SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19EE303 DC MACHINES AND TRANSFORMERS

II YEAR / 03 SEMESTER EEE

Unit 1 – DC Machines

Construction, Operation and EMF Equation of DC Generator

Can You Guess?

- What is This?
- Where we are using?
- For What we have to use?
- When we have to use?

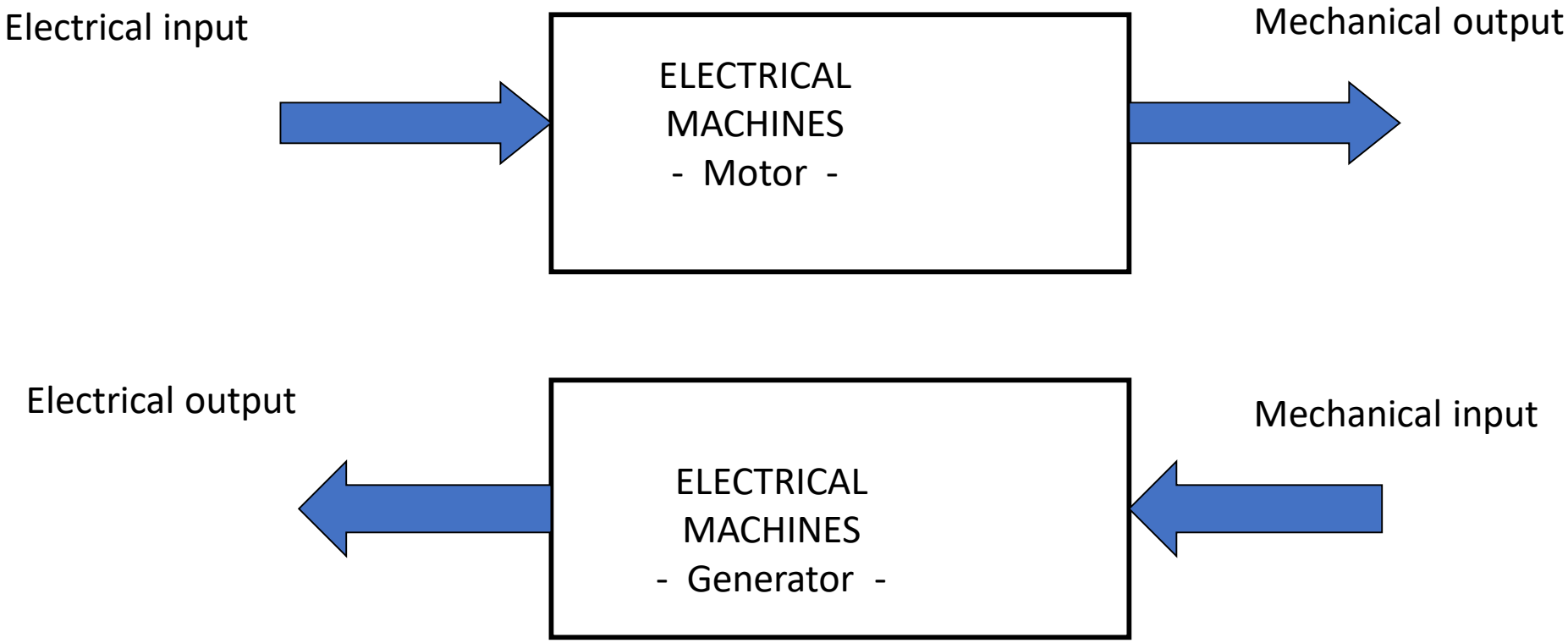
Rotating Electrical Machines

- These can be divided into:

