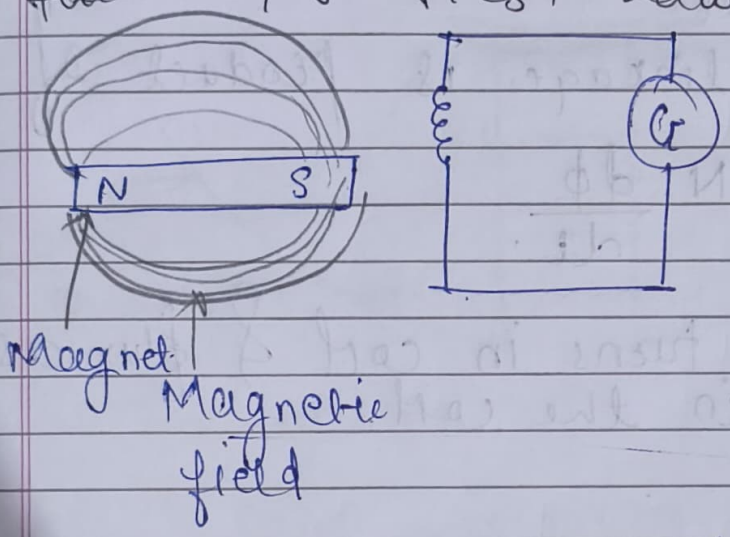
UNIT I - FUNDAMENTALS OF D.C Machine.

Electrical Machine.

	DC	AC
1) Motor	✓	✓
2) Generator	✓	✓
3) Transformer	×	✓

* Faraday's first Law.



When a conductor is placed in varying magnetic field a electromotive force is induced in coil.

If the conductor circuit is closed which is called as induced current.

Mention here are few ways to change the magnetic flux intensity in a closed loop.

1) By Rotating the coil relatively to magnet.

2) By moving the coil in out of the magnetic field.

3) By moving magnet towards or away from the coil.

The induced emf in the coil is proportionalrate of change of flux linkage.

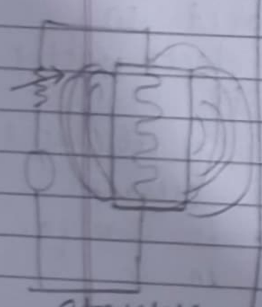
The $e \propto \frac{d\Phi}{dt}$

The flux linkage is product of

$$e = N \frac{d\phi}{dt}.$$

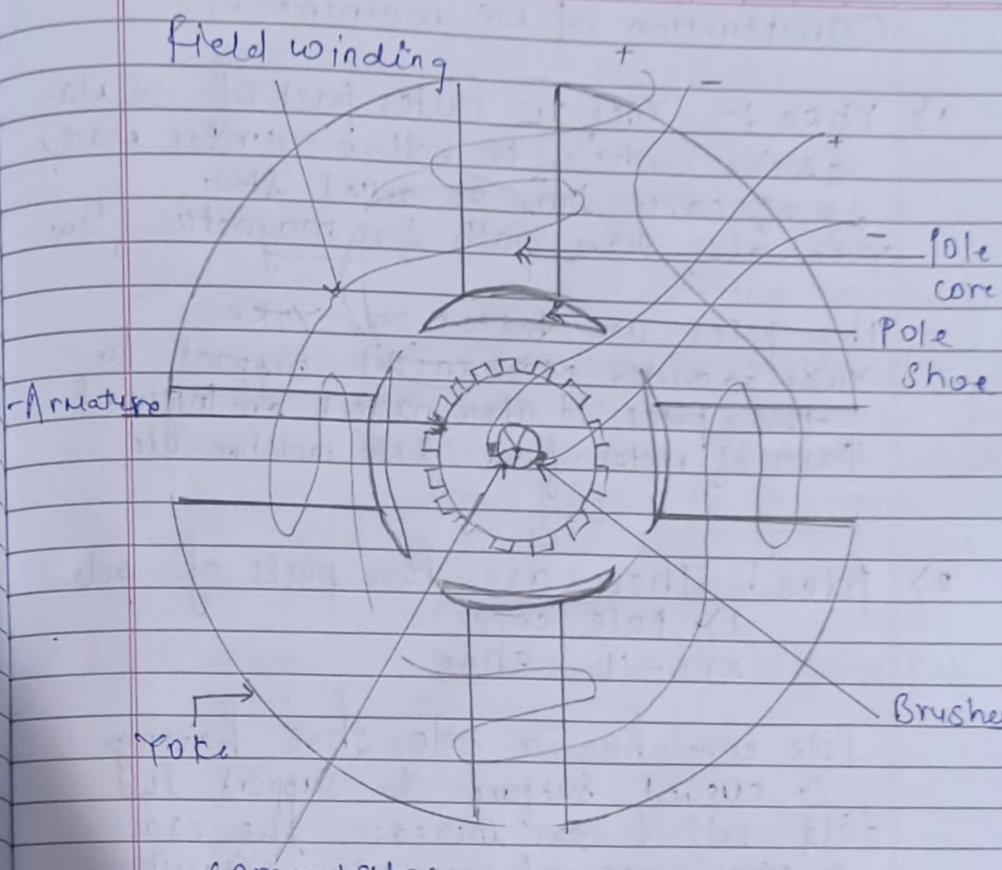
number of turns in coil & flux associated in the coil.

