Fundamentos de Transformadores y Máquinas Eléctricas

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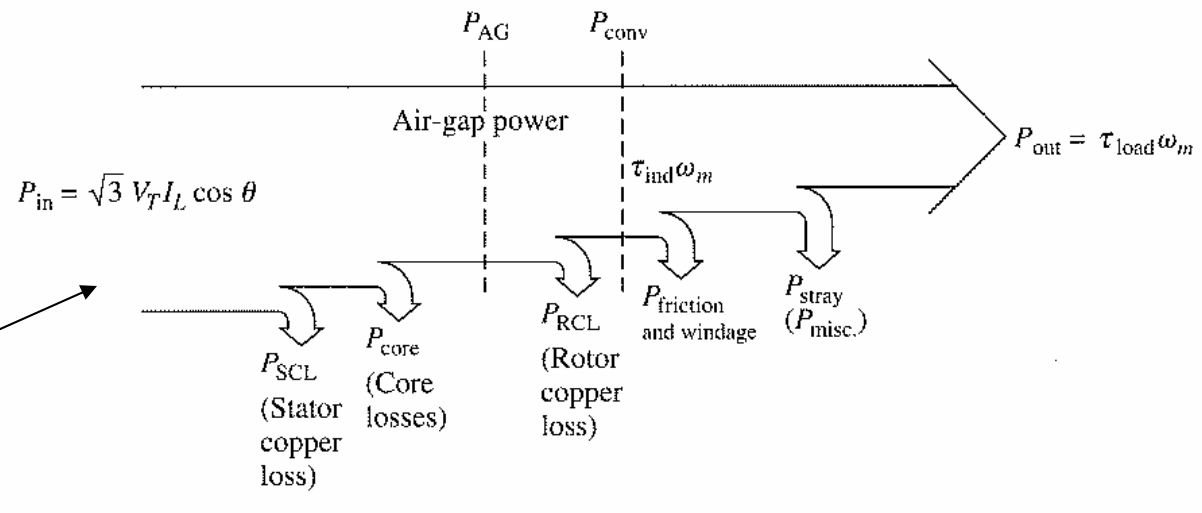
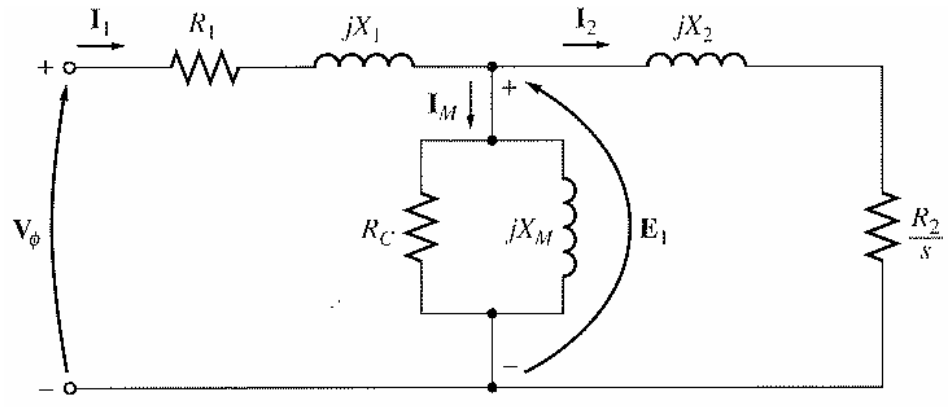
Clase 14

