

# Back emf

The induced emf in the rotating armature conductors always acts in the opposite direction of the supply voltage .

According to the Lenz's law, the direction of the induced emf is always so as to oppose the cause producing it .

In a DC motor , the supply voltage is the cause and hence this induced emf opposes the supply voltage.

# Classification of DC motors

DC motors are mainly classified into three types as listed below:

- Shunt motor
- Series motor
- Compound motor
  - Differential compound
  - Cumulative compound

# Torque Equation

The turning or twisting force about an axis is called torque .

▶  $P = T * 2 \pi N / 60$

▶  $E_b I_a = T_a * 2 \pi N / 60$

▶  $T \propto \phi I_a$

▶  $T_a \propto I_a^2$

# Characteristic of DC motors

- T/  $I_a$  characteristic
- N/  $I_a$  characteristic
- N/T characteristic

# Speed control of DC motors

According to the speed equation of a dc motor

$$N \propto Eb/\phi$$
$$\propto V - I_a R_a / \phi$$

Thus speed can be controlled by-

Flux control method: By Changing the flux by controlling the current through the field winding.

Armature control method: By Changing the armature resistance which in turn changes the voltage applied across the armature

# Flux control

## Advantages of flux control:

- It provides relatively smooth and easy control
- Speed control above rated speed is possible
- As the field winding resistance is high the field current is small. Power loss in the external resistance is small . Hence this method is economical

## Disadvantages:

- Flux can be increased only upto its rated value
- High speed affects the commutation, motor operation becomes unstable

# Armature voltage control method

- ▶ The speed is directly proportional to the voltage applied across the armature .
- ▶ Voltage across armature can be controlled by adding a variable resistance in series with the armature

## Potential divider control :

If the speed control from zero to the rated speed is required , by rheostatic method then the voltage across the armature can be varied by connecting rheostat in a potential divider arrangement .

# Starters for DC motors

Needed to limit the starting current .

1. Two point starter
2. Three point starter
3. Four point starter