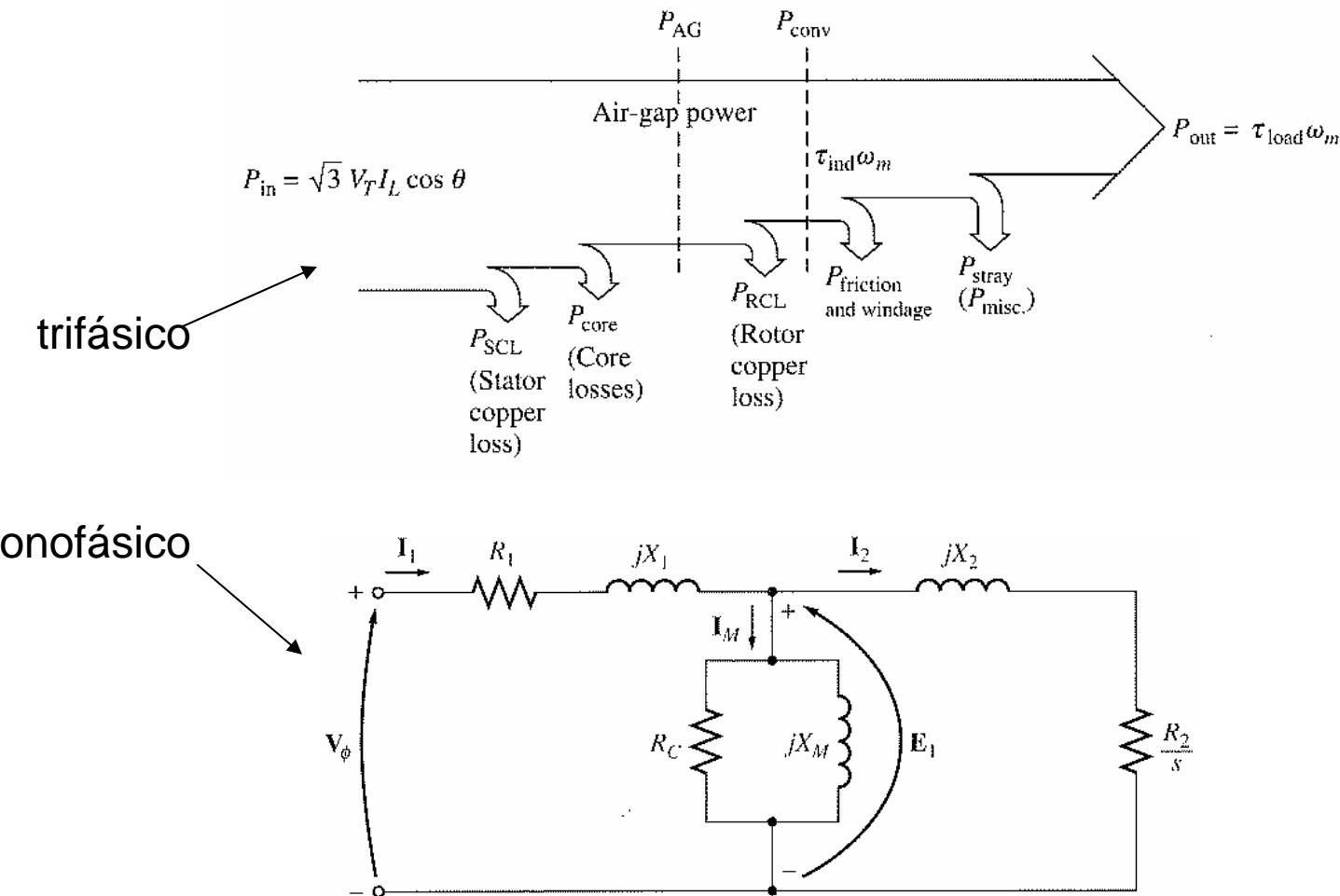


Fundamentos de Transformadores y Máquinas Eléctricas

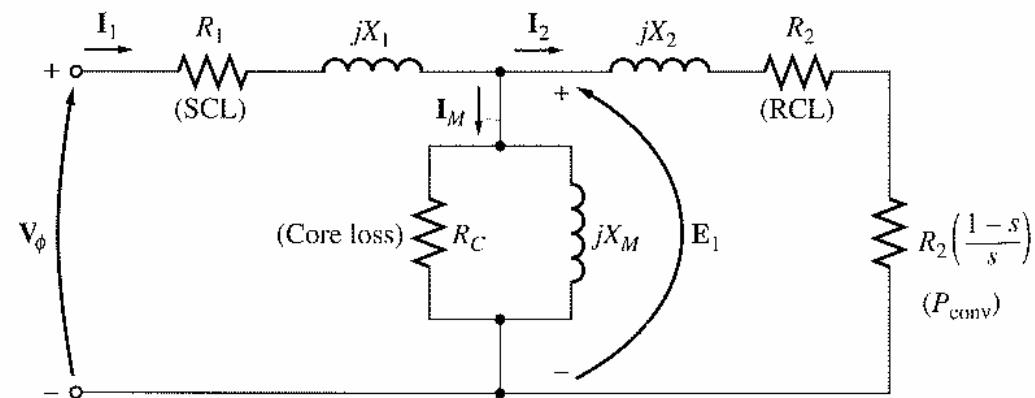
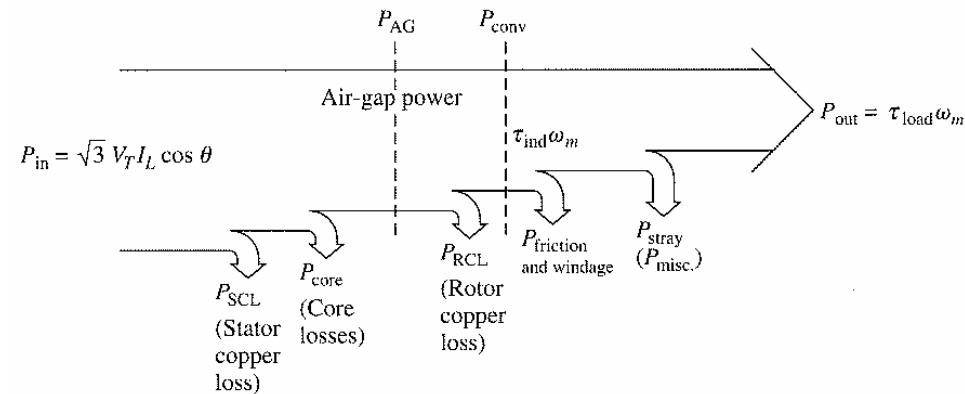
Dr. Lionel R. Orama Exclusa, PE

