# SNS COLLEGE OF TECHNOLOGY

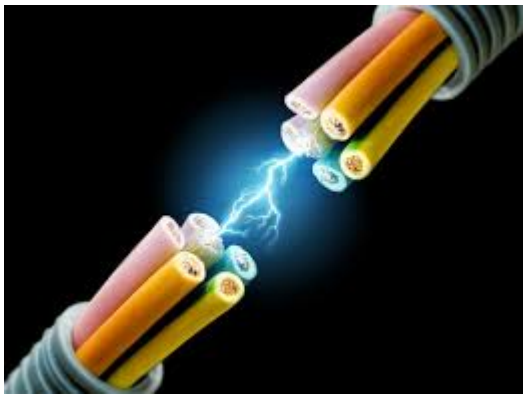
**(An Autonomous Institution)**
**COIMBATORE-35**
**Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade**
**Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai**

## 19EET101 / BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING
## I YEAR / I SEMESTER

## UNIT-II: ELECTRICAL MACHINES

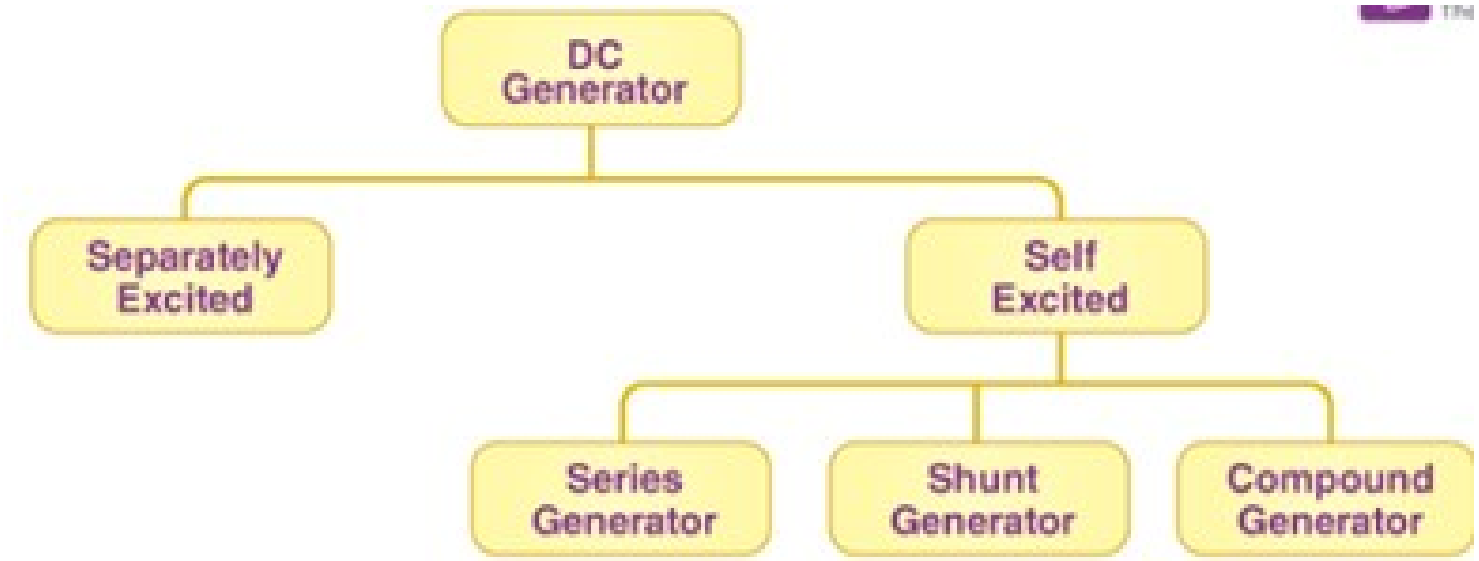
# PRINCIPLE OF OPERATION OF DC GENERATOR

# TOPIC OUTLINE



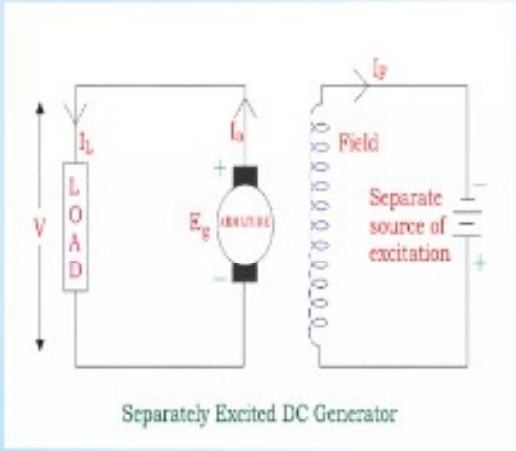
- ✓ Faraday's Laws
- ✓ Lenz Law
- ✓ Working Principle
- ✓ EMF Equation
- ✓ Applications

# Types of DC generator



# Separately Excited

These are the generators whose field magnets are energized by some external dc source such as Battery.



