Significance of back-emf :

Back emf

→ the voltage that is induced in the armature winding of the motor due to motor's rotation.

→ it is called as back/counter emf since it opposes the applied voltage that is driving the motor.

→ the back emf is directly proportional to the speed of the motor.

$$E_b = \frac{NP\phi Z}{60A}$$

↳ the expression is same as that for the generated emf in the DC generator.

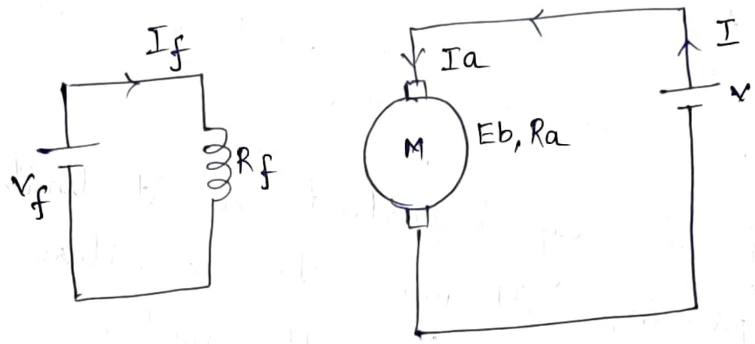
→ The back emf is very important as it limits the current flowing through the armature winding. When the speed of the motor increases, the back emf increases which in turn reduces the voltage difference between the armature and the power supply.

→ This reduces the current flowing through the armature winding, preventing the motor from drawing too much current and overheating.

Types of Motor

1. Permanent magnet
2. Separately excited
3. Self excited
   - ↳ Shunt
   - ↳ Series
   - ↳ compound ↗ long shunt ↘ short shunt

Separately Excited DC Motor



V - Supply voltage (V)

I - Supply current (A)

E_b - back emf (V)

I_a - armature current (A)

R_a - armature resistance (Ω)

V_f - field excitation voltage (V)

I_f - field current (A)

R_f - field resistance (Ω)

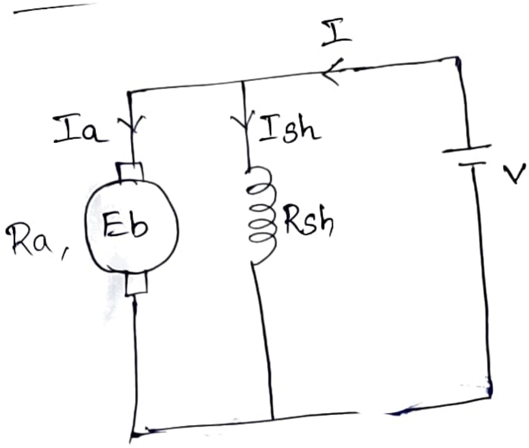
$V = E_b + I_a R_a$

$I = I_a$

$V_f = I_f R_f$

— x —

DC Shunt Motor



$I = I_a + I_{sh}$

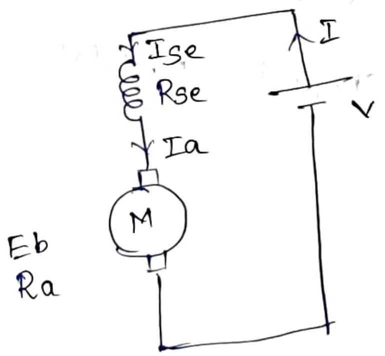
$V = E_b + I_a R_a$

$V = I_{sh} R_{sh}$

I_{sh} - Shunt field current

R_{sh} - Shunt field resistance

DC Series Motor



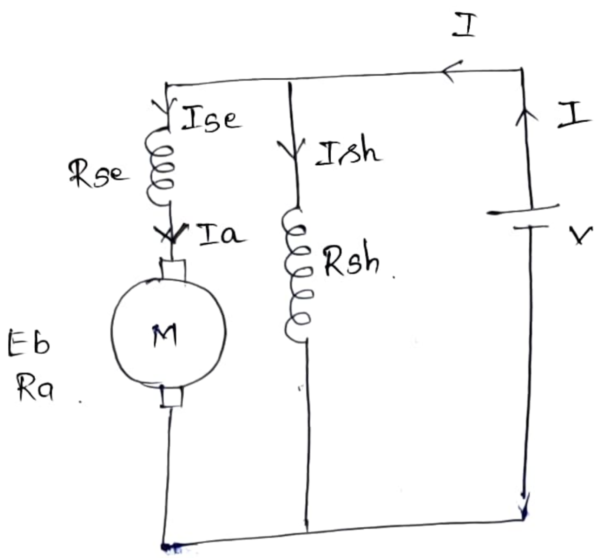
$V = E_b + I_a R_a + I_{se} R_{se}$

$I = I_a = I_{se}$

$V = E_b + I_a (R_a + R_{se})$

DC Compound Motor

Long Shunt



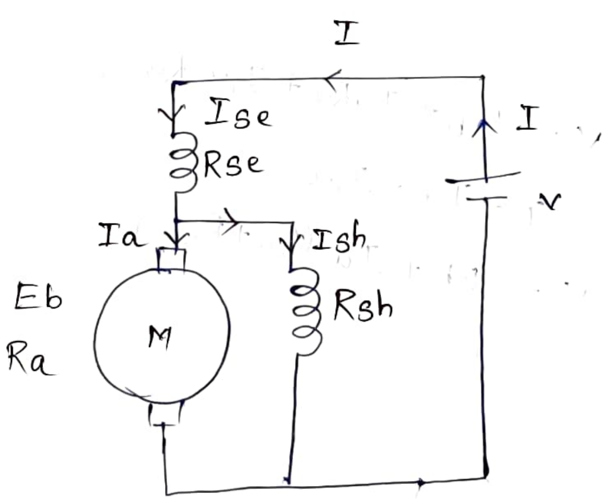
$I = I_a + I_{sh}$

$I_a = I_{se}$

$V = E_b + I_a R_a + I_{se} R_{se}$

$V = E_b + I_a (R_a + R_{se})$

Short Shunt



$I = I_{se}$

$I = I_a + I_{sh}$

$V = E_b + I_a R_a + I_{se} R_{se}$

$I_{sh} R_{sh} = E_b + I_a R_a$