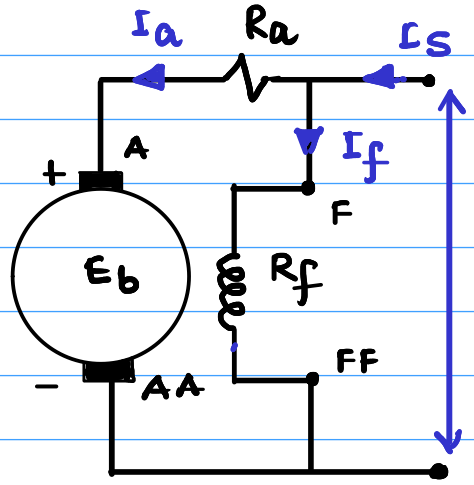
Date - 28|09|2020

Shunt DC Motor :-



$$V_s = E_b + I_a R_a + 2V_{brush}$$

$$E_b = \frac{\phi Z N}{60}\left(\frac{P}{A}\right)$$

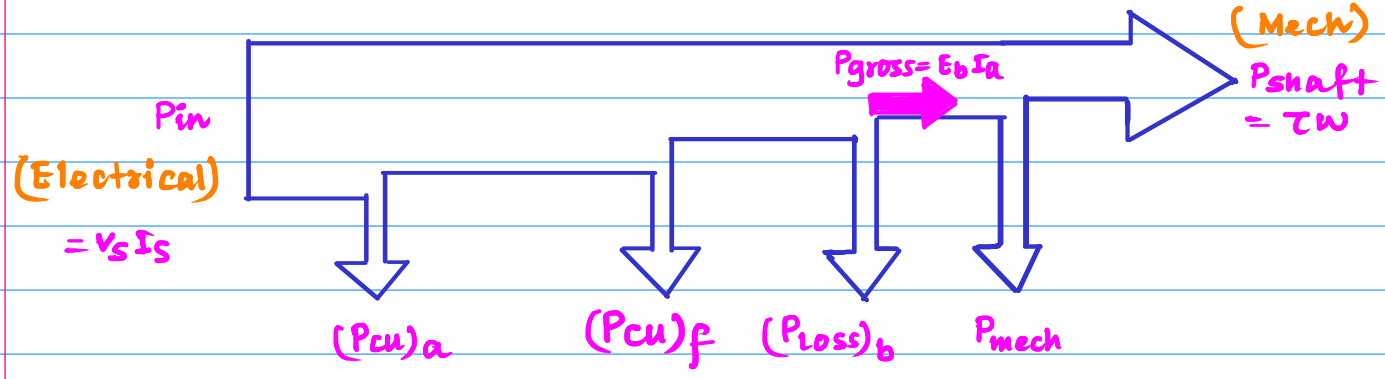
$$I_s = I_f + I_a$$

Gross Mechanical Power Developed $\Rightarrow P_{gross} = E_b I_a$

Shaft power developed $\Rightarrow P_{shaft} = P_{gross} - P_{mech}$

$$\tau_{gross} = \frac{P_{gross}}{\omega} \qquad \tau_{shaft} = \frac{P_{shaft}}{\omega}$$