  Generators – which convert mechanical energy into electrical energy

  Motors – which convert electrical energy into mechanical energy

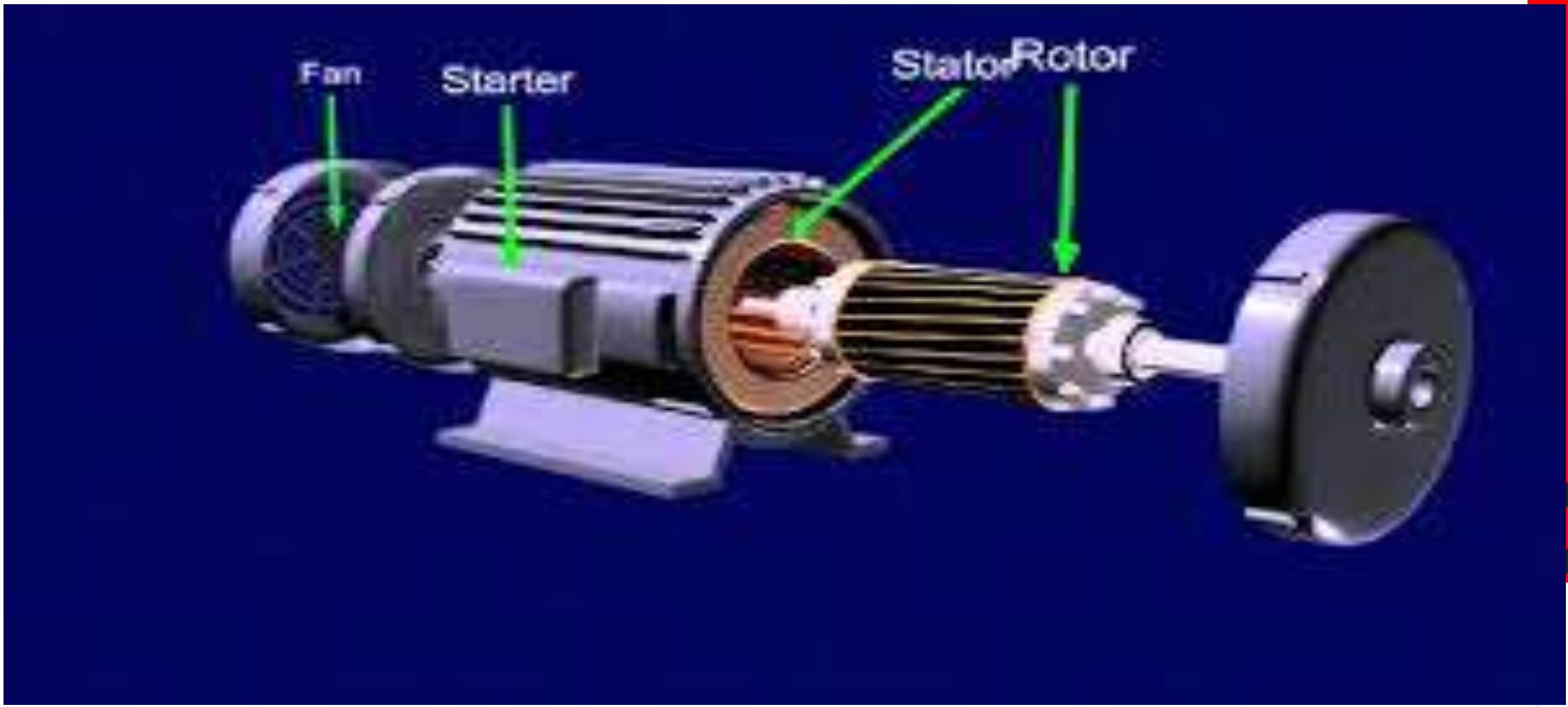
- Both types operate through the interaction between a *magnetic field* and a set of *windings*


Electrical input
ELECTRICAL
MACHINES
- Motor -
Mechanical output
Electrical output
ELECTRICAL
MACHINES
- Generator -
Mechanical input