Separately Excited DC Generator

$I_a$ = Armature current

$I_L$ = Load current

V = Terminal voltage

$E_g$ = Generated emf

Voltage drop in the armature = $I_a \times R_a$ (R/sub>a is the armature Resistance)

Let, $I_a = I_L = I$ (say)

Then, Voltage across the load, $V = IR_a$

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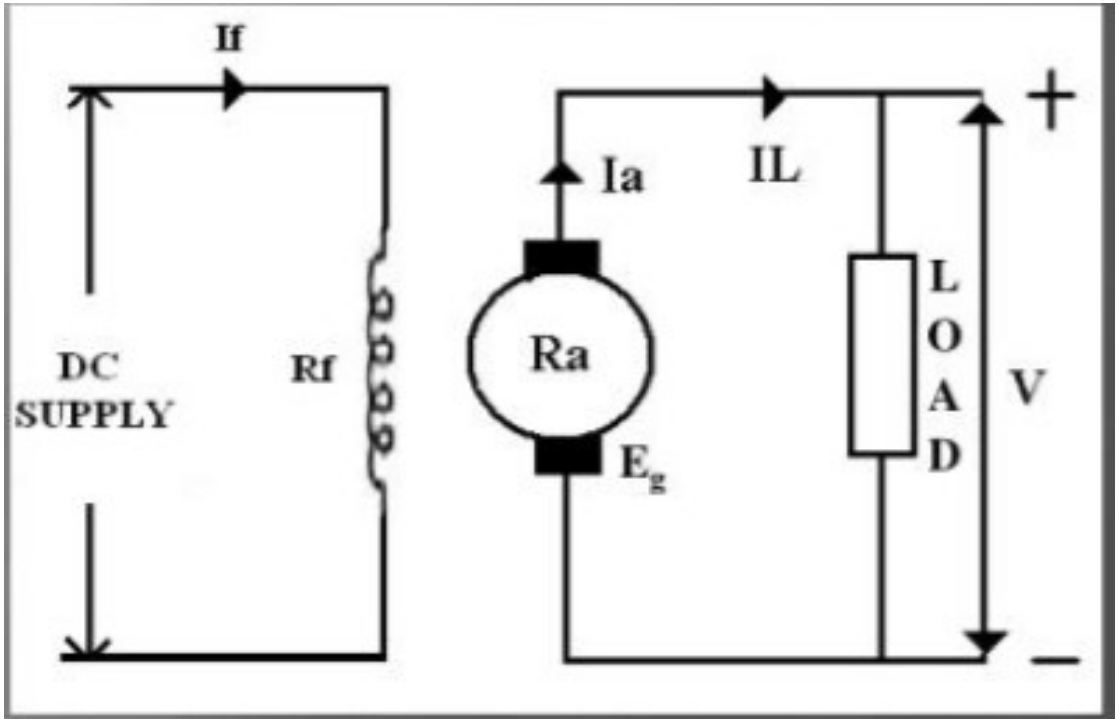
Power generated, $P_g = E_g \times I$



