



SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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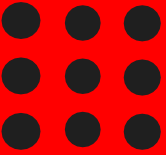
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 19EC309 ELECTRICAL MACHINES AND POWER SYSTEMS

II YEAR / 03 SEMESTER MECH & MCT

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:

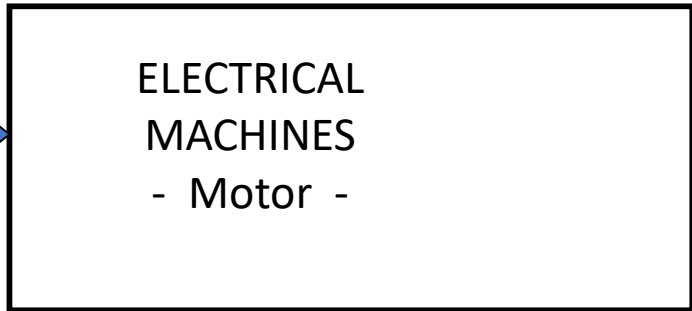
Generators – which convert mechanical energy into electrical energy

Motors – which convert electrical energy into mechanical energy

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

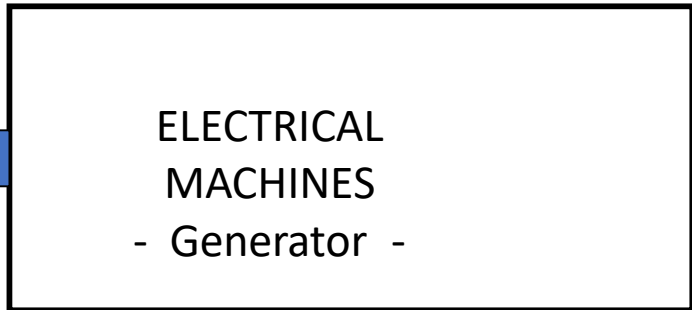


Electrical input

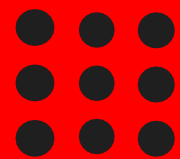


Mechanical output

Electrical output



Mechanical input



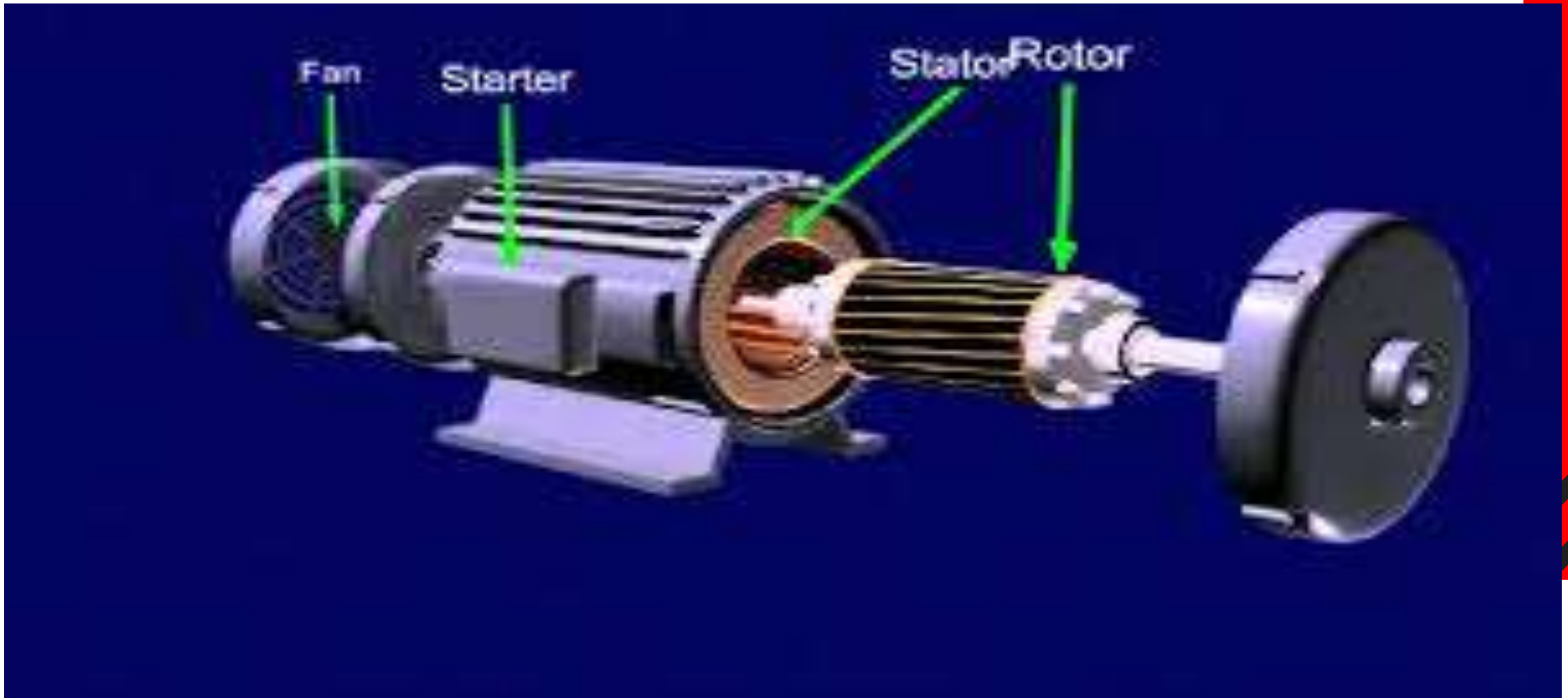
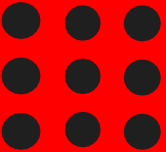