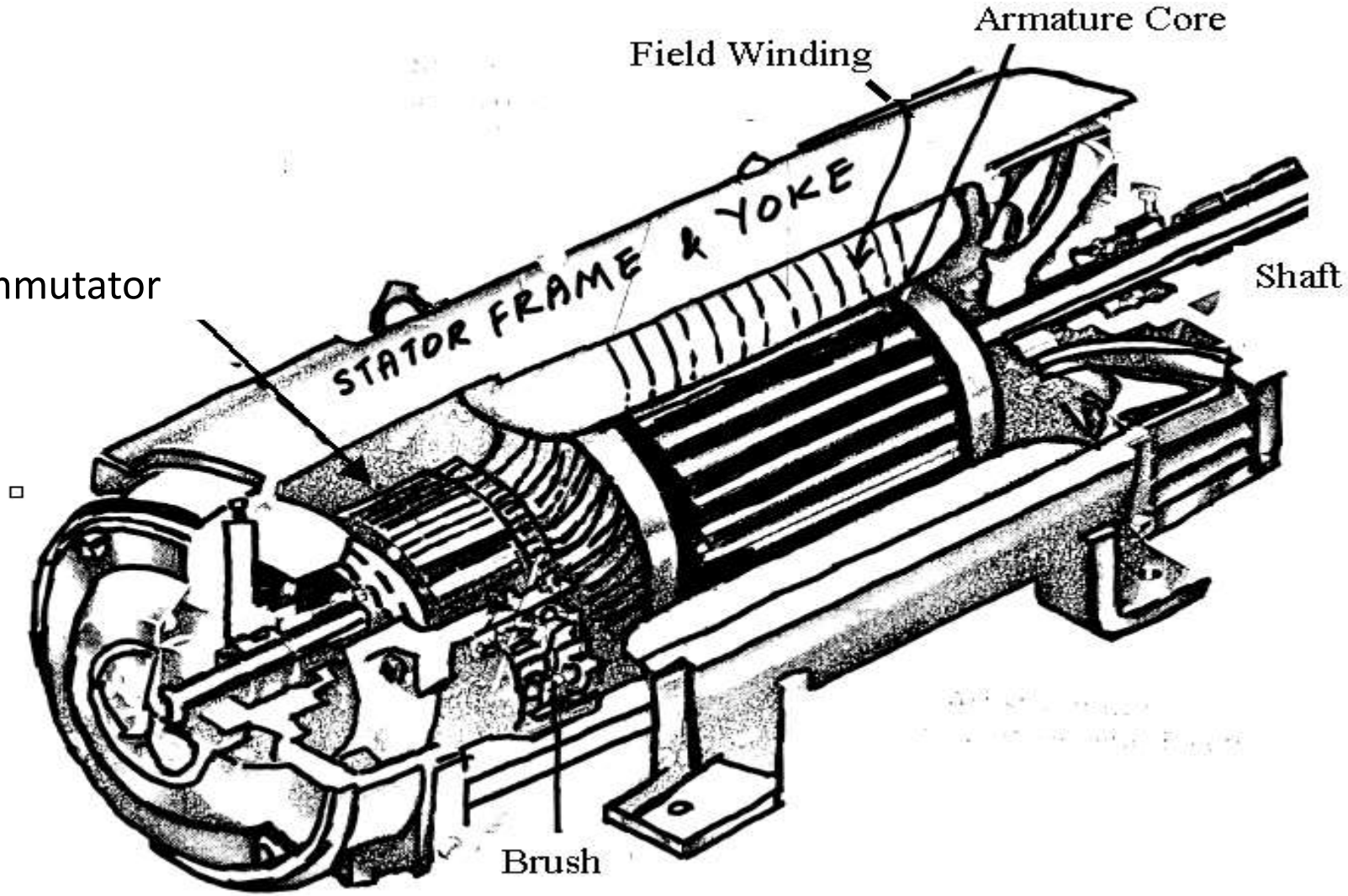
DC Generator

- Principle of operation –Faraday's law of electromagnetic induction
- When a conductor is rotated in a magnetic field to cut the magnetic lines of flux ,dynamically induced EMF is produced in the conductor.
- Basic requirements:
  - A steady magnetic field
  - Conductor or coils
  - Relative motion b/w magnetic field and conductors

