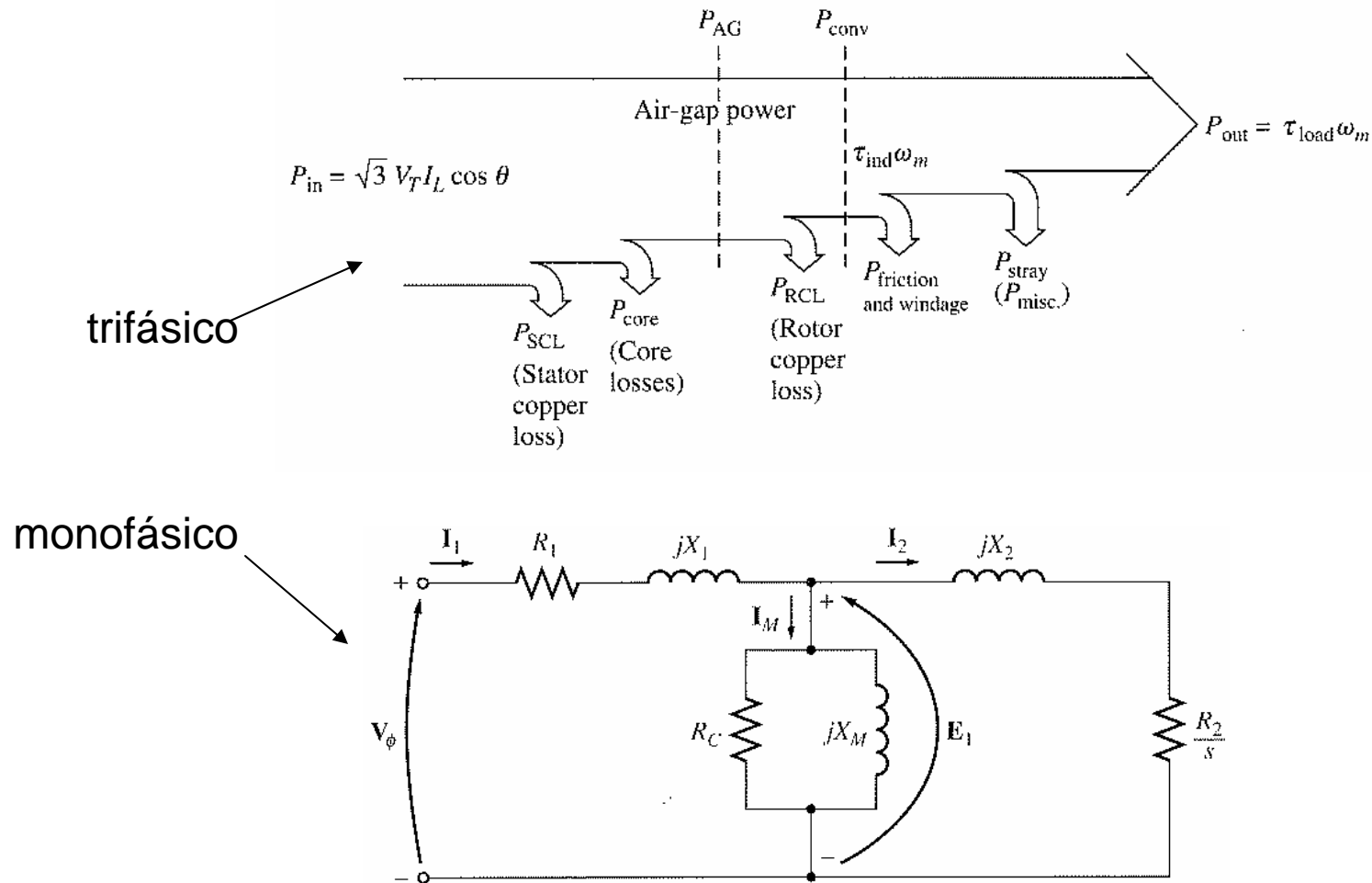


Fundamentos de Transformadores y Máquinas Eléctricas

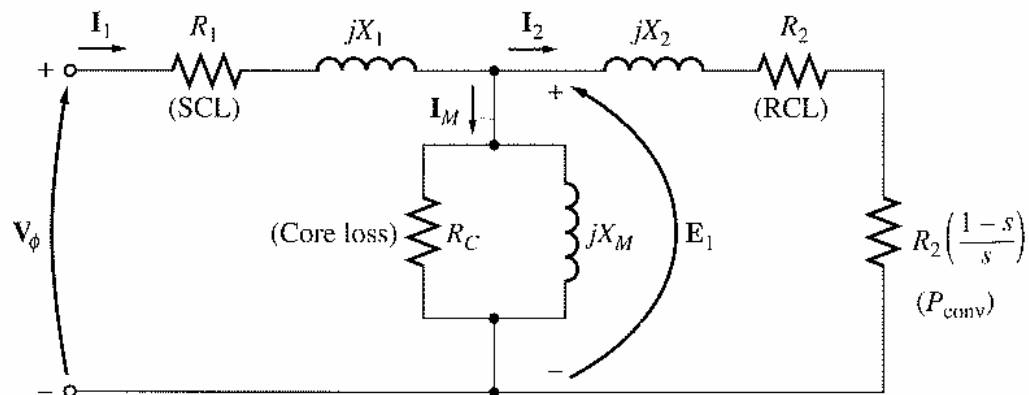
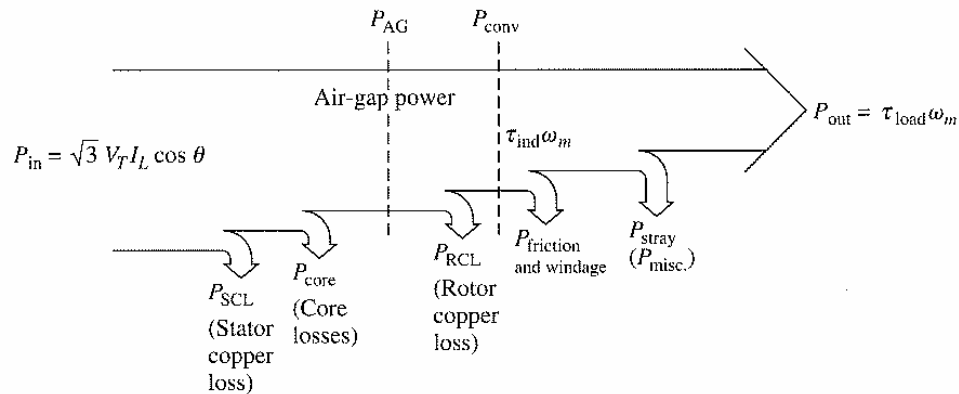
Dr. Lionel R. Orama Exclusa, PE

Clase 15

Potencia y Torque en el IM



Separando Perdidas en Rotor y P_{CONV}



Torque y Velocidad en el IM

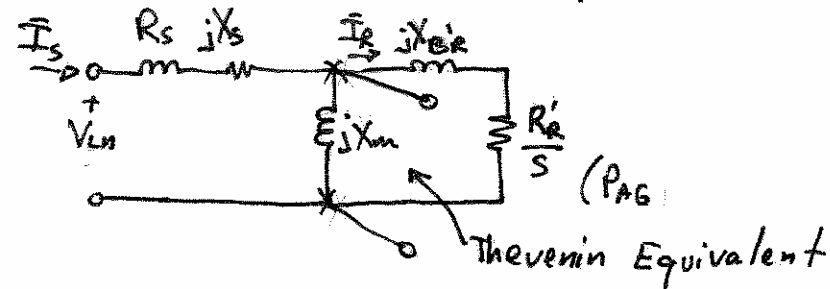
Potencia Convertida

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

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

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

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



Aplicando Teorema de Thevenin

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

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

Torque y Velocidad en el IM

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

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