DC Generator

- 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

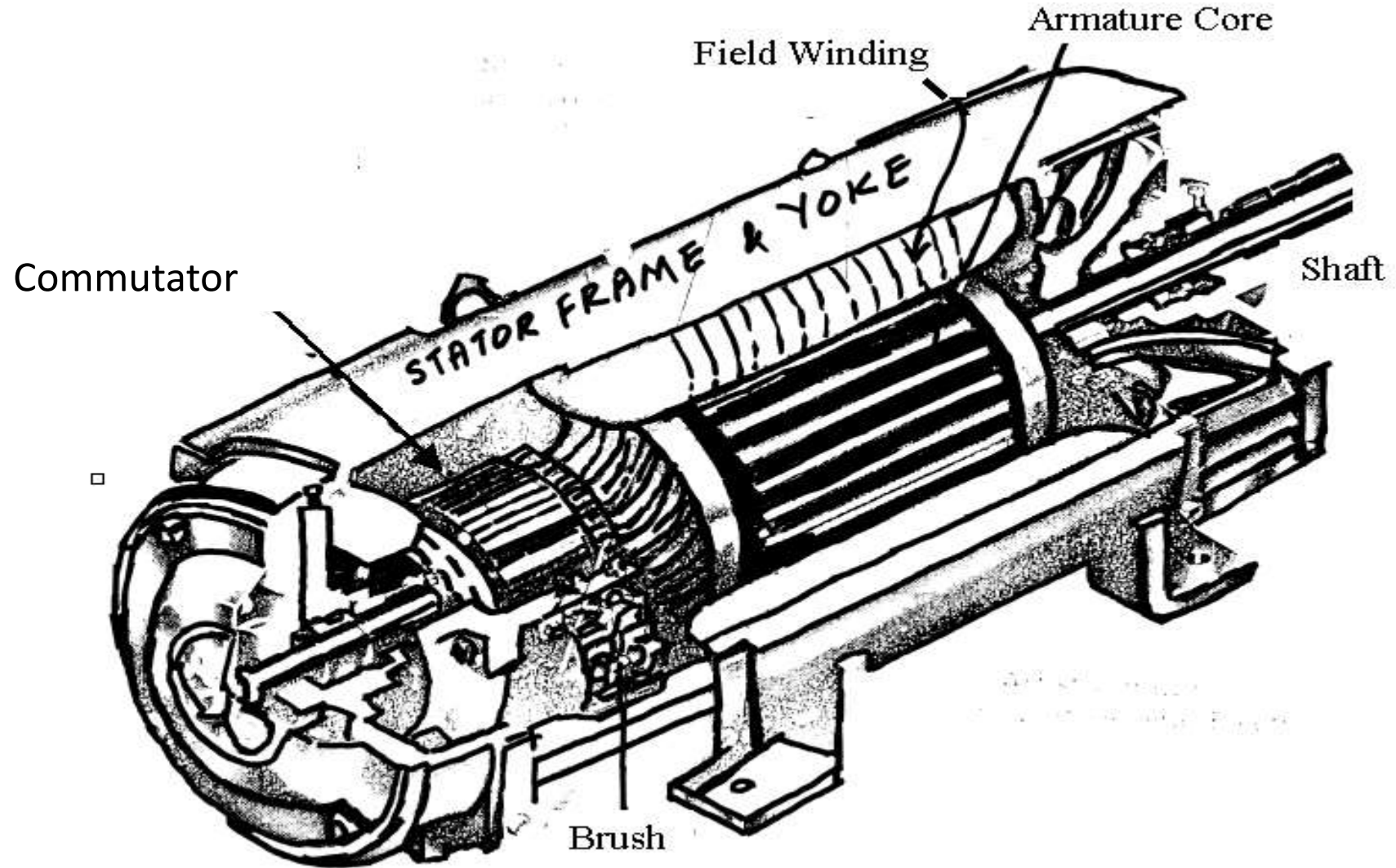


DC Machine



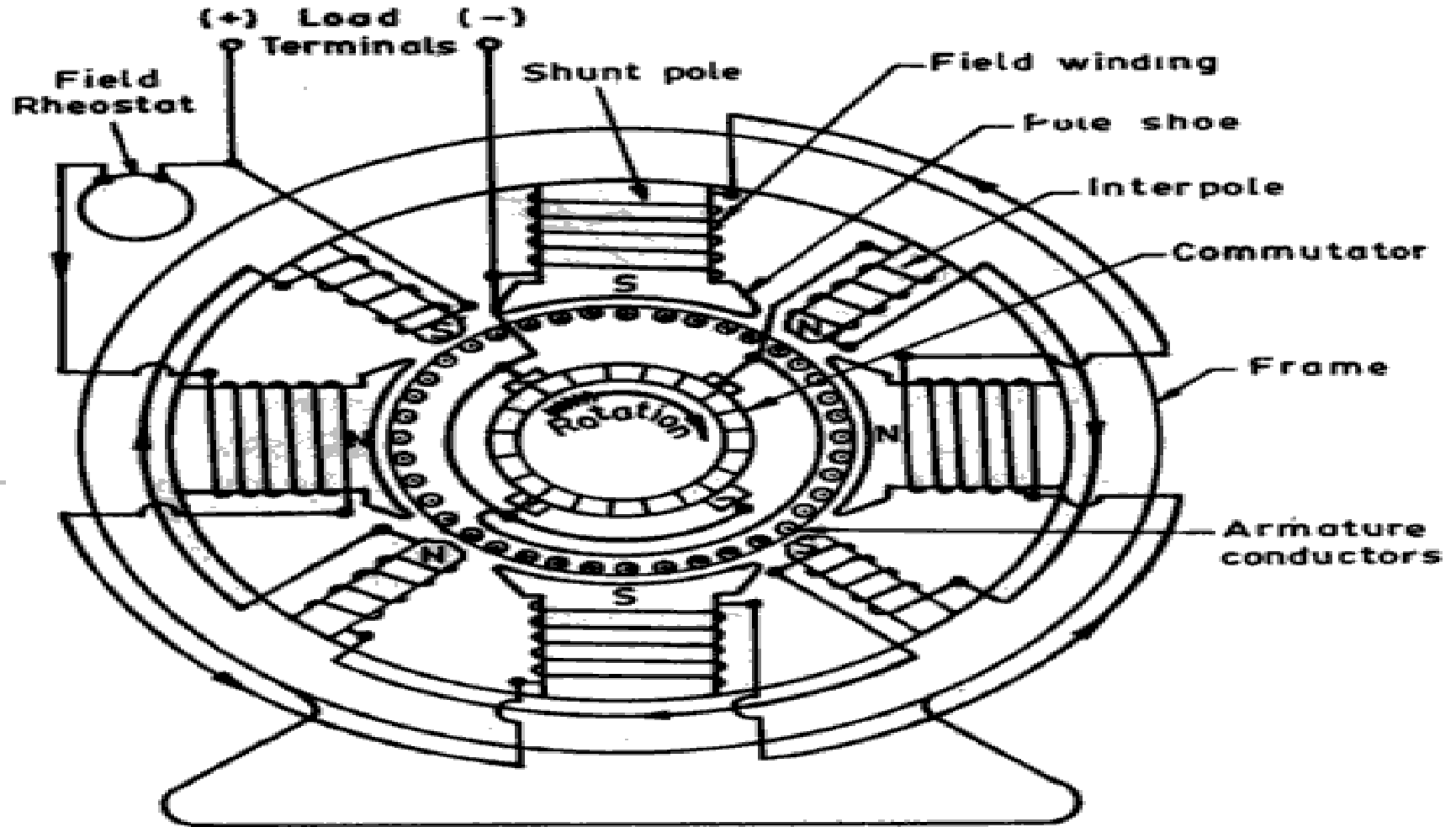


DC Machine





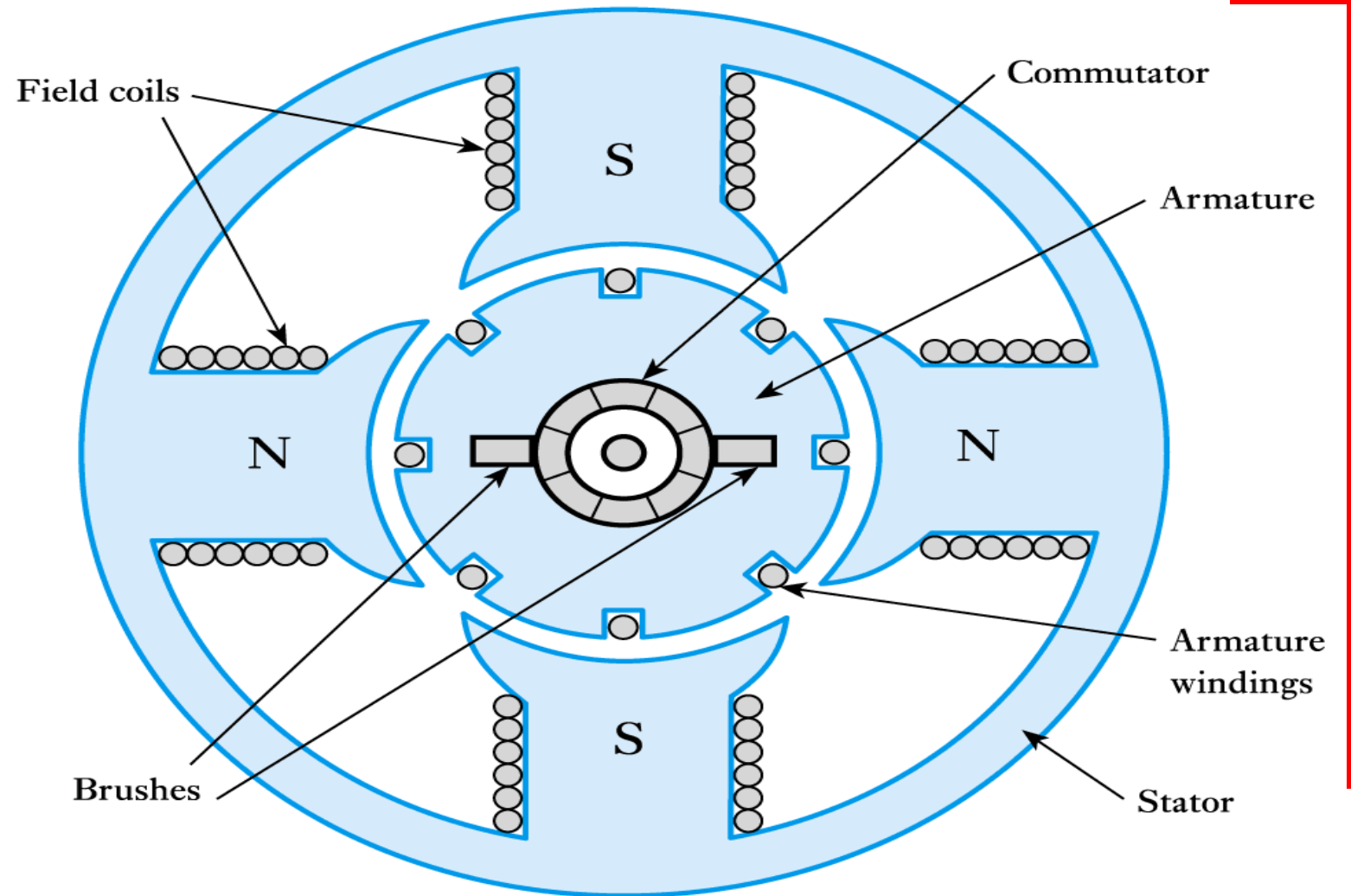
Sectional view of a DC machine





Construction of DC Generator