Clase 15

Potencia y Torque en el IM



Separando Perdidas en Rotor y P_{CONV}



Torque y Velocidad en el IM

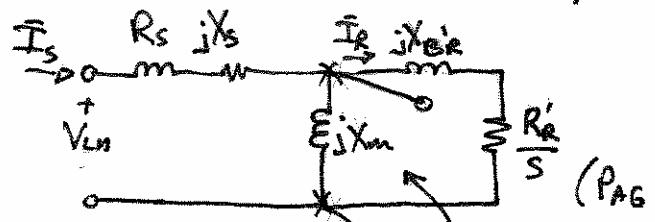
Potencia Convertida

$$P_{\text{conv}} = \tau_{\text{ind}} \omega_r$$

$$\tau_{\text{ind}} = \frac{P_{\text{conv}}}{\omega_r} = \frac{(1-s) P_{\text{AG}}}{(1-s) \omega_{\text{sync}}}$$

$$\tau_{\text{ind}} = \frac{P_{\text{AG}}}{\omega_s} //$$

$$P_{\text{AG}} = 3 I_R^2 \frac{R_R}{s}$$



Thevenin Equivalent

Aplicando Teorema de Thevenin

$$\bar{V}_{TH} = \bar{V}_{m_n} \frac{\bar{Z}_e}{\bar{Z}_s + \bar{Z}_e} = \bar{V}_{m_n} \frac{j X_m}{R_s + j(X_s + X_m)}$$

$$V_{TH} = V_{m_n} \frac{X_m}{\sqrt{R_s^2 + (X_s + X_m)^2}} ; \quad X_m \gg R_s, X_m \gg X_s$$

Torque y Velocidad en el IM

$$V_{TH} = V_{Ln} \frac{X_m}{X_s + X_m}$$

$$\bar{Z}_{TH} = (R_s + jX_s) // jX_m = \frac{1}{\frac{1}{R_s + jX_s} + \frac{1}{jX_m}} = \frac{1}{jX_m(R_s + jX_s)}$$

$$\bar{Z}_{TH} = \frac{jX_m(R_s + jX_s)}{R_s + j(X_m + X_s)} ; X_m \gg X_s ; X_m \gg R_s$$

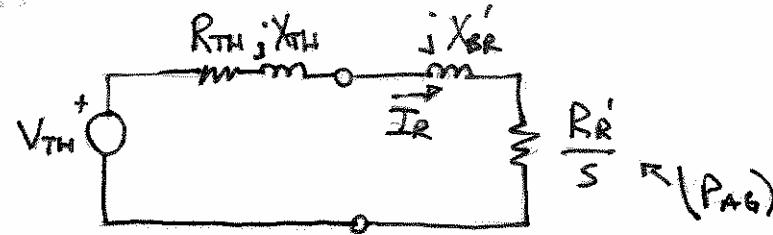
$$R_{TH} \approx R_s \left(\frac{X_m}{X_s + X_m} \right)^2$$

$$X_{TH} \approx X_s$$

Torque y Velocidad en el IM

INTEL 4085

CLASIFICACIÓN



$$\bar{I}_R = \frac{\bar{V}_{TH}}{\left(R_{TH} + \frac{R'_R}{s} \right) + j(X_{TH} + X_{BR}')}$$

$$I_R = \frac{V_{TH}}{\sqrt{\left(R_{TH} + \frac{R'_R}{s} \right)^2 + (X_{TH} + X_{BR}')^2}}$$

$$P_{AG} = 3 \bar{I}_R^2 \frac{R'_R}{s} = 3 \left[\frac{V_{TH}^2}{\left(R_{TH} + \frac{R'_R}{s} \right)^2 + (X_{TH} + X_{BR}')^2} \right] \frac{R'_R}{s}; \quad P_{conu} = (1-s)P_{AG}$$

Torque y Velocidad en el IM

$$T_{ind} = \frac{P_{AG}}{\omega_{syn}}$$

$$T_{ind} = \frac{3 V_{TH}^2 R_e}{s \omega_s [(R_{TH} + R_e/s)^2 + (X_{TH} + X_{BE})^2]}$$

$$\omega_R = (1-s) \omega_{syn}$$

- Notas:
- 1) A n_{sync} , T_{ind} es 0.
 - 2) Torque Vs n_r es casi lineal entre sin carga y plena carga
 - 3) Hay un torque máximo ("Pull out or Breakdown Torque") después del cual el T_{ind} decrece rápidamente a 0.