Tutorial 3 Solutions EE 101

Fri 14/08/2015 5-6:30 PM

1.

$\theta = 116.6° - 45° = 71.6°$ (lag)

$Z = \frac{V}{I} = 10 + j30\Omega$

$L = \frac{30}{2000} = 0.015\text{H}$

With second source, $\theta = 30°$

$Z = \frac{R}{\cos\theta} = 11.5\Omega$

$X_L = Z\sin\theta = 5.75\Omega$

$\omega = \frac{X_L}{L} = 385$ rad/s

Case II:

$|I| = 6\text{A}$ and $|Z| = 150/6 = 25\Omega$

$X_L = \sqrt{Z^2 - R^2} = 22.9\Omega$

$\omega = \frac{22.9}{0.015} = 1528$ rad/s

Change in $\omega = \frac{2000-1528}{2000} = 23.6\%$

I is maximum when Z is minimum. Z is minimum when $X_L = 0$, $\omega = 0$

2.

For given loads, we have

P	Q
250	0
1500	726.5
1000	750
700	−339

(1)

So Total P=3450 kW and Total Q= 1137.5 kVAr

Using $Q = P\tan\theta$ we have $\cos\theta = \cos(\tan^1(\frac{Q}{P})) = 0.95$ lag and $S = \sqrt{P^2 + Q^2} =$ 3633 kVA.

Hence for the same current, load that the cable can carry at UPF is 3633 kW.

3.

$X_{L1} = \omega L_1 = 8\Omega \qquad L_1 = 0.0255\text{H}$

$X_C = \frac{1}{\omega C} = 8\Omega \qquad C = 318\mu\text{F}$

Z_{eq} of parallel branch $= \frac{(5+j8)(8-j10)}{(5+j8)+(8-j10)} = 9.15\angle 15.4°\Omega$

$X_{L2} = \omega L_2 = 12\Omega \qquad L_2 = 0.038\text{H}$

$Z_{tot} = 9.15\angle 15.4°\Omega + (7 + j12) = 21.4\angle 42°\Omega$

$\theta = 42° \qquad$ Inductive

$V = IZ = 214\text{V}$

4.

$\theta = 60°$ and $\tan\theta = X_C/R$

$R = 5\Omega$ therefore $X_C = 8.66\Omega$

$C = \frac{1}{\omega X_C} = 57.7\mu\text{F}$

5.

Active Power $= 440 \times 40 \times 0.7 = 12320$ W and

Reactive Power $= 440 \times 40 \times \sin(\cos^{-1}(0.7)) = 12569$ VAr.

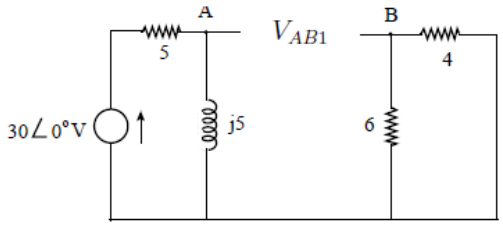
At 0.9 lag, P remains same and

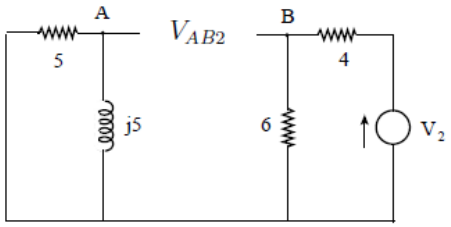
Q supplied by the capacitor $= 12569 - 12320\tan(\cos^{-1}(0.9)) = 6602$ VAr

Capacitive reactance $X_c = \frac{V^2}{6602}$ so $C = \frac{6602}{440^2 \times 314} = 108\mu\text{F}$

6.

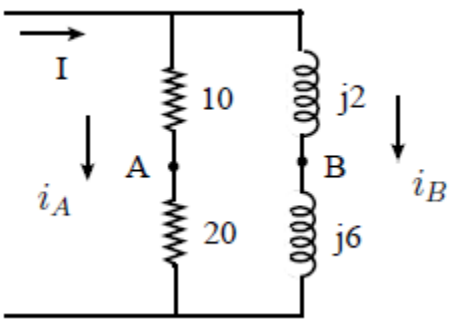
$$V_{AB1} = (\frac{30\angle 0°}{5+j5})j5 = 15 + j15\text{V}$$
$$V_{AB2} = (\frac{V_2}{4+6})6 = 0.6V_2 \text{ V}$$
$$V_{AB} = 15 + 0.6V_2 + j15 \text{ V}$$
For zero current to flow in $2 + j3\Omega$ resistance, $V_{AB} = 0$
$$V_2 = -25 - j25 \text{ V}$$





7.

$$I_A = I(\frac{j8}{30+j8}) = 4.66\angle 120°\text{A}$$
$$I_B = I(\frac{30}{30+j8}) = 17.5\angle 30°\text{A}$$
$$V_{20\Omega} = I_A(20) = 93.2\angle 120°\text{V}$$
$$V_{j6\Omega} = I_B(j6) = 105\angle 120°\text{V}$$
$$V_{AB} = 11.8\angle -60°\text{V}$$



8.

$3V_{ph}I_{ph}\cos\theta = 5000$ kW

$I_{ph} = 360.8$ A

Active component $= I\cos\theta = 288.7$ A

Reactive component $= I\sin\theta = 216.5$ A

At 0.9 power factor, new output $= 5000 * 0.9/0.8 = 5625$ kW