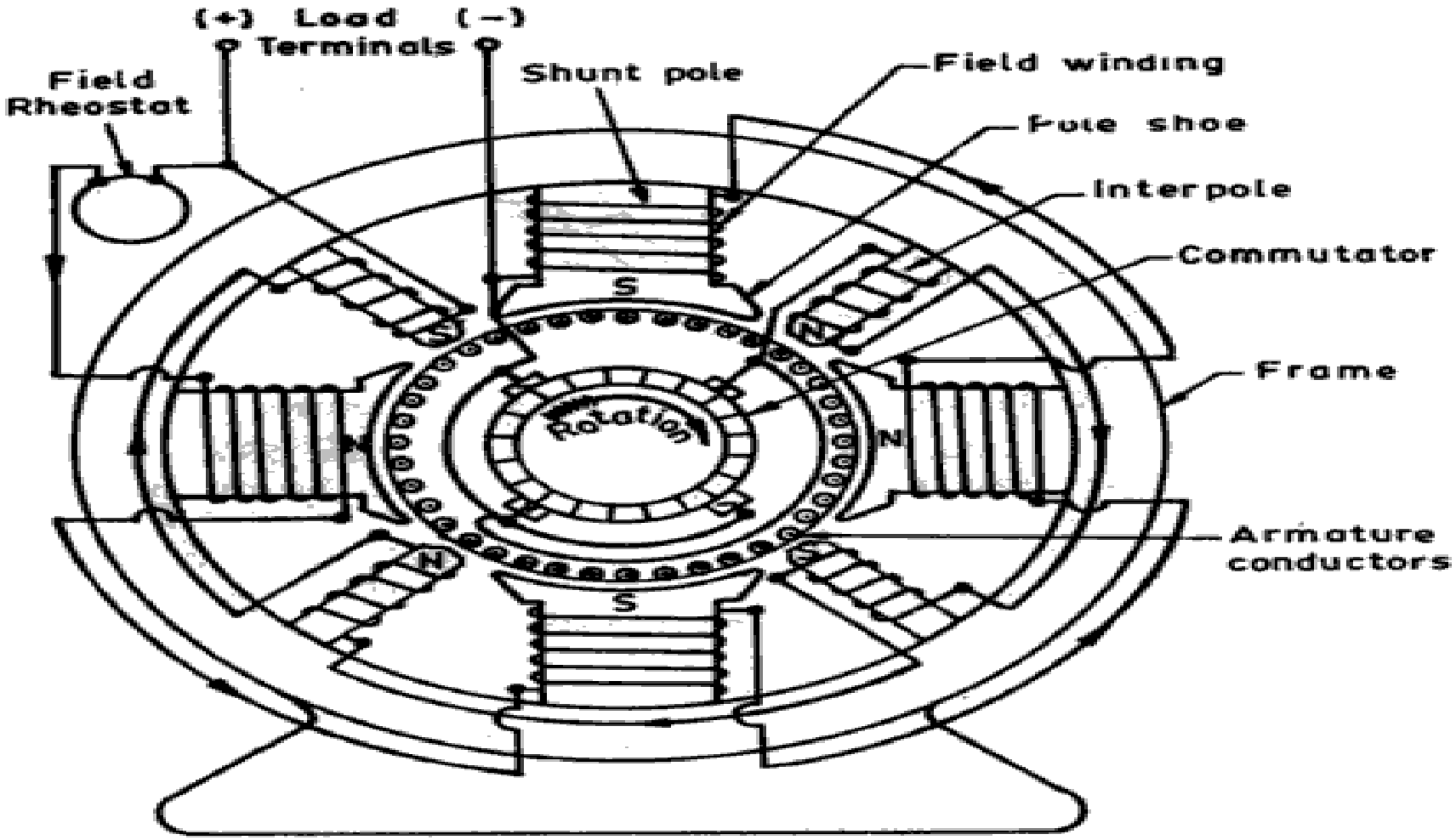
DC Machine



DC Machine

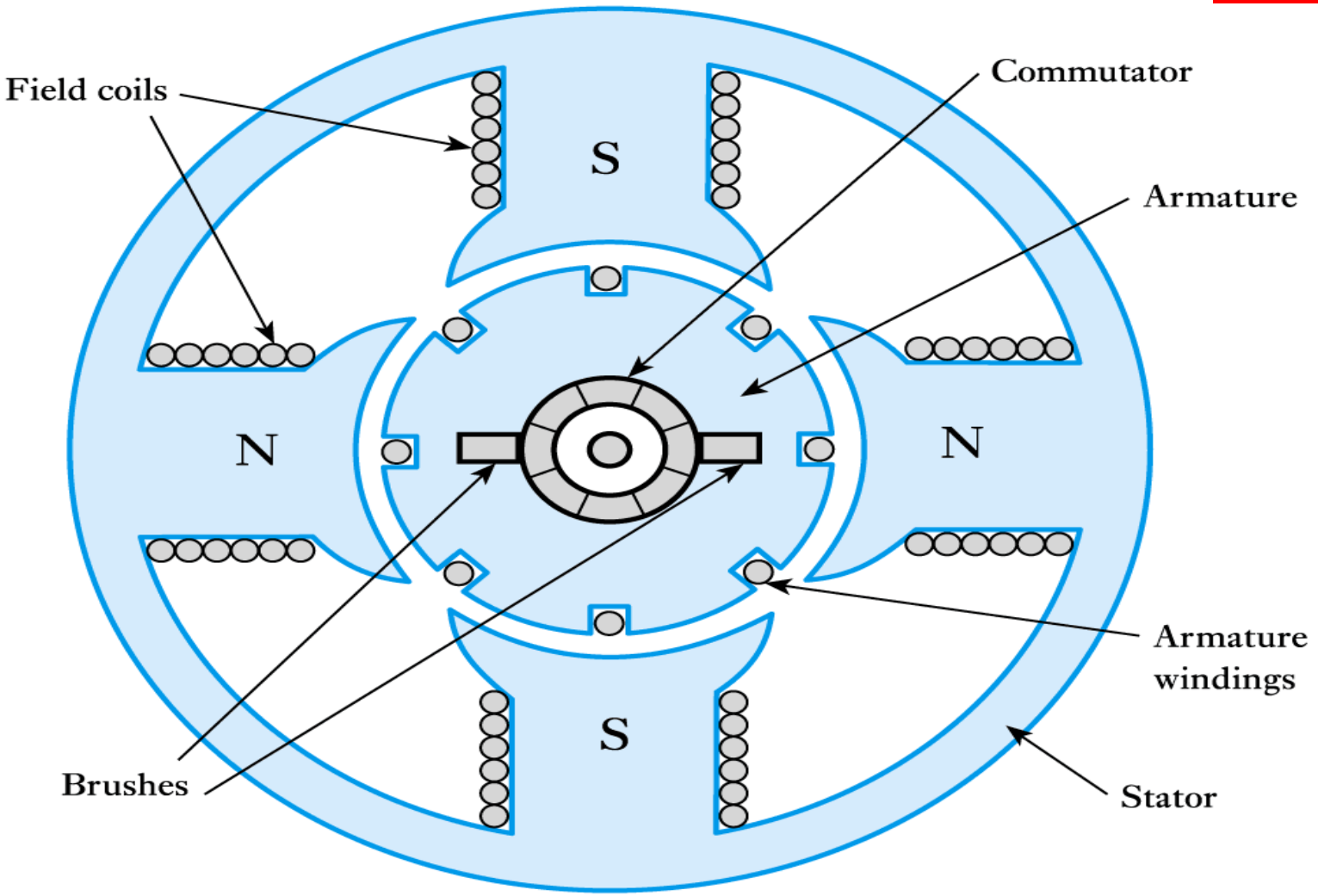

Armature Core
Field Winding
STATOR FRAME & YOKE
Commutator