Potencia y Torque en el IM

trifásico



monofásico



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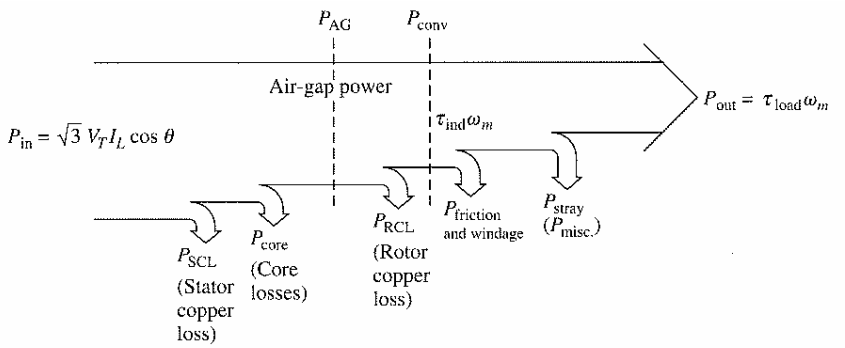
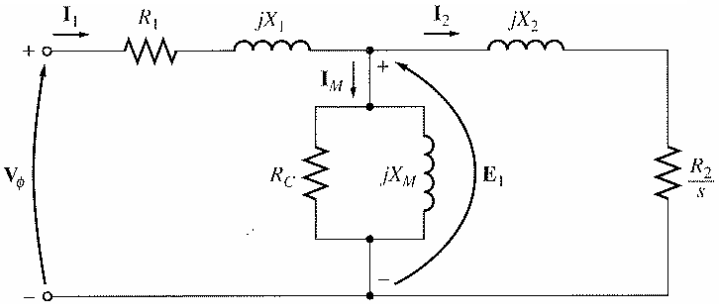




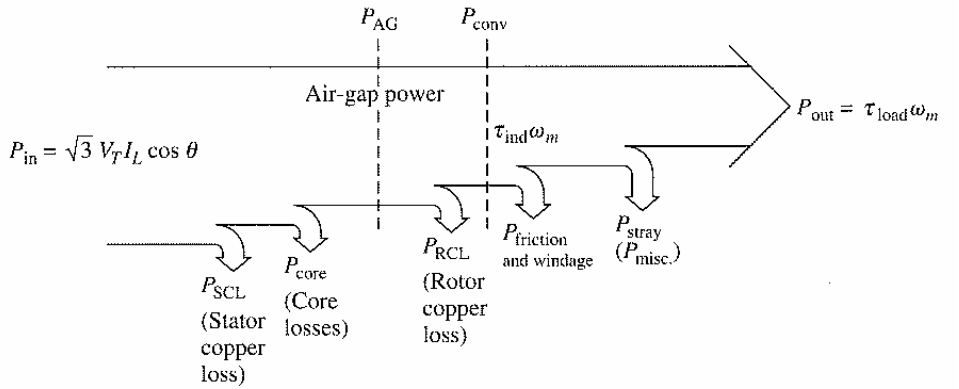
$P_{in} = \sqrt{3}\, V_{LL} I_\phi \cos\theta$ Potencia de Entrada

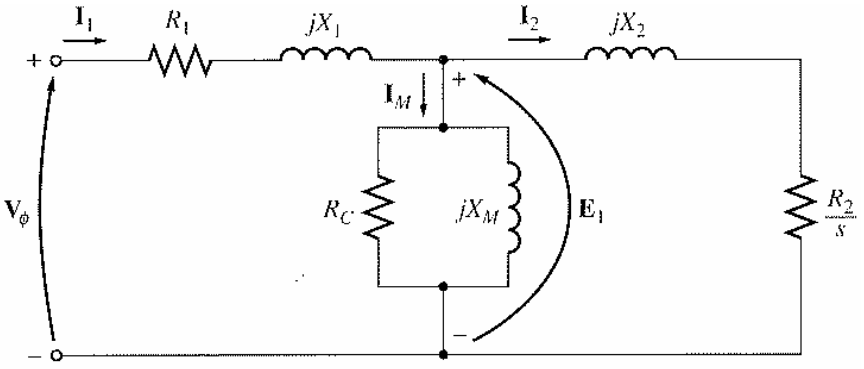
- $P_s = 3I_s^2 R_s$ Embobinado del estator
- $P_c = 3E_i^2/R_c$ Histeresis y Corrientes Eddie
- $P_{AG} = P_{in} - P_s - P_c$ Transmitida del estator al rotor
- $P_R = 3I_R^2 R'_R$ Embobinado del rotor
- $P_{conv} = P_{AG} - P_R = \tau_{ind}\,\omega_r$
- $P_{F\&W}$ → Friction and windage (fricción y aire)
- P_{stray} → otras perdidas

Nota: – A mayor n_r, mayor $P_{F\&W}$ y P_{stray}, pero menor P_c.