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



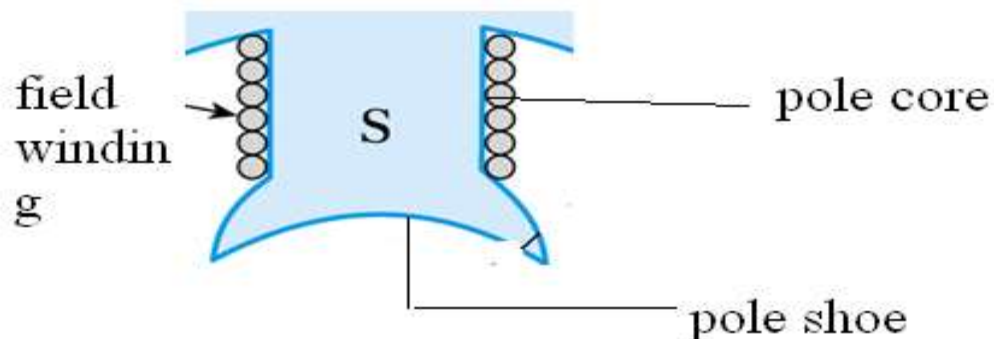


Yoke:

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

Field system:

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





Inter poles

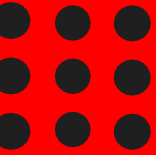