Shaft
Brush

Sectional view of a DC machine



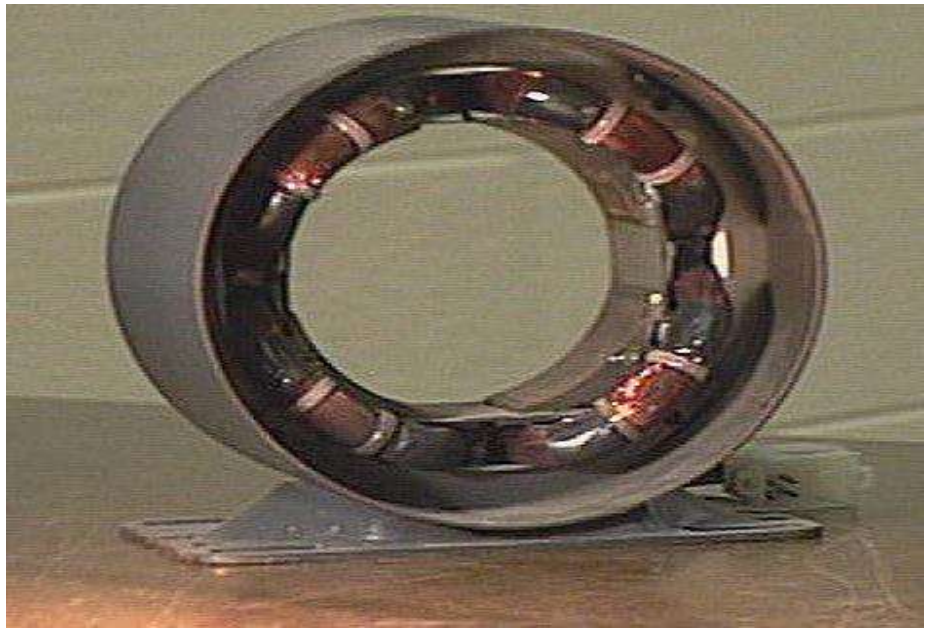
Construction of DC Generator

- Field system
- Armature core
- Armature winding
