Tutorial 6

Sol^n 3 $C = 1\,mF$; $L = 10\,mH$; $R = 500\,\Omega$ (given)

$$X_C = \frac{1}{j2\pi f \cdot C}$$

$$= \frac{1}{j(2\pi \times 50 \times 1 \times 10^{-3})} \qquad (f = 50H : \text{given})$$

$$X_C = -j3.18\,\Omega$$

$$X_L = j2\pi f L = j(2\pi \times 50 \times 10 \times 10^{-3}) = j3.14\,\Omega$$

Total Impedence :-

$$Z_T = \frac{1}{Y_T}$$

$$Y_T = \frac{1}{R} + \frac{1}{X_L} + \frac{1}{X_C}$$

$$Z_T = 99.73 + j\,199.86\ \Omega$$

(a) FOR STAR Connection

(a) $I_L = \frac{V_L}{Z_T} = \frac{400\angle 0^\circ}{99.73 + j199.86}$.

(Line Current)

$$I_L = 1.79\angle -63.48^\circ \text{ A}$$

For Star Connection phase and line currents are equal. $I_L = I_{ph}$.

Line Voltage:-

$$V_L = \sqrt{3} V_p \angle 30^\circ = \sqrt{3}(400\angle 0^\circ)\angle 30^\circ$$

$$= 692.82\angle 30^\circ \text{ V}$$

Power factor:- $\cos(\phi)$

$$= \cos(0^\circ - (-63.48^\circ))$$

$$= 0.45$$

(b) For Delta Connection:-

Line Voltage: $V_{ab} = \sqrt{3} V_p \angle 30^\circ$

$$= 692.82\angle 30^\circ \text{ V}$$

$$V_{ab} = 692.82\angle 30^\circ \text{ V}$$

phase Current:-

$$I_p = \frac{V_p}{Z_T} = \frac{692.82 \angle 30^\circ}{99.73 + j\,199.86}$$

$$I_p = \underline{3.1 \angle -33.48^\circ \text{ A}}$$

Line Current:-

$$I_L = \sqrt{3}\, I_p \angle 30^\circ$$

$$= \sqrt{3}\,(3.1 \angle -33.48^\circ) \angle 30^\circ$$

$$I_L = 5.37 \angle -63.48^\circ \text{ A}$$

power factor = $\cos(\phi_L)$

$$= \cos(0 - (-63.48^\circ))$$

$$= \underline{0.45}$$

Q4

$S_1 = 10 \times 10^3$ VA $PF_1 = 0.75$ lagging

$\theta_1 = 41.41°$

$S_2 = 25 \times 10^3$ VA $PF_2 = 0.80$ leading

$\theta_2 = -36.87°$

(a) Total power drawn by load :-

$S_{total} = S_1 + S_2$

$= 10 \times 10^3 (\cos\theta_1 + j \sin\theta_1) + 25 \times 10^3 (\cos\theta_2 + j \sin\theta_2)$

$= 7499.9 + j\,6614.4 + 19999.97 - j\,15000$

$= 27499.87 - j\,8385.6$

$= 28749.9 \angle -16.96°$ VA

$= 28.74 \angle -16.96°$ KVA

Source PF :- $= \cos(-16.96°)$

$= 0.956$ leading

(b) Total power drawn by circuit,

$$P_{total} = S_{total} \cos(\theta)$$

$$= 28.75 \text{ KVA} \cos(-16.96°)$$

$$\underline{P_{total} = 27.5 \text{ KW}}$$

(c) Phase current of loads:-

$$I_{p_1}^* = \frac{S_1}{3V_p} \qquad I_{p_2}^* = \frac{S_2}{3V_p}$$

$$= \frac{(7.49 + j\,6.61)\text{KVA}}{3 \times (400)\text{V}} \qquad = \frac{(19.99 - j\,15)\text{KVA}}{3 \times (400)\text{V}}$$

$$I_{p_1}^* = 8.33 \angle 41.41° \text{ A} \qquad I_{p_2}^* = 20.83 \angle -36.87° \text{ A}$$

$$\underline{I_{p_1} = 8.33 \angle -41.41° \text{ A}} \qquad \underline{I_{p_2} = 20.83 \angle +36.87°}$$