– A veces, estas se unen en Perdidas de rotación "Rotational Losses" y se consideran constantes.

Ejemplo

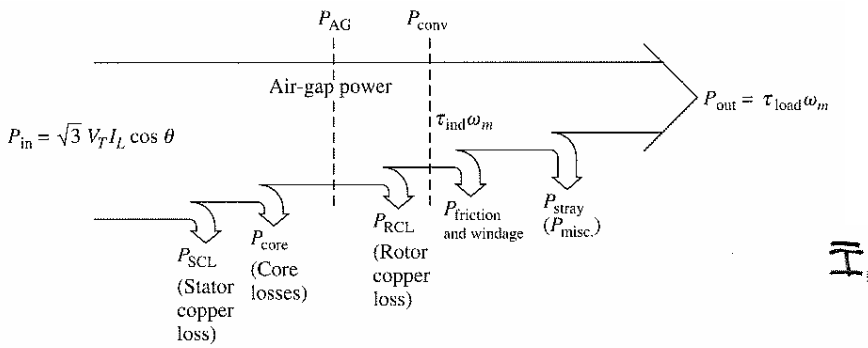


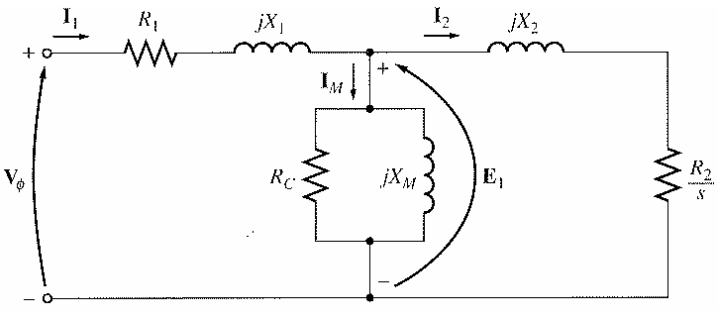


IM: trifásico, 480V, 50hp, 60A, 0.85PF lagging, P_S=2kW, P_R=0.7kW, $P_{F\&W}$=0.6kW, P_C=1.8kW, P_{STRAY} descartable. Hallar:

- P_{AG}
- P_{CONV}
- P_{OUT}
- Rendimiento

Potencia y Torque en el IM



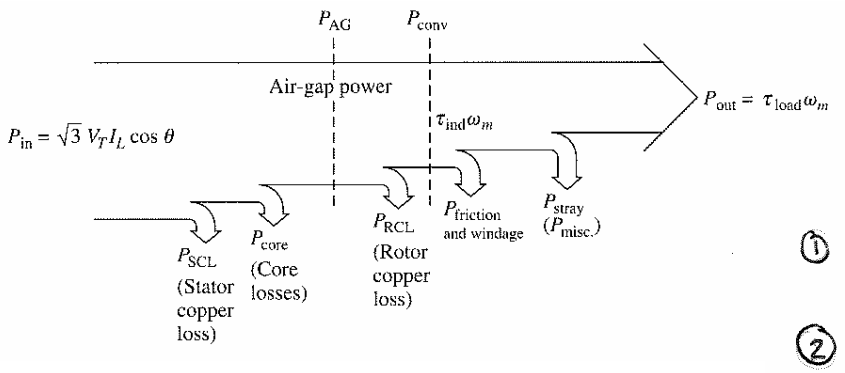


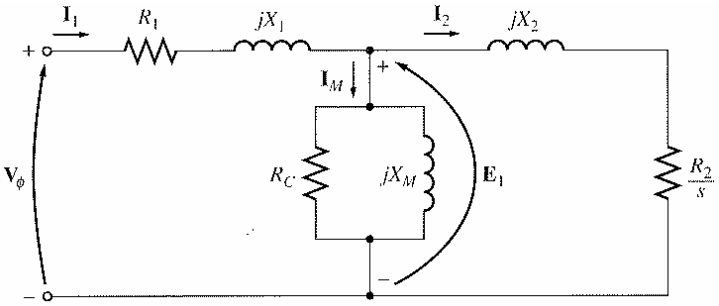
$$\bar{I}_1 = \bar{I}_s = \frac{\bar{V}_\phi}{\bar{Z}_{eq}}$$

