Assignment

$S_r = 25\ KVA$, $V_L = 415\ V$, 3-Ø, 4-pole
$f = 60\ Hz$, $X_2 = 1.5\ \Omega$, $R_2 = 0$
Cos Ø; pf = 0.8 lagging.

(a)

Eq;

$$E_a = V_p + j X_2 I_a + R_2 I_a$$
$$\equiv V_p + j X_2 I_a$$

- Cos Ø = 0.8
  ∴ Ø = 36.87
- $V_L = 415 \rightarrow V_p = \frac{415}{\sqrt{3}}$
  $= 239.6\ \angle 0$
- $I_a = \frac{S_r}{\sqrt{3} \times V_L} = \frac{25 \times 10^3}{\sqrt{3} \times 415}$
  $= 34.78$
  $\simeq 34.78 \angle -36.87$

from a

$$E_a = V_p + j X_2 I_a$$

$$\rightarrow E_a = 239.6\angle 0 + 1.5\angle 90^\circ \times 34.78\angle -36.87^\circ$$

$$= 270.9 + j41.74$$

$$\simeq 274.1 \angle 8.76^\circ \text{ V/ph}$$

(b)

If I_f increased 20%, find I_a, P.f & Q

i) I_a

$$I_a = \frac{E_a - V}{jX_s}$$

$$\therefore I_a = \frac{E_{a2} - V_2}{jX_s}$$

$$E_{a2} = 1.2 \times E_a = 1.2 \times 274.1$$

$$= 328.92$$

$$\therefore E_1 \sin\delta_1 = E_2 \sin\delta_2$$

$$\rightarrow \sin\delta_2 = \frac{E_1 \sin\delta_1}{E_2}$$

$$= \frac{274.1 \sin 8.76}{328.92}$$

$$\sin\delta_2 = 0.127$$

$$\therefore \delta_2 = 7.47$$

$$\therefore I_a = \frac{328.92\angle 7.47 - 239.6\angle 0}{1.5\angle 90^\circ}$$

$$= 28.51 - j57.69$$

$$I_a \simeq 64.35\angle -63.7 \text{ A}$$

h) $p.f = \cos\theta$

$= \cos(-63.7)$

$= 0.4$ lagging

iii) $Q = \sqrt{3} \times V_L \times I_L \times \sin\theta$

$= \sqrt{3} \times 415 \times 64.35 \times \sin 65.7$

$= 41466.85$

$\simeq 41.5$ KVAR

(c)

i) $I_{A_1} = \dfrac{E_{A3} - V}{j X_s}$

Since KPS using the same condition as in (a)

$\rightarrow = \dfrac{274.1\angle 90^\circ - 259.6\angle 0}{1.5\angle 90}$

$= 164.73 + j\,159.73$

$I_{A_3} \simeq 229.46\angle 44.12$

ii) $p.f = \cos\theta$

$= \cos(44.12)$

$= 0.7$ leading

iii) $Q = \sqrt{3} \times V_L \times I_L \times \sin\theta$

$= \sqrt{3} \times 415 \times 229.46 \times \sin 44.12$

$= 114822.48$

$\simeq 11.5 \text{ KVAR}$ //