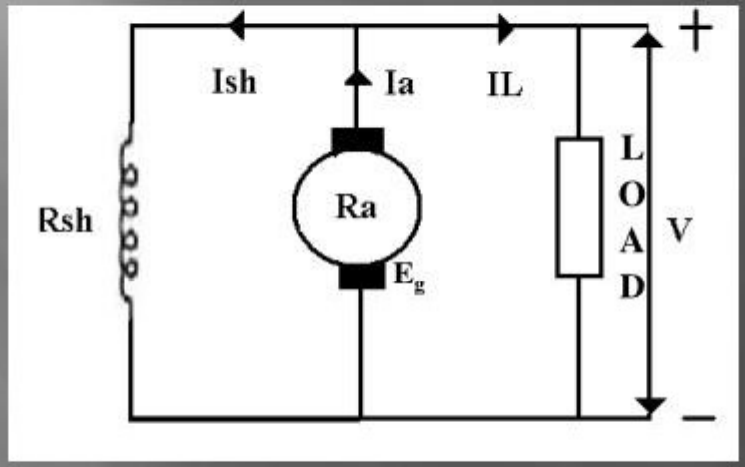

Armature current, $I_a = I_L$

Terminal voltage, $V = E_g - I_aR_a$

Electric power developed $= E_gI_a$

Power delivered to load $= E_gI_a - I_a^2R_a = I_a(E_g - I_aR_a) = VI_a$

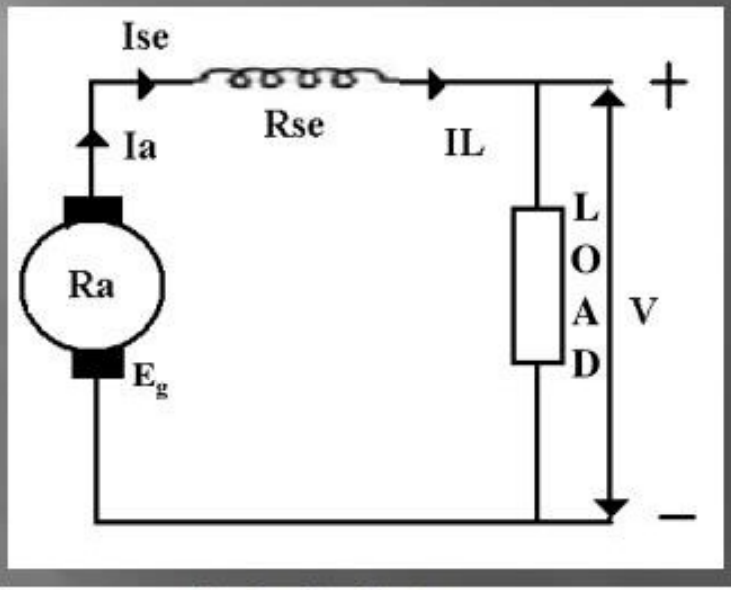
# SELF EXCITED SHUNT GENERATOR




Shunt field current, $I_{sh} = V/R_{sh}$
Armature current, $I_a = I_L + I_{sh}$
Terminal voltage, $V = E_g - I_aR_a$
Power developed in armature = $E_gI_a$
Power delivered to load = $VI_L$

D.N.DEVANI (ELECTRICAL)

# SELF EXCITED SERIES GENERATOR




Armature current, $I_a = I_{se} = I_L = I$(say)
Terminal voltage, $V = E_G - I(R_a + R_{se})$
Power developed in armature $= E_g I_a$
Power delivered to load

$$= E_g I_a - I_a^2(R_a + R_{se}) = I_a\left[E_g - I_a(R_a - R_{se})\right] = VI_a \text{ or } VI_L$$

