

Required Homework 6
Unbalanced Operation of Induction Machine
Date Due Oct 26 2006

For the 100 Hp, 460 Volt, 60 Hz, three phase, 4 pole induction machine of problem 3 with the following per unit parameters:

$$r_1 = 0.01$$

$$x_1 = 0.125$$

$$x_m = 2.5$$

$$r_2 = 0.015$$

$$x_2 = 0.125$$

a) find (or copy from Problem 5) the steady state values of rated slip S_R , rated torque T_R , rated current I_R , rated I^2R loss (rotor + stator) and rated power factor $\cos\theta_R$ when the machine is operated at rated voltage and frequency.

$$S_R = \underline{\hspace{2cm}}$$

$$T_R = \underline{\hspace{2cm}} \text{ pu}$$

$$I_R = \underline{\hspace{2cm}} \text{ pu}$$

$$I^2R_R = \underline{\hspace{2cm}} \text{ pu}$$

$$\cos\theta_R = \underline{\hspace{2cm}}$$

b) find the corresponding values at rated slip ($S = S_R$) plus the power developed P_d if the machine is operated operated single phase with one phase open and rated line to line voltage applied to the remaining two lines.

$$S = S_R$$

$$T = \underline{\hspace{2cm}} \text{ pu}$$

$$I_1 = \underline{\hspace{2cm}} \text{ pu}$$

$$P_d = \underline{\hspace{2cm}} \text{ pu}$$

$$I^2R_{\text{tot}} = \underline{\hspace{2cm}} \text{ pu}$$

$$\cos\theta_1 = \underline{\hspace{2cm}}$$

c) find the corresponding values plus the power developed P_d if the machine is operated operated unbalanced with the three line voltages equal to 460, 430 and 430. For this condition also find the three line currents and the pu I^2R loss in each stator phase. Take the applied voltage V_{bc} as reference, i.e., $V_{bc} = 1.732 e^{j0^\circ}$

$$S = S_R$$

$$T = \underline{\hspace{2cm}} \text{ pu}$$

$$P_d = \underline{\hspace{2cm}} \text{ pu}$$

$$I^2R_{\text{tot}} = \underline{\hspace{2cm}} \text{ pu}$$

$$I_a = \underline{\hspace{2cm}} \text{ pu} \quad I_a^2R = \underline{\hspace{2cm}} \text{ pu}$$

$$\text{Angle } a = \underline{\hspace{2cm}}^\circ$$

$$I_b = \underline{\hspace{2cm}} \text{ pu} \quad I_b^2R = \underline{\hspace{2cm}} \text{ pu}$$

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$$I_c = \text{_____ pu} \quad \text{Angle b} = \text{_____}^\circ$$
$$I_c^2 R = \text{_____ pu}$$
$$\text{Angle c} = \text{_____}^\circ$$