Lecture 22

Friday, 12 April 2024 3:33 PM

EE114 - Power Engineering 1

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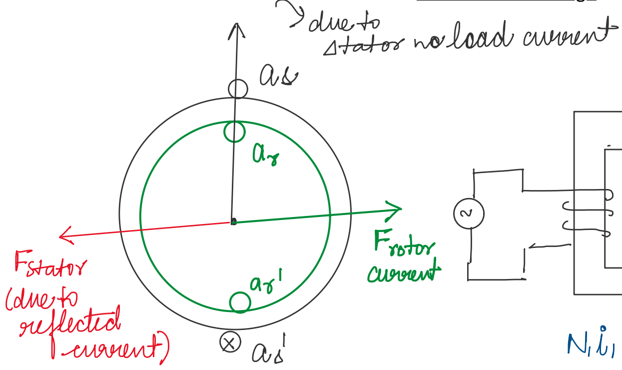
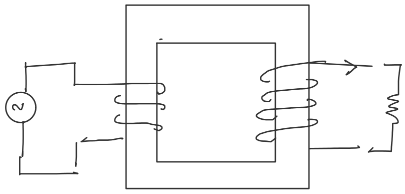
Fnet



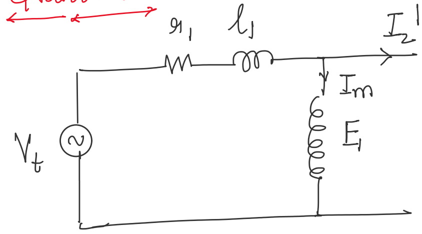


$N_1 i_1 = N_2 i_2$

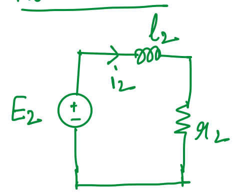
Consider the snapshot of the induction motor, The net MMF (F_{net}) is vertical. The F being linked to coil is 0, the voltage induced is maximum in rotor winding. It produces a large current producing a rotor flux in horizontal direction (F_{rotor}). To keep the net flux unchanged, stator produces a reflected current. (Draw the analogy from transformer)

$$N_r I_r = I_r' N_s$$

Stator side:-



Rotor side



$$E_2 = 4.44 N_2 s f_1 \phi_m$$

$$E_1 = 4.44 N f \phi_m$$

$$= s(4.44 N_2 f_1 \phi_m) = I_2 \times \sqrt{r_2^2 + (s l_2 \omega_1)^2}$$

$$E_1 = \frac{E_2 N_1}{s N_2}$$

Stator → Rotor

$$\frac{E_1}{N_1} = \frac{E_2}{s N_2}$$

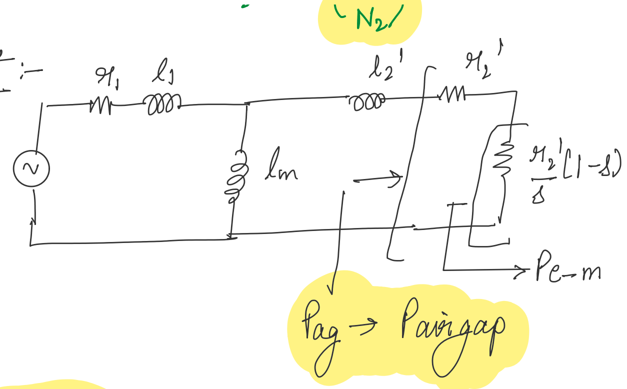
$$E_1 = \frac{N_1}{s N_2} I_2 \sqrt{r_2^2 + (s l_2 \omega_1)^2}$$

$$= \frac{N_1}{s N_2} \times \frac{N_1}{N_2} I_2' \sqrt{r_2^2 + (s l_2 \omega_1)^2}$$

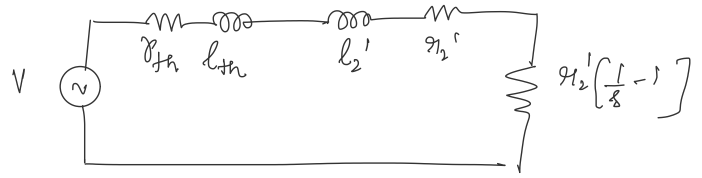
$$E_1 = I_2' \sqrt{\left(\frac{r_2'}{s}\right)^2 + (\omega l_2')^2}$$

$$r_2' = r_2 \left(\frac{N_1}{N_2}\right)^2$$

Equivalent ckt :–



$$\boxed{P_{e-m} = 3 I_2'^2 r_2' \frac{(1-s)}{s}}$$



$$\omega_r T_{em} = 3 I_2'^2 r_2' \frac{(1-s)}{s}$$

$$s = \frac{\omega_1 - \omega_r}{\omega_1}$$

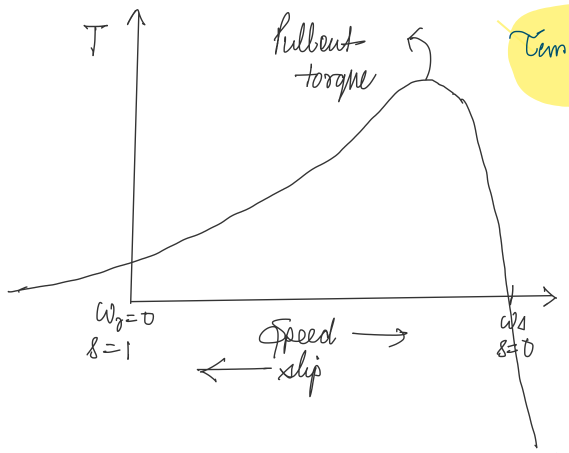
$$\omega_r = (1-s)\omega_1$$

$$T_{em}(1-s)\omega_1 = 3 I_2'^2 r_2 \frac{(1-s)}{s}$$

$$T_{em} = \frac{3}{\omega_s}\left[\frac{V_{th}^2}{\left(r_{th} + \frac{r_2'}{s}\right)^2 + (X_2' + X_{th})^2}\right] \times \frac{r_2'}{s}$$

When $s \rightarrow 0$

$$T_{em} = \frac{3}{\omega_s} \frac{V_{th}^2}{r_2'} \times s$$



At starting the induction motor draws large current because at starting $s = 1$.