c) At max power $\delta = 90°$

$$P_{max} = \frac{3E_a V_t}{X_s} = \frac{3 \times 274.098 \times 239.6}{1.5} = 131.347\ KW$$

$$I_{max} = \frac{E_a - V_t}{jX_s} = \frac{274.098\angle 90° - 239.6\angle 0}{1.8j}$$

$$= 242.71 A \angle 4.16°$$

$$P.F = \cos(41.16°) = 0.753 \text{ leading}$$

$$Q_{max} = 3 V_t I_a^{max} \sin(41.16°)$$

$$= 3 \times 239.6 \times 242.71 \times 0.6582 = 114829.5\ VAR$$

$$= 114.829\ KVAR$$

Mshammed Salim Othman 17ENG06055 MECH-6th

1a - $E_f = V_t + jI_a X_s$; $X_s = 4154$, $S = 25kVA = 25000 VA$

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

$X_s = 1.5\Omega$; $P_f = 0.8$ lagging

$\therefore \theta = \cos^{-1}(-0.8) = 143.13°$

$I_a = \frac{S}{V_t\sqrt{3}} = \frac{25000}{415\sqrt{3}} = 34.78 A \angle 143.13°$

$E_f = 239.6 - j[(34.78 \angle 143.13°)(1.5)]$

$E_f = 270.90 + j41.74$

$E_a = 274.098V \angle 8.76°$

b = 20% Increase $= 1 + 0.2 = 1.2$

$\delta = 8.76°$

$E_a' = 1.2 \times 274.058 = 328.92V$

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

$= \frac{274.098}{328.92} \times \sin 8.76° = 0.1269$

$\delta = \sin^{-1}(0.01269) = 7.29°$

(i) $I_A = \frac{E_a' - V_t}{jX_s} = \frac{328.92 \angle 7.29° - 239.6 \angle 0°}{j1.5} = 27.82 - j57.77$

$I_A = 64.13A \angle -64.28°$

(ii) $P.f = \cos(-64.28°) = 0.434$ lagging

(iii) $Q = 3V_t I \sin\theta = 3 \times 239.6 \times 64.13 \times \sin(64.28) = 41529.65$ VAR