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FACULTY OF ENGINEERING & TECHNOLOGY

Electrical Machine-ii

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• Rotor Frequency

The rotor e.m.f. is induced by an alternating flux and the rate at which the flux passes the conductors is the slip speed. Thus the frequency of the rotor e.m.f. is given by:

$$F_r = (n_s — n_r)\, p =(n_s — n_r)\, p \times (n_s / n_s)$$

However $(n_s — n_r)/n_s$ is the slip S and $(n_s p)$ is the supply frequency f,

Hence, $f_r = S\, f$

• Rotor Resistance

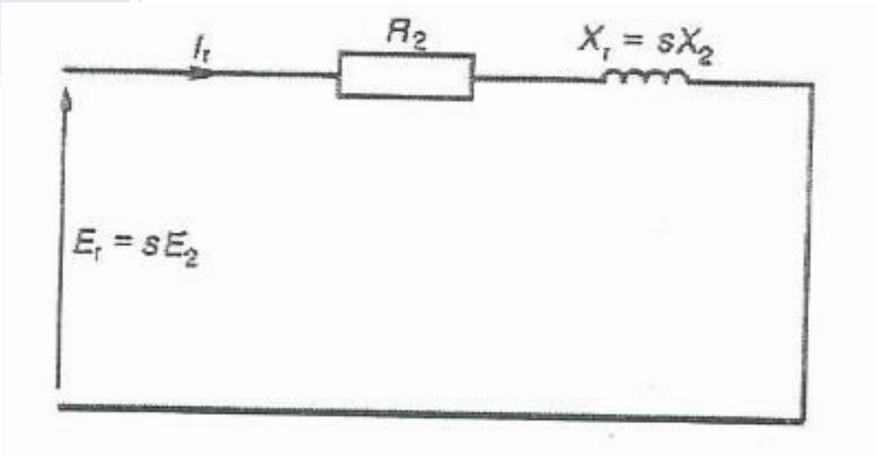
The rotor resistance R_2 is unaffected by frequency or slip, and hence remains constant.

$X_r = 2\pi\, f_r L$

$= 2\pi\, (S\, f\,)\, L$

$= S\, (2\pi\, f\, L)$

$\boldsymbol{X_r = S\, X_2}$



- ## Rotor Impedance

Rotor impedance per phase,

when running: $Z_r = \sqrt{R_2^2 + s\,X_2^2}$

At standstill, slip $S = 1$, then: $Z_r = \sqrt{R_2^2 + X_2^2}$

- ## Rotor Current

At standstill ($S=1$), starting current: $I_2 = E_2 / Z_2$

Rotor current, when running: $I_r = E_r / Z_r$

TORQUE EQUATION OF A THREE-PHASE INDUCTION MOTOR

The torque of a three-phase induction motor depends on the following factors:

- Rotor current *(I2)*
- Power factor of the rotor circuit
- Flux which links with the rotor *(φ)*

or

$$\text{Torque}(T) \propto \varphi I_2 \cos\theta_2$$

$$\text{Torque}\,(T) \propto E_2 I_2 \cos\theta_2$$

Torque Equation for Induction Motor in Running Condition

$$T_{\text{run}} = \frac{KsE_2^2 R_2}{R_2^2 + (sX_2)^2}$$

Where,

$$\text{Constant}(K) = \frac{3}{2\pi N_2}$$