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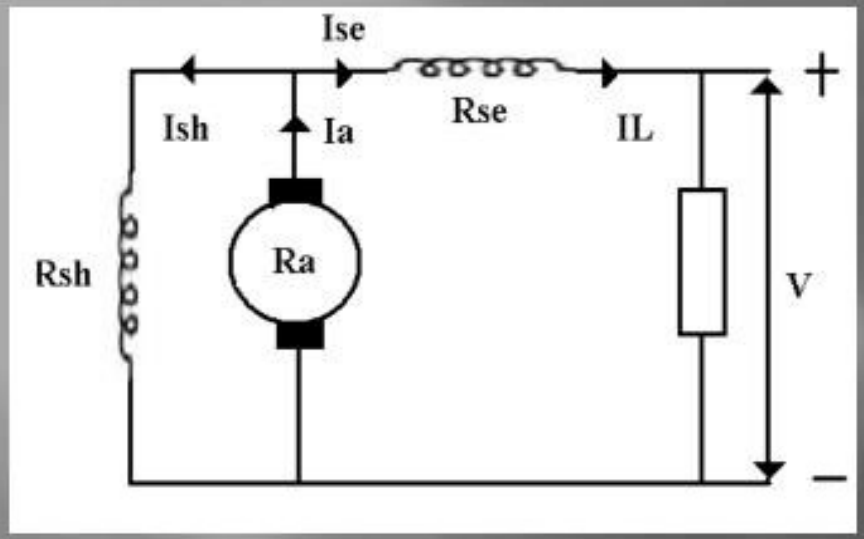
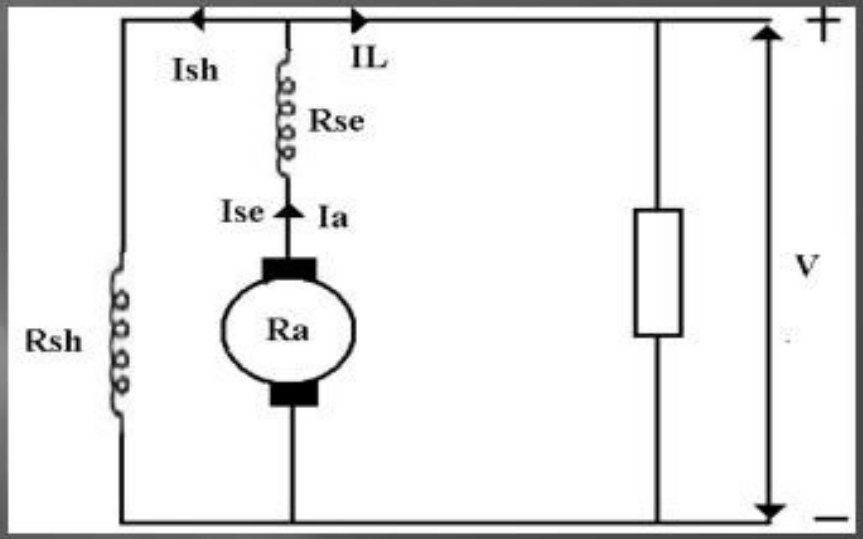
# SELF EXCITED COMPOUND GENERA.




Short shunt

Series field current, $I_{se} = I_L$

Shunt field current, $I_{sh} = \dfrac{V + I_{se}R_{se}}{R_{sh}}$

Terminal voltage, $V = E_g - I_aR_a - I_{se}R_{se}$

Power developed in armature = $E_gI_a$

Power delivered to load = $VI_L$

Long shunt

Series field current, $I_{se} = I_a = I_L + I_{sh}$

Shunt field current, $I_{sh} = V/R_{sh}$

Terminal voltage, $V = E_g - I_a(R_a + R_{se})$

Power developed in armature = $E_gI_a$

Power delivered to load = $VI_L$

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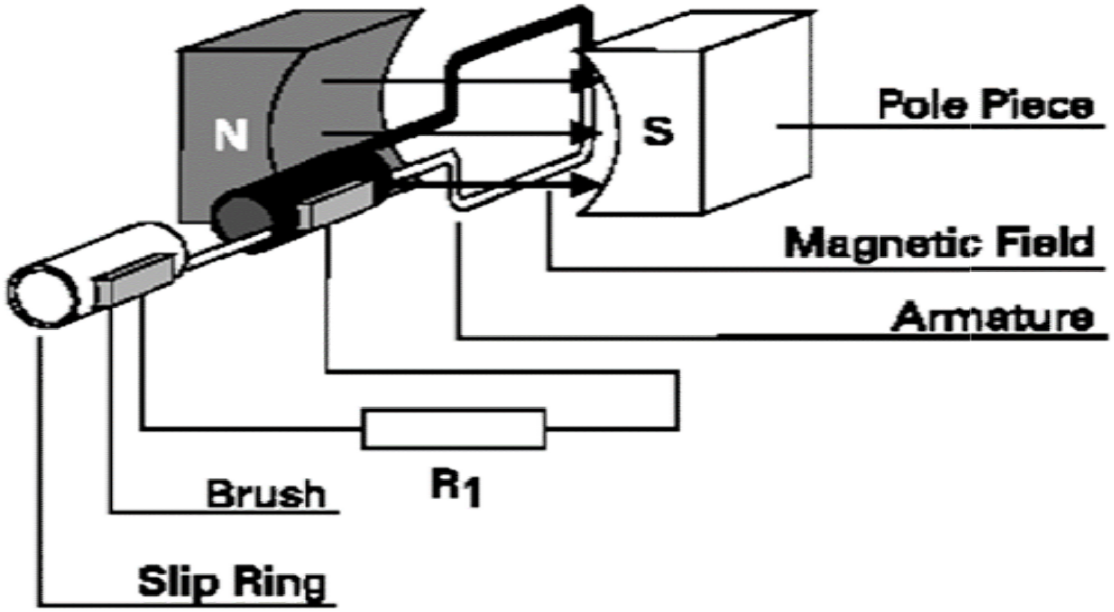
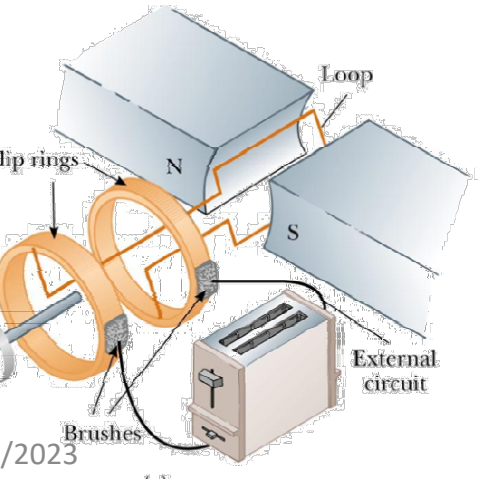
# Basic requirements to be satisfied for generation of E.M.F

