2- Rotor at running

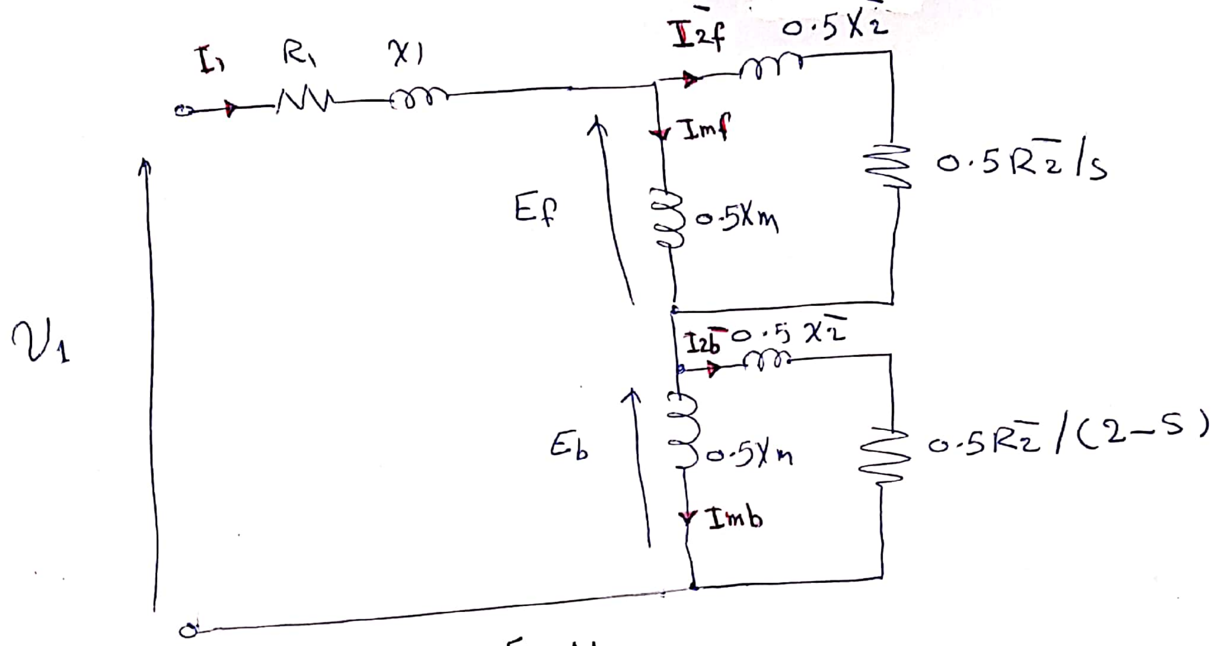
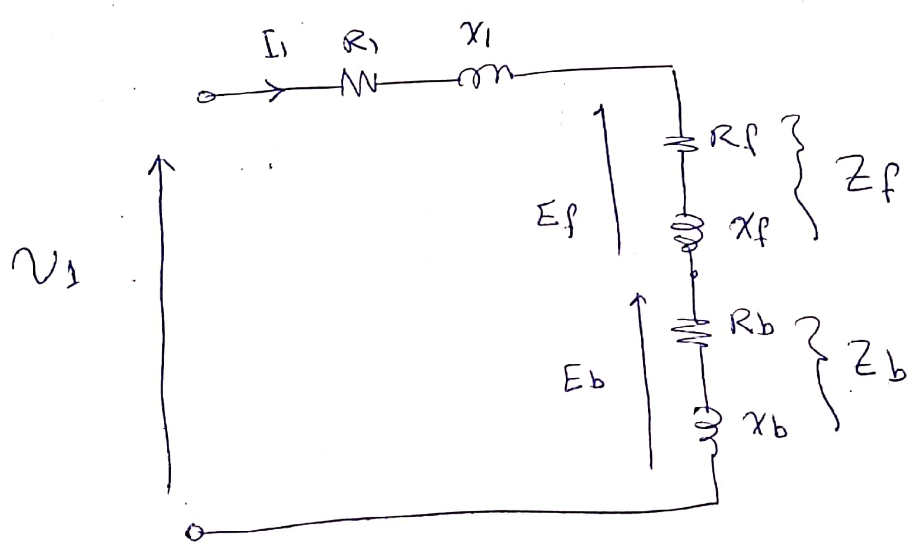


Fig. 11



$$Z_f = R_f + jX_f = j0.5X_m \,||\, (0.5R_2/S + j0.5X_2)$$

$$Z_b = (R_b + jX_b) = j0.5X_m \,||\, (0.5R_2/(2-S) + j0.5X_2)$$

Fig. 12

Inputpower = $P_i = V_1 I_1 \cos\theta$

$P_i = SCL + P_{sr}$

$P_{sr} = P_{gf} + P_{gb}$

Forward air gap power = $P_{gf} = I_{2f}^2 \frac{\bar{R_2}}{S}$

$= I_1^2 R_f$

Backward airgap power = $P_{gb} = I_{2b}^2 \frac{\bar{R_2}}{2-S}$

$= I_1^2 R_b$

$T_f = \frac{P_{gf}}{\omega_s}$, $T_b = \frac{P_{gb}}{\omega_s}$

$T = T_f - T_b$

$= \frac{1}{\omega_s} I_1^2 (R_f - R_b)$

$= \frac{1}{\omega_s} (P_{gf} - P_{gb})$

mechanical developed power = P_m

$P_m = T . \omega_r$, $\omega_r = (1-S)\omega_s$

$\therefore P_m = T . (1-S)\omega_s$

$= (1-S)\omega_s . \frac{1}{\omega_s} (P_{gf} - P_{gb})$

$= (1-S)(P_{gf} - P_{gb})$

Single phase Motors

$$\frac{0.5\bar{R_2}}{S} = 0.5\bar{R_2} + 0.5\bar{R_2}\frac{(1-S)}{S}$$

$$= R_{cuf} + R_{mech.f}$$

$$R_{cuf} = S \cdot \frac{0.5\bar{R_2}}{S} \quad , \quad R_{mech.f} = (1-S) \cdot \frac{0.5\bar{R_2}}{S}$$

$$\frac{0.5\bar{R_2}}{2-S} = 0.5\bar{R_2} + 0.5\bar{R_2}\frac{1-(2-S)}{2-S}$$

$$= R_{cub} + R_{mech.b}$$

forward rotor cuppor losses = $P_{rcuf} = S P_{gf}$

backward rotor cuppor losses = $P_{rcub} = (2-S) P_{gb}$

$$P_{rcu} = S P_{gf} + (2-S) P_{gb}$$

$$P_m = (1-S) P_{gf} + [1-(2-S)] P_{gb}$$

$$= (1-S) P_{gf} + [-1+S] P_{gb}$$

$$= (1-S)(P_{gf} - P_{gb})$$

$P_o = P_m - P_{rot}$, P_o = output power

P_{rot} = core + friction & windage losses

T_L = load torque

$$= \frac{P_o}{\omega_r}$$