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ELECTRICAL / ELECTRONICS ENGINEERING II
EEE 520 : Electrical Machines II

Assignment

$S_r = 25KVA$, $V_L = 415V$, 3 - ϕ, 4 - pole f = 60Hz,
$X_s = 1.5 \Omega$, $R_a = 0$ $\cos\theta$ ∴ P.f = 0.8 lagging

Answer

i) $E_a = V_p + jX_s I_a + R_a I_a$
$= V_p + jX_a I_a$

$\cos\theta = 0.8$
$\theta = 36.87$

$V_L = 415$ → $V_p = \frac{415}{\sqrt{3}}$
$= 239.6$

$I_A = \frac{S_r}{\sqrt{3} \times V_L} = \frac{25 \times 10^3}{\sqrt{3} \times 415} = 34.78$
$\simeq 34.78 \angle -36.87$

$E_a = V_p + jX_a I_a$
$E_a = 239.6\angle 0 + 1.5\angle 90^\circ \times 34.78\angle -36.89$
$= 270.9 + j41.7.4$
$\simeq 274.1 \angle 8.76\ V$,

If increased 20%, find the I_A, Pf & Q

i) I_A

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

$I_+ = \frac{E_{a2} - V_2}{jX_2}$

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

$E_1 \sin\delta = E_a \sin\delta_a$

$\sin\delta_a = \frac{E_1 \sin\delta}{E_a} = \frac{274.1 \sin 8.76}{324.92}$

$\sin\delta_a = 0.129$

$\delta_a = 7.47$

$I_a = \frac{324.92 \angle 7.47 - 259.6 \angle 0}{1.5 \angle 90^\circ}$

$= 28.51 - j57.69$

$I_a \simeq 64.35 \angle -63.7$ A

(ii) $P.f = \cos\theta$

$= \cos(-63.7)$

$= 0.4$ Lagging

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

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

$= 41466.85$

$\simeq 41.5$ KVAR

(3) $I_a = \frac{E_{a_0} - V}{jX_2}$

Since its using the same condition as in (2)

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

$= 164.78 + j159.78$

$I_{a_1} = 229.46 \angle 44.12$

Fa.

(i) $P.f = \cos\theta$

$= \cos(44.12)$

$= 0.7$ leading

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

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

$= 114822.4$ VAR

$\simeq 11.5$ KVAR