1. A uniform Magnetic field
2. A System of conductors
3. Relative motion between the magnetic field and conductors

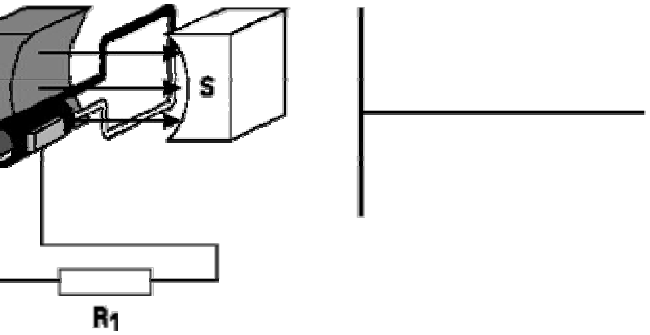


# PRINCIPLE OF OPERATION

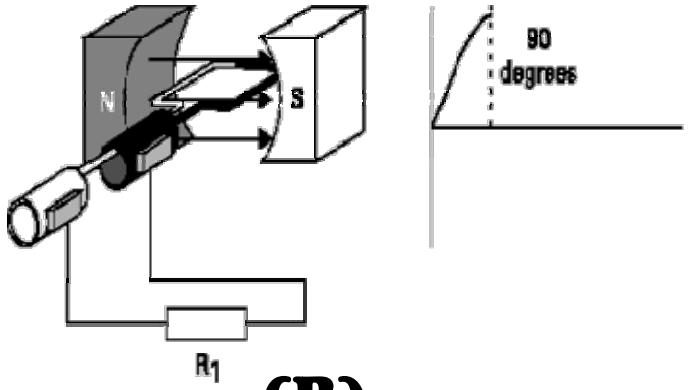
- ✓ DC generator converts mechanical energy into electrical energy.
- ✓ when a conductor move in a magnetic field in such a way conductors cut across a magnetic flux of lines and e.m.f. produces in a generator and it i defined by faradays law of electromagnetic induction e.m.f. causes curre to flow if the conductor circuit is closed.