- ✓ Placed b/w main poles
- ✓ Used for improving commutation

Field winding:

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

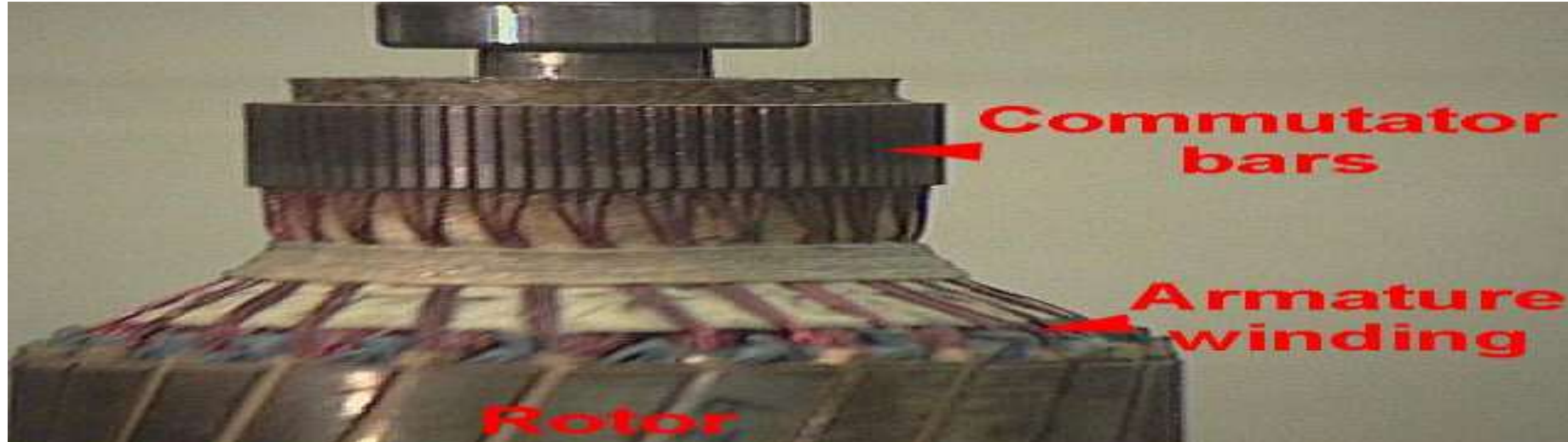
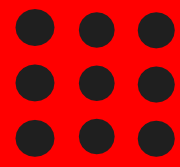
Armature :

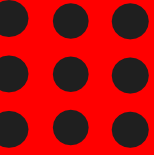
- ✓ Armature core –mounted on shaft & is cylindrical
- ✓ Armature winding-emf is induced in armature conductors
- ✓ Winding is made up of copper
- ✓ High permeability silicon steel stampings
- ✓ Lamination is to reduce the eddy current loss





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.