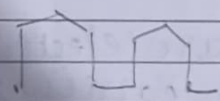
Solenoid

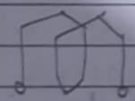


Structure is solenoid.

Generator => B => -A1







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Construction of DC machine :-

1) Yoke :- Yoke is outer part of DC machine which is hollow cylinder made up of caste ion or rolled stea. Yoke also serve path for magnetic flow.

- The poles are bolted on Yoke.
- Yoke provides Mechanical support to the poles it also protect ~~or~~ internal parts of motor from dust moisture etc.

2) Poles :- There are two parts of pole
   1) Pole core
   2) -11- shoe.

Pole core has a pole shoe having a curved surface to support the field coil & to increase the cross section area of magnetic circuit.

- Poles of DC machines are electromagnetes and pole core carries the field winding which is necessary to produce magnetic flux.
- Poles are made up of still lamination which are insulated from each other to reduce any other
- Small size machines use permanent magnet

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3) Field winding :- The coil wind around pole core are called as field winding.

- This field coils from each of pole core are connected in series to form a field winding
- This is ~~also~~ also called exciting winding.
- When current flow through field coil alternate north south poles are produce in direction of rotation. which create magnetic field to magnetize the poles & poles shoe in the air gap between pole & armature.

4) Armature :- It is called as rotating part of Dc machine.

The Armature consist of
   A) Shaft
   B) Armature core
   C) Armature winding.

The Armature consist of a shaft which is laminated cylinder

The Armature core has grooves on it outer surface.

Armature core provides housing for armature winding that is armature conductor

~~Armature winding this~~

Armature winding: This are insulated conductor made up of an armature core. The conductor are suitably connected and this arrangement is called as armature winding

1) Lap
2) Wave

5) Commutator:- An alternating voltage is produce in the armature winding. In order to obtain direct current in the external circuit. A commutator is used used to convert AC induced emf to DC.

A commutator is cylindrical drum mounted on shaft along with armature core. It rotates with armature & made up from hard drawn copper bars. insulated from each other as well as shaft.

For motor commutator is used to produce uni-directional Torque.

6) Brushes:- Brushes are stationary & resting on the surface of commutator. Commutator is rotating so it is not possible to connect load directly to it. Hence the current is collected by means of 2 or more carbon brushes resting on commutator. Made up of material like carbon or graphite

Bearing:-
It is use to support rotating part & allow uniform motion of the shaft with extremely low friction.

* DC Generator working

1) DC Generator works on principle of Faraday's Law of electromagnetic induction

2) If flux linkages with coductor (Armature winding) changes due to relative motion between magnetic field & conductor then emf is induced in the conductor

$$E = n \frac{d\phi}{dt}$$

3) This induced emf is also called as dynamically induced emf

$E = \frac{P \phi N Z}{60 A}$ = Emf induced in total armature winding

P = Number of poles.

ϕ = Flux.

N = Number of rotation / revolution

Z = No. of conductor

A = No. of path (lap path = A = P, wave path = A = 2)

Q. A four pole wave wound armature has 720 conductor is rotation at 1000 rotation per min, useful flux = 20 mili weaber. Calculate the generated voltage

→ P = 4 A = 2

Z = 720

N = 1000 rpm

$\phi = 20 \text{ mwb} = 20 \times 10^{-3}$ wb

E = ?

$$E = \frac{P\phi NZ}{60A}$$

$$= \frac{4 \times 720 \times 1000 \times 20 \times 10^{-3}}{60 \times 2}$$

E = 480 V

Q. A Eight pole lap connected armature has 40 slots with 12 conducter per slot. Generates a voltage of 500 V. Determine the speed at which it is running if flux per pole is 50 milliweber.

→ pole = 8

A = 8

$Z = 12 \times 40 = 480$ (conductor × slot)

$\phi = 50 \times 8 = 400 \times 10^{-3}$

N = ?

$$500 = \frac{8 \times 400 \times 10^{-3} \times 480 \times N}{60 \times 8}$$

$$\frac{500}{N} = \frac{8 \times 400 \times 10^{-3} \times 480}{60 \times 8}$$

$$\frac{1}{N} = \frac{8 \times 400 \times 10^{-3} \times 480 \times 500}{60 \times 8 \times 500}$$

$$N = \frac{60 \times 8 \times 500}{8 \times 400 \times 10^{-3} \times 480 \times 500}$$

= 1250 rpm

$E = \frac{P\phi NZ}{60A}$

$\frac{E}{N} = \frac{P\phi Z}{60A}$

$\frac{1}{N} = \frac{P\phi Z}{60AE}$

$N = \frac{60AE}{P\phi Z}$

A 6 pole wave connected armature has 250 conductors & runs at 1200 rpm. The emf generated is 600 V : Calculate the useful flux per pole

pole = $p = 6$

$N = 1200$

$Z = 250$ $\quad E = 600$ $\quad \boxed{A = 2}$

$$E = \frac{P \phi N Z}{60 \times A}$$

$$E = \frac{6 \times \phi \times 1200 \times 250}{60 \times A}$$

$$\phi = \frac{60 \times 2 \times 600}{6 \times 1200 \times 250}$$