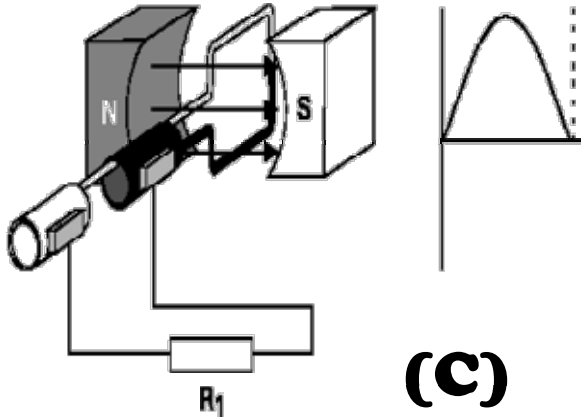
# Operation of a Generator



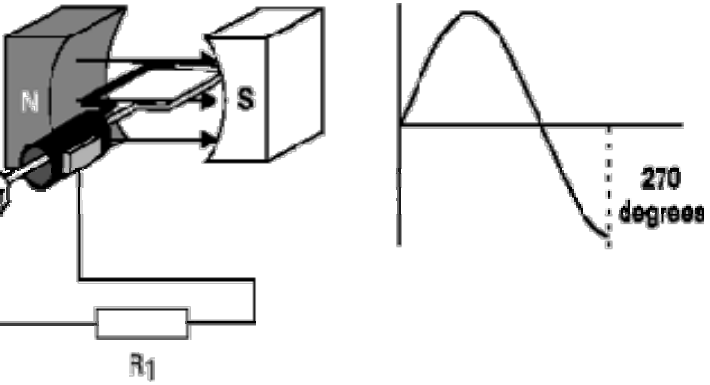

(A)



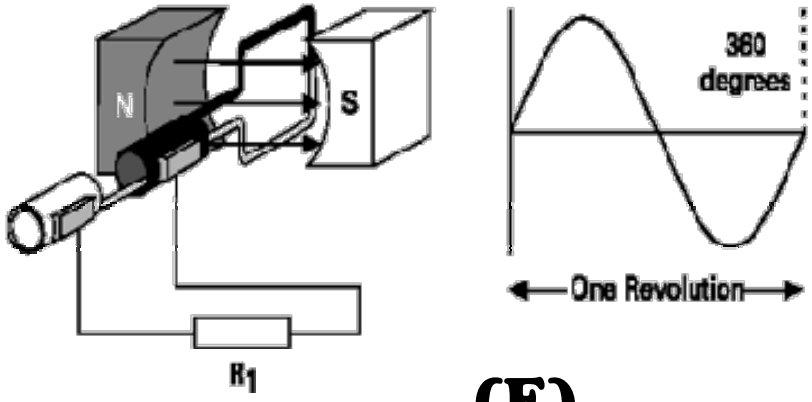

(B)




(C)

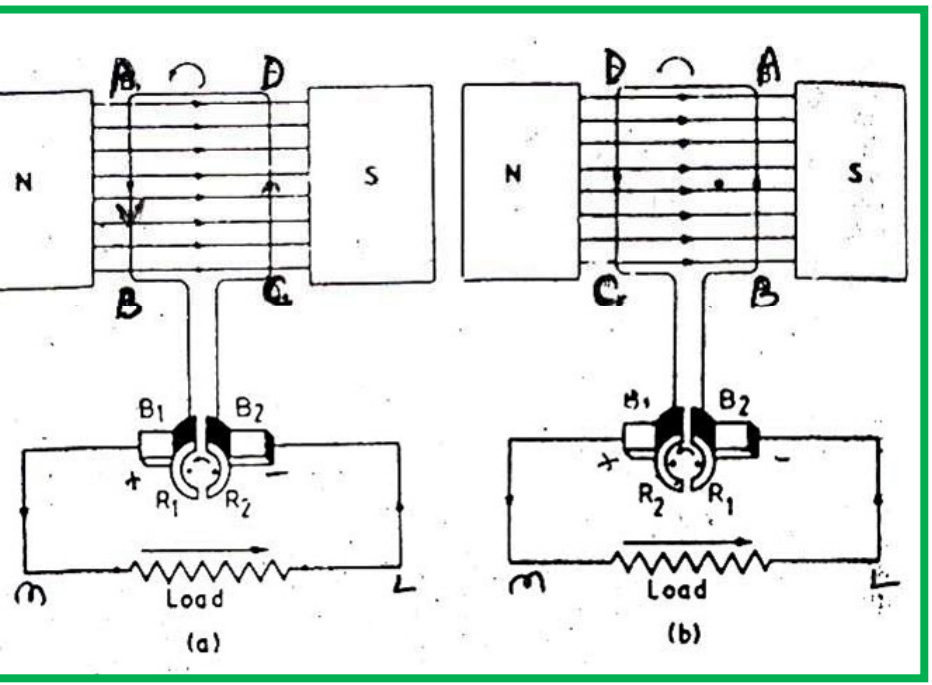



(D)