$$\omega = \frac{2\pi N}{60} \text{ rad/sec.}$$



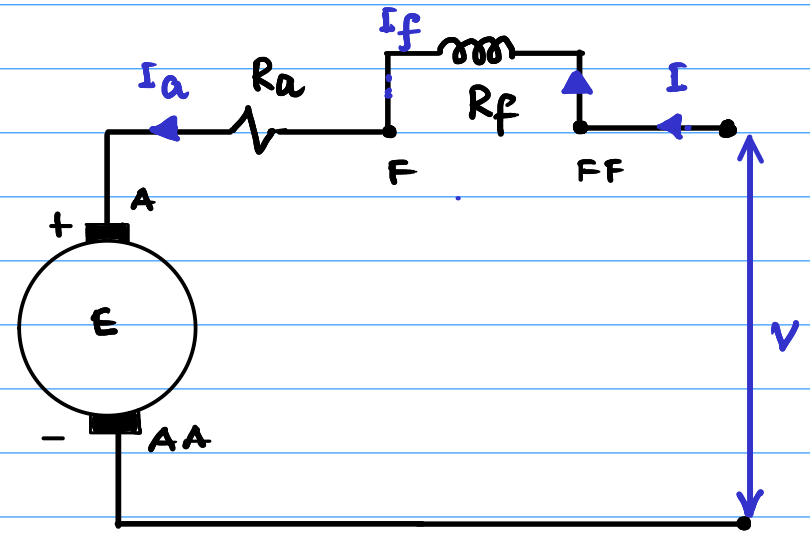
Power flow diagram of DC Shunt Motor

Efficiency for DC Motor

$$= \frac{P_{out}}{P_{in}} \times 100$$

$$= \frac{P_{out}}{P_{out} + (P_{cu})_a + (P_{loss})_b + (P_{cu})_f + P_{mech}} \times 100\ \%$$

Series DC Motor :-



$$V_s = E_b + I_a (R_a + R_f) + 2V_{brush}$$

$$E_b = \frac{\Phi Z N}{60}\left(\frac{P}{A}\right)$$

$$I_a = I_f = I_s$$

Gross mechanical power generated $P_{gross} = E_b I_a$

$(P_{cu})_a = I_a^2 R_a$

$(P_{cu})_f = I_f^2 R_f = I_a^2 R_f$

$(P_{loss})_b = 2 V_{brush} I_a$

P_{mech} = Friction and windage loss

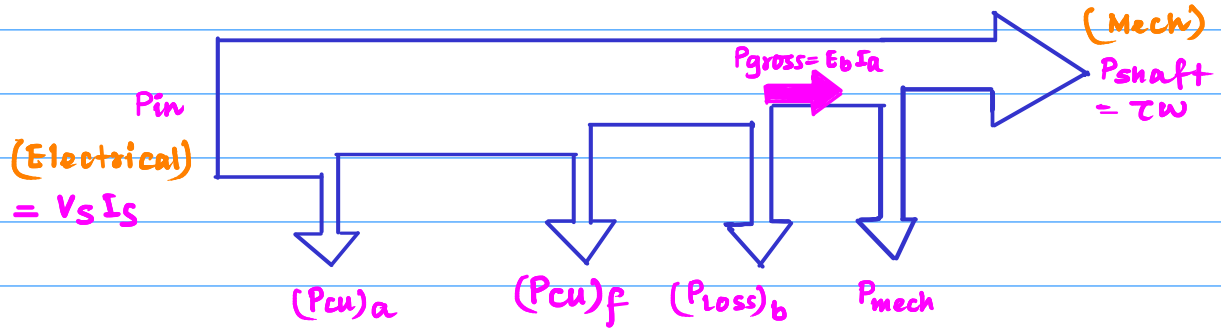
$\omega = \frac{2\pi N}{60}$ rad/sec

N = Speed in RPM

Shaft power developed $\Rightarrow P_{shaft} = P_{gross} - P_{mech}$

$\tau_{gross} = \frac{P_{gross}}{\omega}$ $\tau_{shaft} = \frac{P_{shaft}}{\omega}$

$\omega = \frac{2\pi N}{60}$ rad/sec.



Power flow diagram of DC Series Motor

Efficiency for DC Series Motor

$$= \frac{P_{out}}{P_{in}} \times 100$$

$$= \frac{P_{out} \times 100}{P_{out} + (P_{cu})_a + (P_{loss})_b + P_{mech} + (P_{cu})_f} \%$$

Problem :-

4 pole 220 V shunt motor has 540 lap-wound conductors.

Motor rating ⇒ 5.595 kw

I_f = 1 A $\qquad$ I_a = 32 A

R_a = 0.09 Ω $\qquad$ ϕ = 30 mwb

Calculate Speed and torque developed in shaft.

Soln :-

$$E_b = V_t - I_a R_a = ?$$

$$N = ?$$

$$\tau_{sh} = \frac{P_{shaft}}{\frac{2\pi N}{60}} = ?$$

Problem :-

A 500 V DC shunt motor takes a current of 5A at no load.

$R_a = 0.22\ \Omega$ $R_f = 250\ \Omega$

Find efficiency when taking a current of 100 A.

Soln :-