

Given: No of poles = 4,  $f = 60\text{Hz}$ ,  $S_r = 25\text{kVA}$ ,  $V_L = 415\text{V}$   
 $X_2 = 1.5$ ,  $R_2 = 0$ , NOTE: it is a wye connection  
 $\text{Pf} = \cos\theta = 0.8$

① recall  $E_a = V_p + jX_2 I_a + R_2 I_a$   
 $E_a = V_p + jX_2 I_a$

recall  $\cos\theta = 0.8$

$\theta = \cos^{-1}(0.8) = 36.87^\circ$

$I_p = I_L$

$V_L = \frac{V_p \sqrt{3}}{\sqrt{3}} \quad \therefore V_p = \frac{V_L}{\sqrt{3}}$

$\therefore V_p = \frac{415}{\sqrt{3}} = 239.600 \text{ volts}$

$I_a = \frac{S_r}{\sqrt{3} \times V_L} = \frac{25 \times 10^3}{\sqrt{3} \times 415} = 34.780 \text{ A}$

$\therefore I_a = 34.780 \angle -36.87$

$\Rightarrow$  recall  $E_a = V_p + jX_2 I_a$

$E_a = 239.6 \angle 0 + (1.5 \angle 90^\circ \times 34.780 \angle -36.87)$

$E_a = 274.0986 \angle 8.758^\circ \text{ A}$

OR  $E_a = 270.902 + 41.735j \text{ A}$

(6) using:  $I_a = \frac{E_a - V_2}{jX_2}$

$$\frac{I_a}{1} \times jX_2 = E_a - V_2$$

$$I_a jX_2 = E_a - V_2$$

$$E_{a2} = 1.2 \times E_a = 1.2 \times 274.098$$

$$= 328.9176$$

$$\Rightarrow E_{a2} = 1.2 \times E_a = 1.2 \times 274.098 = 328.9176 \text{ V}$$

$$E_1 \sin S_1 = E_2 \sin S_2$$

$$\sin S_2 = \frac{E_1 \sin S_1}{E_2}$$

$$\sin S_2 = \frac{274.098 \sin(8.758)}{328.92}$$

$$\sin S_2 = 0.12688$$

$$S_2 = 7.289 \quad S_2 = 7.289$$

$$I_A = \frac{328.92 \angle 7.289}{1.5 \angle 90^\circ} = 219.28 \angle -82.711$$

$$I_a = 219.28 \angle -82.711 \text{ A}$$

$$\underline{I_a} = 64.10 \angle -64.348^\circ \text{ A}$$

$$I_a = 27.8209 - 57.7746j \text{ A}$$

$$\underline{I_a} = 64.1242 \angle -64.287^\circ \text{ A}$$

$$(c) \quad I_a = \frac{E_{a2} - V}{jX_2}$$

$$I_a = \frac{274.0981 \angle 90^\circ - 239.600}{jX_2 \angle 90^\circ}$$

$$\underline{I_a} = 1.6473 + j15$$

$$I_a = 242.705 \angle 41.157^\circ \text{ A}$$

$$\underline{I_a} = 182.734 + 159.7301j \text{ A}$$

$$PF = \cos \theta$$

$$PF = \cos (41.157)$$

$$PF = 0.7529$$

$$\begin{aligned}\text{reactive power, } Q &= \sqrt{3} \times V_L \times I_L \times \sin \theta \\ &= \sqrt{3} \times 415 \times 242.705 \times \sin(41.157) \\ &= 483173.2593\end{aligned}$$

$$\begin{aligned}Q &= \sqrt{3} \times 415 \times 242.705 \times \sin(41.157) \\ &= \underline{\underline{114814.1904 \text{ Watt}}}\end{aligned}$$