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

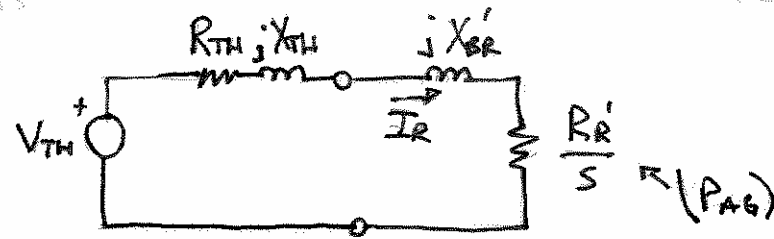
$$R_{TH} \approx R_s \left(\frac{X_m}{X_s + X_m} \right)^2$$

$$X_{TH} \approx X_s$$

Torque y Velocidad en el IM

INEL 4085

CLASE 12



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

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

$$P_{AG} = 3 I_R^2 \frac{R'_R}{s} = 3 \left[\frac{V_{TH}^2}{\left(R_{TH} + \frac{R'_R}{s}\right)^2 + \left(X_{TH} + X'_{BR}\right)^2} \right] \frac{R'_R}{s} ; P_{conv} = (1-s)P_{AG}$$

Torque y Velocidad en el IM

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

$$\tau_{ind} = \frac{3 V_{TH}^2 R'_e}{s \omega_s [(R_{TH} + R'_e/s)^2 + (X_{TH} + X'_{eR})^2]}$$

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

Notas: 1) A n_{sync} , τ_{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 τ_{ind} decae rápidamente a 0.