11.05.2019

Adepoju Adeshina Adejuwon
17/ENG06/003
EEE 326

Answers

a) $E_a = V_t - j I_2 X_3 \quad \therefore V_L = 415V, \; S = 25KVA$
$= 25000VA$

$V_t = \frac{V_L}{\sqrt{3}} = \frac{415}{\sqrt{3}} = 239.6V$

$X_3 = 1.5\Omega \; ; \; Pf = 0.8 \text{ tagging} \; \therefore \theta = \cos^{-1}(-0.8)$
$= 143.13^\circ$

$I_a = \frac{S}{V_L\sqrt{3}} = \frac{25000}{415\sqrt{3}} = 34.78A \angle 143.13^\circ$

$E_a = 239.6 - j[(34.78 \angle 143.13^\circ)(1.5)]$

$E_a = 270.70 + j41.74$

$E_a = 274.098V \angle 8.76^\circ$

11.05.2019

B) ∴ 20% increase = 1 + 0.2 = 1.2

$\delta = 8.26^\circ$

$E_a' = 1.2 \times 274.098 = 328.92\,V$

$\therefore \frac{V_t E_a \sin\delta}{X_s} = \frac{V_t E_a' \sin\delta'}{X_s} \therefore \sin\delta'$

$= \frac{E_2 \sin\delta}{E_2'} \Rightarrow \frac{274.098}{328.92} = \sin 8.26^\circ$

$\sin\delta' = 0.1269 \quad \therefore \delta = \sin^{-1}(0.1269)$

$\delta' = 7.29^\circ$

(i) $I_A' = \frac{E_2' \angle 0^\circ}{jX_B} = \frac{328.92 \angle 7.29^\circ - 339.6 \angle 0^\circ}{j1.5}$

$= 27.82 - j57.77$

ii) Power factor = $\cos(64.28^\circ) = 0.454$ lagging

iii) $Q = 3V_t I_2 \sin\theta = 3 \times 235.6 \times 64.13 \times \sin(64.28) = 41525.65\,VAR$

11.05.2019

c) At max power $\delta = 90^\circ$

$P_{max} = \frac{3E_0V_t}{X_3} = \frac{3 \times 274.098 \times 239.6}{1.5}$

$= 131347.74kW = 131.347kW$

$I_{max} = \frac{E_2 \angle \delta}{jX_3} = \frac{274.098 \angle 90^\circ - 239.6\angle 0}{1.5j}$

$= 242.71 \angle 41.16^\circ$

Power factor $= \cos(41.16)^\circ = 0.7529$ Leading

$Q_{max} = 3V_t I_2 \max \sin(41.16^\circ)$

$= 3 \times 239.6 \times 242.71 \times 0.6582 = 1148.295$ VAR

$= 114.829$ KVAR