$$\bar{Z}_{eq} = R_s + jX_s + (R_c \,//\, jX_m) \,//\, \left(\frac{R'_R}{s} + jX'_{BR}\right)$$

$$= R_s + jX_s + \frac{1}{\frac{1}{\frac{1}{\frac{1}{R_c} + \frac{1}{jX_m}}} + \frac{1}{\frac{R'_R}{s} + jX'_{BR}}}$$

Potencia y Torque en el IM





① $P_s = 3 I_1^2 R_s$

② $P_c = \dfrac{3 E_1^2}{R_c}$

③ $P_{AG} = P_{in} - P_s - P_c$

④ $P_{AG} = 3\, I_2^2 \dfrac{R_R'}{s}$

⑤ $P_R = 3\, I_2^2 R_R'$

$R_R' = a_{eff}^2 R_R$ ↑ embobinado del rotor

$P_{conv} = P_{AG} - P_R = 3 I_2^2 R_R' \left(\frac{1}{s} - 1\right)$

⑥ $P_{conv} = 3 I_2^2 R_R' \left(\dfrac{1-s}{s}\right)$

de ④ y ⑤

⑦ $s P_{AG} = P_R$

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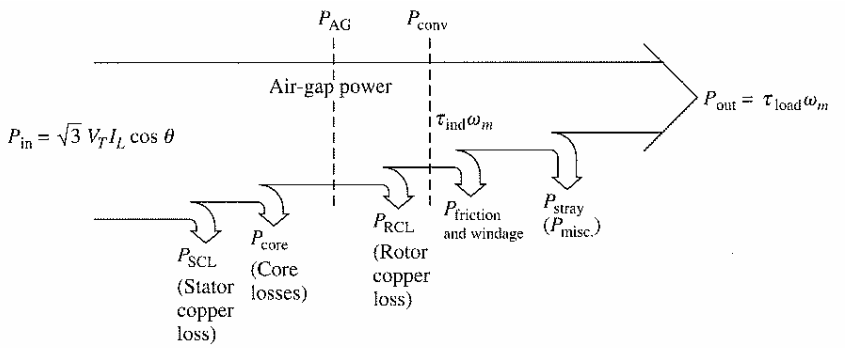

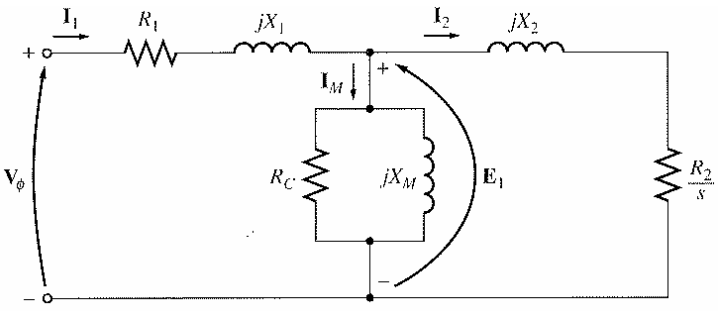

$P_{conv} = P_{AG} - P_R \quad ; \quad P_R = s\,P_{AG}$

(8) $P_{conv} = P_{ag}(1-s)$

(9) $P_{out} = P_{conv} - P_{FW} - P_{misc}$

$$\tau_{ind} = \frac{P_{conv}}{\omega_R} = \frac{(1-s)P_{AG}}{(1-s)\omega_s}$$

(10) $$\tau_{ind} = \frac{P_{AG}}{\omega_s}$$

Separando Perdidas en Rotor y P_{CONV}

$$R_{conv} = \frac{R_R'}{s} + R_R'$$

$$R_{conv} = R_R'\left(\frac{1}{s} - 1\right) = R_R'\left(\frac{1-s}{s}\right)$$