Chapter 4 : Synchronous generator

$$n_m = \frac{120 f_e}{P} = n_{sync}$$

$$E_A = \sqrt{2}\, \pi N_c \phi f = K \phi \omega$$

E_A → induced voltage

General equation

$$E_A = V_\phi + I_A (R_A + X_s j)$$

Power calculations

$$P_{in} = \tau_{app} \omega_m$$

δ : The angle between E_A and V_ϕ

$$P_{conv} = \tau_{ind} \omega_m$$

$$P_{out} = \sqrt{3} V_L I_L \cos \theta$$

$$P_{copper\ losses} = 3 R_A (I_A)^2$$

Voltage Regulation

$$V_R = \frac{V_{nl} - V_{fl}}{V_{fl}}$$

Chapter 5: Synchronous Motors

At coupling $n_m = \frac{120 f_e}{P}$

General equation

$$V_\phi = E_A + I_A (R_A + X_s j)$$

$$P = \frac{3 E_A V_\phi \sin \delta}{X_s}$$ Assuming $R_A = 0$

$$\tau_{pull\ out} = 3 \tau_{rated} \text{ (full load)}$$

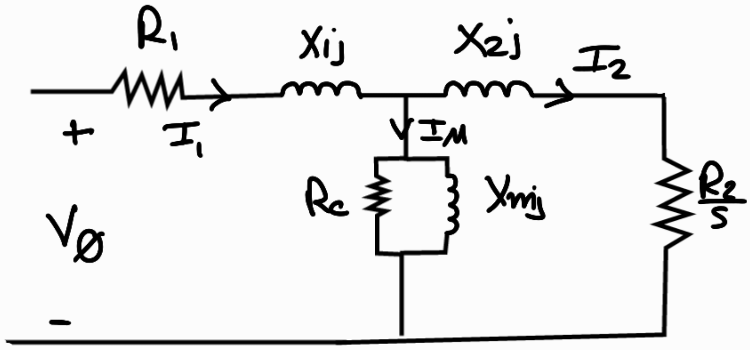
Chapter 6 : Induction Motors

$n_{slip} = n_{sync} - n_m$ $\qquad n_m =$ at full load

$n_{sync} = \frac{120 f_e}{P}$

$n_m = (1-S)\, n_{sync}$

$f_r = s f_e = \frac{P}{120}(n_{sync} - n_m)$



$Z_{eq} = R_1 + X_{1j} + \left(X_{2j} + \frac{R_2}{S} \parallel X_{mj} \right)$

$I_2 = a_{eff}\, I_1$

Power calculations

$P_{in} = \sqrt{3}\, V_L I_L\, PF$

$P_{SCL} = 3 \underbrace{I_1^2 R_1}_{\text{Stator Side}}$

$P_{RCL} = 3 I_2^2 R_2 = S P_{AG}$

$P_{AG} = P_{in} - P_{SCL} - P_{core} = 3 I_2^2 \frac{R_2}{S}$

$P_{conv} = (1-S) P_{AG}$

$$\tau_{ind} = \frac{P_{AG}}{\omega_{sync}}$$

$$\tau_{load} = \frac{P_{out}}{\omega_m}$$

$$P_{out} = P_{conv} - P_{mech} - P_{core} - P_{misc}$$

Rotor power factor

$$\theta_R = \tan^{-1}\left(\frac{X_2}{R_2/s}\right)$$

:-

$$3I_A^2 R_F = 3I_2^2 \frac{R_2}{S}$$

↳ R_F parallel of $R_2 + X_2 j$ and $X_m j$

H

General

$$PF = \tan^{-1}\left(\frac{Q}{P}\right)$$

$$S_{3\phi} = \sqrt{3}\, V_L\, I_L$$

$$P_{in} = \sqrt{3}\, V_L\, I_L\, PF$$

$$P_{out} = PF \times S_{given}$$

Y: Given

Δ: Given

$$Z_{Base} = \frac{V_{2 \text{ to } L}}{S_{3\phi} \text{ (given)}}$$