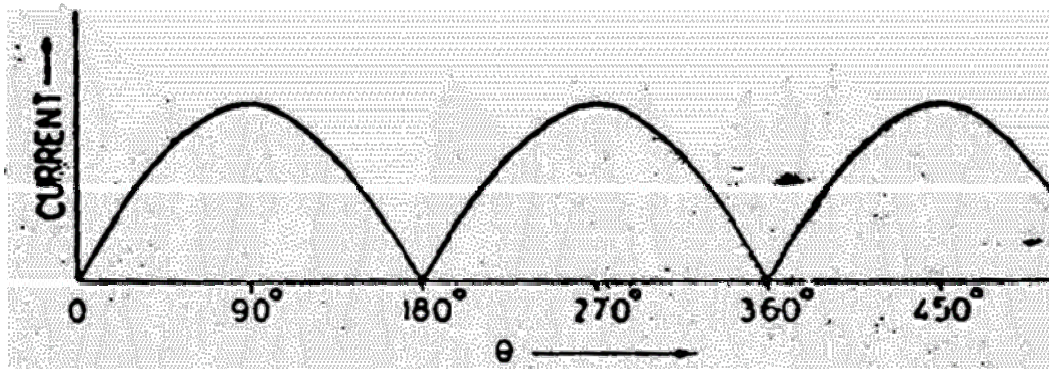

(E)

# Operation of DC Generator – Split Rings




1st half cycle($0^0$ to $180^0$ ) Path of current $ABR_1B_1MLR_2B_2CD$

2st half cycle($180^0$ to $360^0$) Path of current $DCR_2B_1MLB_2R_1BA$



# EMF Equation of DC Generator

As the armature rotates, a voltage is generated in its coils. In the case of a generator, the emf of rotation is called the Generated emf or Armature emf and is denoted as Er = Eg.

P – number of poles of the machine
ϕ – Flux per pole in Weber.
Z – Total number of armature conductors.
N – Speed of armature in revolution per minute (r.p.m).
A – number of parallel paths in the armature winding.

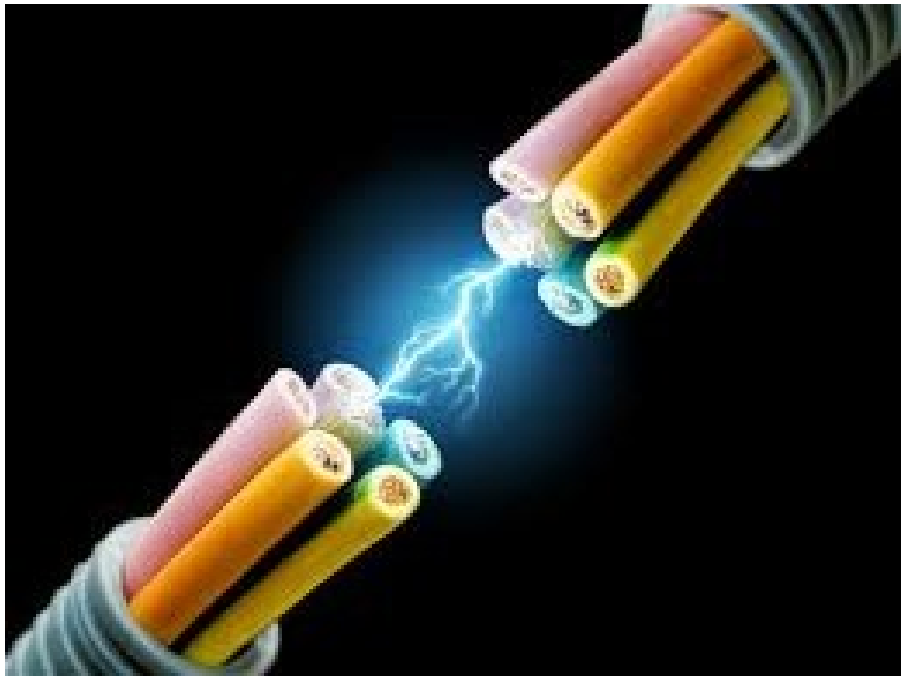
If the DC Machine is working as a Motor, the induced emf is given by the equation shown below:

$$E_g = \frac{PZ\,\varphi\,N}{60\,A} \quad \text{volts}$$

# APPLICATIONS

They are used for general lighting.
They are used to charge battery.
They are used for giving the excitation to the alternators.
They are also used for small power supply (such as a portable generator).
They are used for supplying field excitation current in DC locomotives for regenerative breaking.
This types of generators are used as boosters to compensate the voltage drop in the feeder in various types of distribution systems such as railway service.

# RECAP….



# …THANK YOU