- Commutator
- Brushes



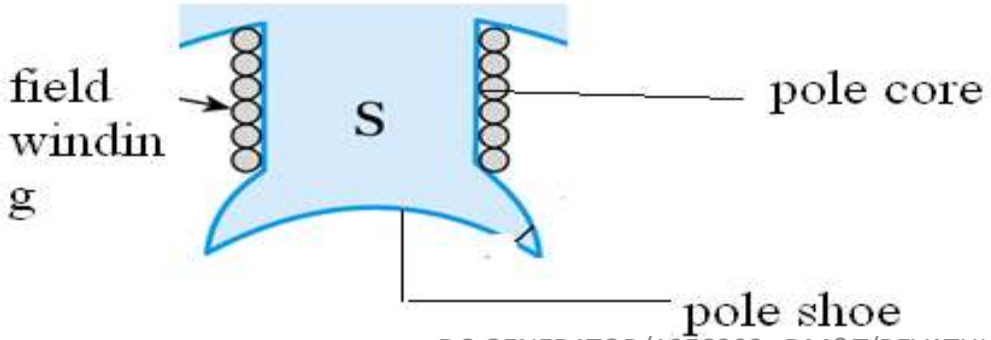
Yoke:

- ✓Provides mechanical support
- ✓Carries magnetic flux
- ✓Made up of cast iron



Field system:

- ✓Poles & field winding
- ✓Made up of Electromagnets



Inter poles

- ✓Placed b/w main poles
- ✓Used for improving commutation

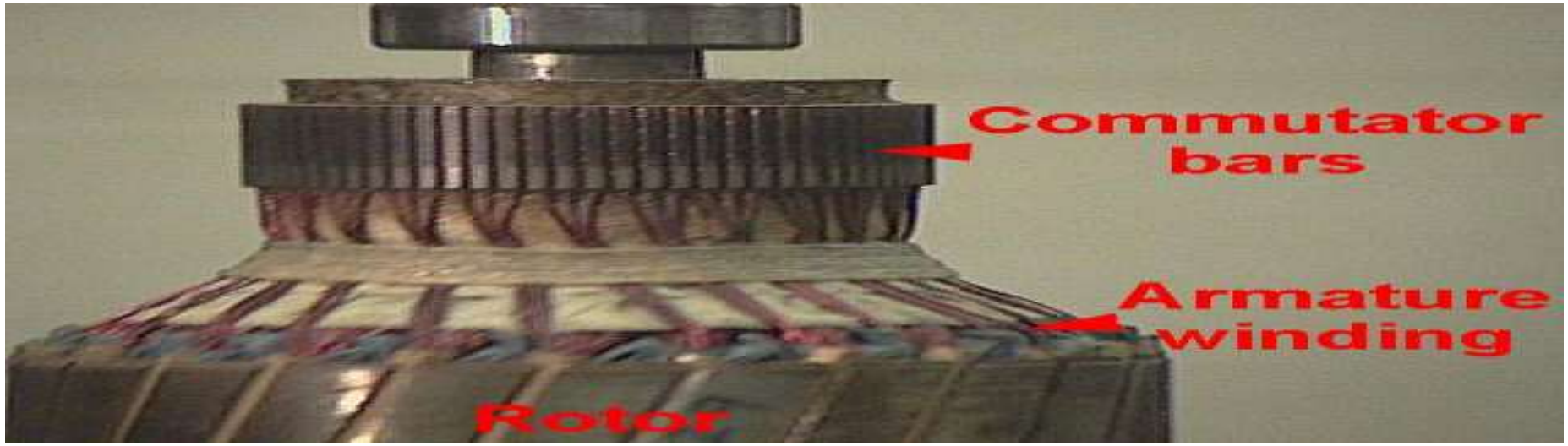
Field winding:

- ✓Placed on pole core
- ✓Carry the current and produces the magnetic flux

Armature :

- ✓Armature core –mounted on shaft & is cylindrical
- ✓Armature winding-emf is induced in armature conductors
- ✓Winding is made up of copper
- ✓High permeability silicon steel stampings
- ✓Lamination is to reduce the eddy current loss

Rotor and rotor winding



Commutator

- ✓Emf induced is alternating
- ✓To convert AC into DC
- ✓Cylindrical in shape
- ✓Made of wedge shaped copper segments
- ✓Segments are insulated from each other
- ✓Each commutator segment is connected to armature conductors.

Brushes:

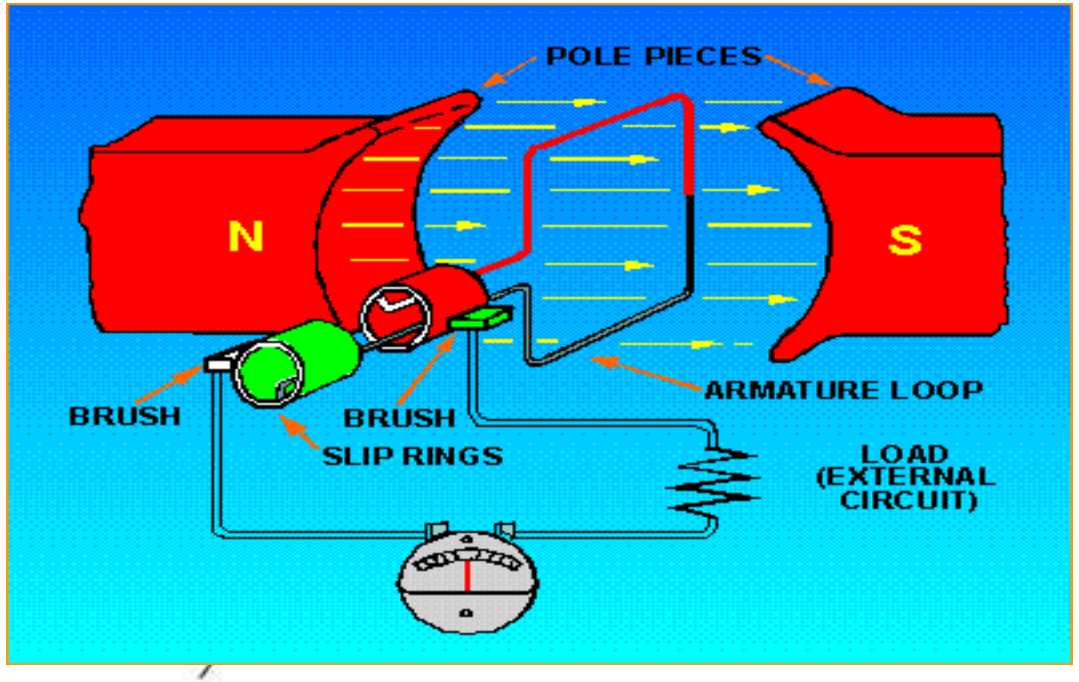
- ✓To collect current from commutator
- ✓Made up of carbon or graphite
- ✓Connected with external circuit