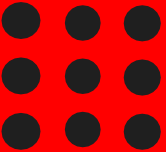
Brushes:

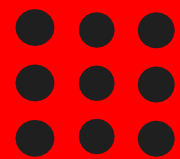
- ✓ To collect current from commutator
- ✓ Made up of carbon or graphite
- ✓ Connected with external circuit





Brush rock and holder





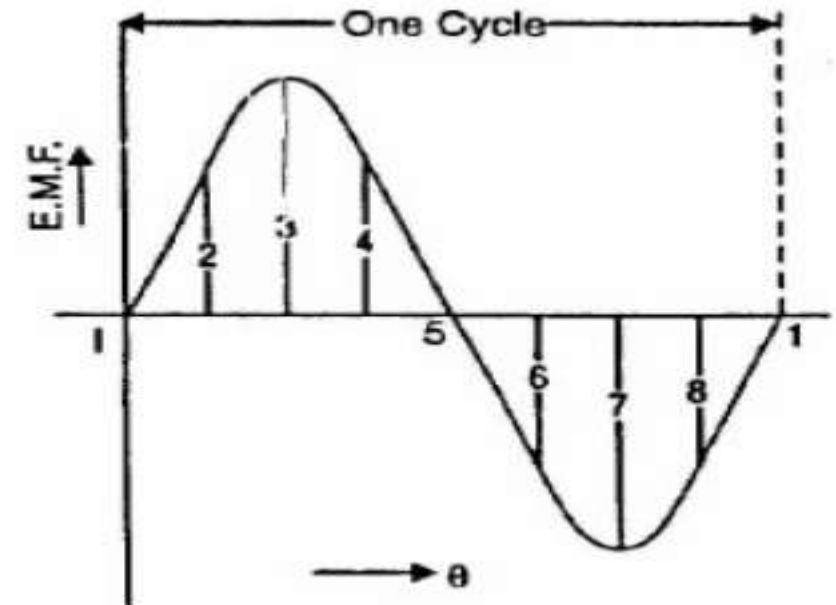
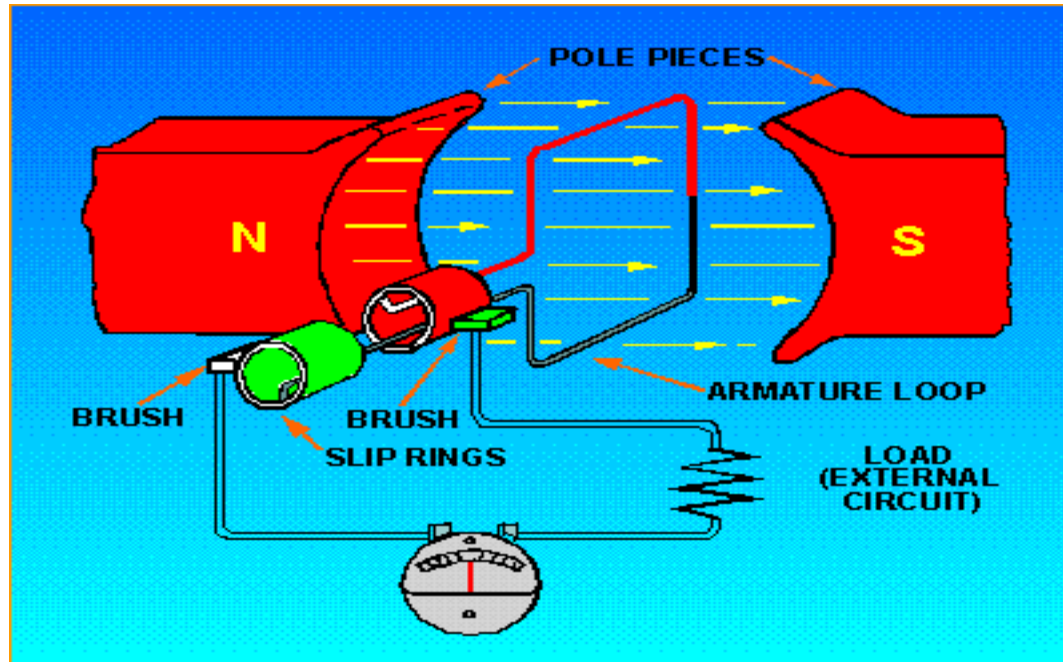
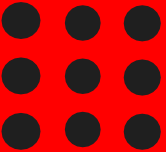
Activity

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,

$$d\phi = P\phi \text{ webers}$$

Time taken to complete one revolution,

$$dt = 60/N \text{ second}$$

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

e.m.f. of generator,

$$E_g = \text{e.m.f. per parallel path}$$

$$= (\text{e.m.f./conductor}) \times \text{No. of conductors in series per parallel path}$$

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

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

where

$$A = 2$$

DC GENERATOR/19EC309- EM&PS/MANI V/EEE/SNSCE

for-wave winding



REFERENCES

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THANK YOU