

YAKUBU NATHAN BALA

17/EN6041076

ELECT.

EEF 326

ASSIGNMENT

$S_v = 25 \text{ kVA}$, $V_L = 415 \text{ V}$, 3- ϕ , 4-wire. $f = 60 \text{ Hz}$, $X_2 = 1.5$, $R_2 = 0$
 $\cos \phi$; P.F. = 0.8 lagging.

$$\textcircled{a} E_a = V_f + jX_2 I_a + R_2 I_a \\ = V_f + jX_2 I_a$$

$$- \cos \theta = 0.8$$

$$\therefore \theta = 36.87^\circ$$

$$- V_L = 415 \Rightarrow V_f = \frac{415}{\sqrt{3}} = 239.6 \angle 0^\circ$$

$$- I_a = \frac{S_v}{\sqrt{3} \times V_L} = \frac{25 \times 10^3}{\sqrt{3} \times 415}$$

$$= 34.78$$

$$\approx 34.78 \angle -36.87^\circ$$

Recall, $E_a = V_f + jX_2 I_a$

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

$$= 270.9 + j11.74$$

$$E_a \approx 274.1 \angle 8.76^\circ \text{ V}$$

\textcircled{b} Find I_a , P.F. & θ if increased by 20%

$$- I_a = \frac{E_a - V_f}{jX_2}$$

$$\therefore I_a = \frac{E_{a2} - V_f}{jX_2}$$

$$E_{a2} = 1.2 \times E_a = 1.2 \times 274.1 \\ = 328.92$$

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

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

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

$$= 0.127$$

$$\sin S_2 = 0.127$$

$$\therefore S_2 = 7.47^\circ$$

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

$$= 28.51 - j57.69$$

$$I_A \approx 64.35 \angle -63.7^\circ$$

$$\text{P.f.} = \cos \theta$$

$$= \cos(-63.7)$$

$$= 0.4, \text{ lagging}$$

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

$$= \sqrt{3} \times 415 \times 64.35 \times \sin 63.7$$

$$= 41466.85$$

$$\approx 41.5 \text{ KVAR}$$

$$\textcircled{c} \textcircled{1} I_{A3} = \frac{E_{A3} - V}{jX_2}$$

Since it's under the same condition as \textcircled{a}

$$\therefore \frac{274.1 \angle 90^\circ - 239.6 \angle 0^\circ}{1.5 \angle 90^\circ}$$

$$= 164.73 + j159.73$$

$$I_{A3} = 229.46 \angle 44.12^\circ$$

$$\textcircled{ii} \text{ P.f.} = \cos \theta$$

$$= \cos(44.12)$$

$$= 0.7, \text{ leading}$$

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

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

$$= 114922.48$$

$$\approx 11.5 \text{ KVAR}$$