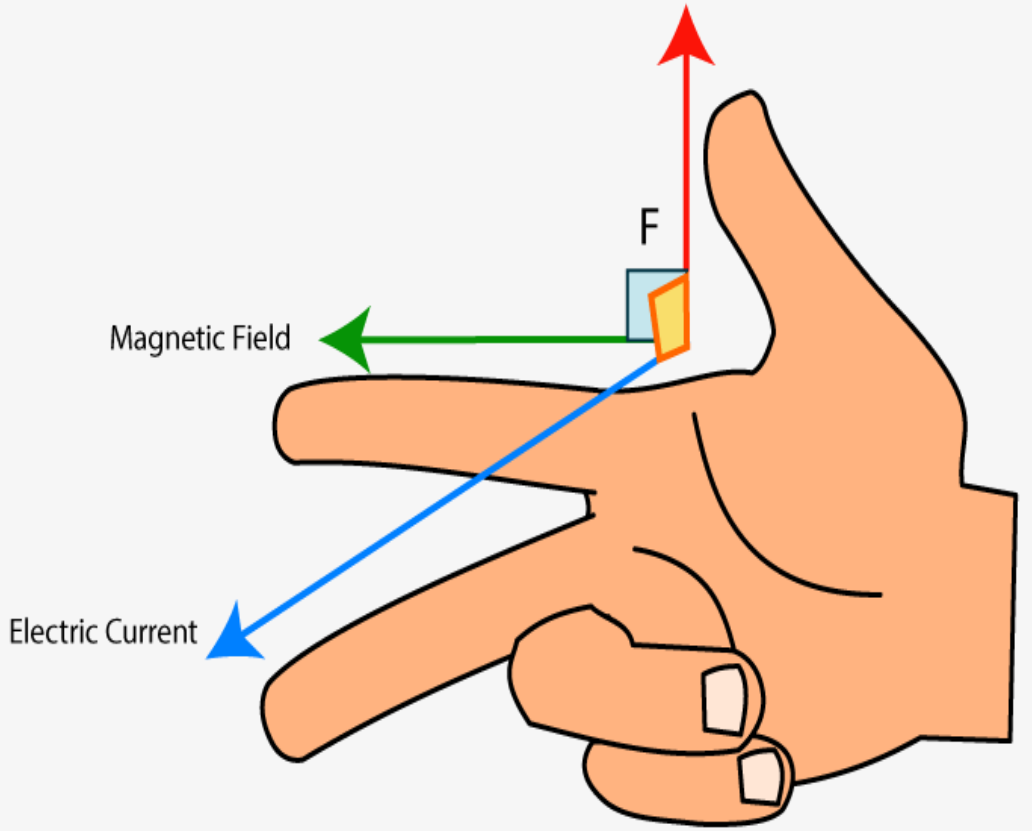
Fleming Right Hand Rule

To find the direction of induced EMF

Thumb – Direction force or rotation

For finger – magnetic field

Middle finger – direction of induced current



EMF EQUATION

$$E_g = \frac{\Phi ZN}{60} * \frac{P}{A}$$

Φ = flux per pole

Z = Total number of armature conductor = conductor per slots x number of slots

N = armature rotation in rpm

P = Number of poles

A = Number of parallel path

Types of winding

Lap winding

Number of parallel path = pole x m

Wave winding

Number of parallel path = 2 x m

m = multiplux
m = 1 for simplex
m = 2 for duplex
m = 3 for triplex
m = 4 for quadruplex