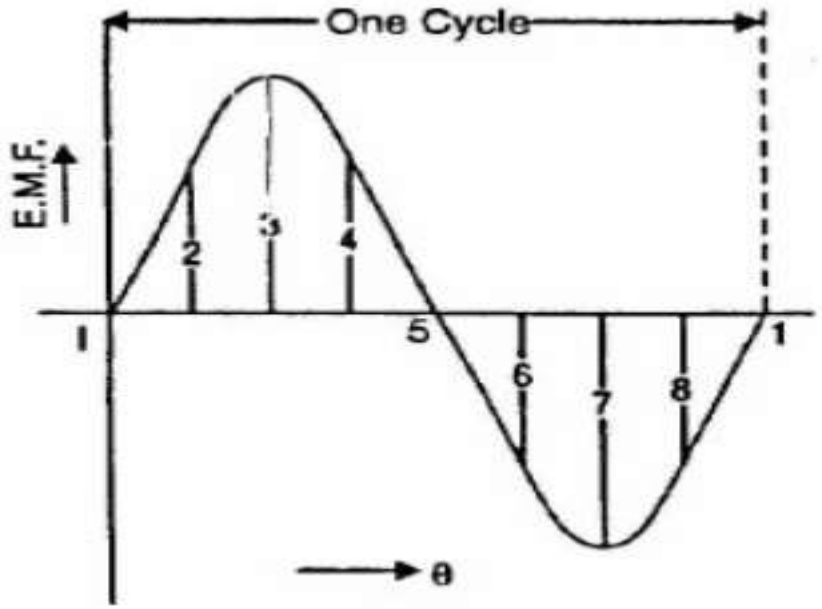
Brush rock and holder

Activity

Find the Ten Difference

Simple loop generator





ASSESSMENT

1. **The Field coils of the DC generator are made up of ----?**

(A) Steel

(B) Copper

(C) Aluminum

(D) Iron

2. **The insulating material used between the commutator segments is normally**

(A) Graphite
(B) Paper
(C) Mica
(D) Insulating varnish

EMF equation of DC generator

Let
ϕ = flux/pole in Wb
Z = total number of armature conductors
P = number of poles
A = number of parallel paths = 2 ... for wave winding
= P ... for lap winding
N = speed of armature in r.p.m.
E_g = e.m.f. of the generator = e.m.f./parallel path

Flux cut by one conductor in one revolution of the armature,

$d\phi = P\phi$ webers

Time taken to complete one revolution,

$dt = 60/N$ second

$$\text{e.m.f generated/conductor} = \frac{d\phi}{dt} = \frac{P\phi}{60/N} = \frac{P\phi N}{60} \text{ volts}$$

e.m.f. of generator,

E_g = e.m.f. per parallel path
= (e.m.f/conductor) × No. of conductors in series per parallel path

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

$$\therefore \quad E_g = \frac{P\phi ZN}{60A}$$

where A = 2 for wave winding

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THANK YOU