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ASSIGNMENT

1 $f = 50\ Hz$

$R = 10\ \Omega$

$L = 100 \times 10^{-3}\ H$

$C = 100 \times 10^{-6}\ F$

$X_L = 2\pi f L = 2 \times 3.14 \times 50 \times 100 \times 10^{-3} = 31.4\ \Omega$

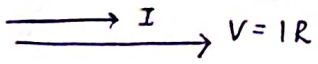
$X_C = \frac{1}{2\pi f C} = \frac{1}{2 \times 3.14 \times 50 \times 100 \times 10^{-6}} = \frac{10^6}{31400} = 31.84\ \Omega$

$I_R = \frac{100}{10} = 10\ A$

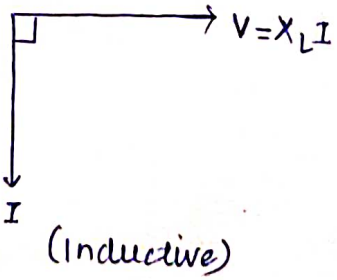
$I_L = \frac{100}{31.4} = 3.18\ A$

$I_C = \frac{100}{31.84} = 3.14\ A$

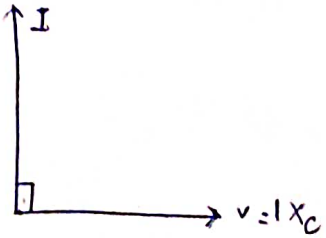
* Resistive circuit is in phase with V.
* Inductive circuit lags V by 90°.
* Capacitive circuit is ahead of V by 90°.



(Resistive)

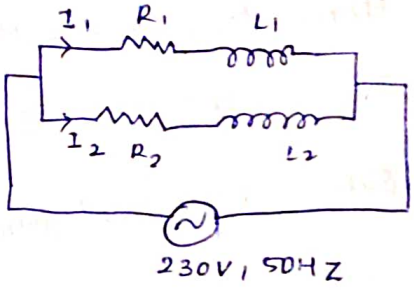


(Inductive)



(Capacitive)

2



Given, $R_1 = 14\,\Omega$

$L_1 = 16\,mH = 16 \times 10^{-3}\,H$

$R_2 = 18\,\Omega$

$L_2 = 32 \times 10^{-3}\,H$

$\omega = 2\pi f$

$f = 50\,Hz$

$Z_1 = R_1 + j X_{L_1} = 14 + j(\omega \times 16 \times 10^{-3})$

$= 14 + j(2 \times 3.14 \times 50 \times 16 \times 10^{-3})$

$= 14 + j(5.024)$

$= \sqrt{14 + (5.02)^2} \times \angle \tan^{-1}\left(\frac{5.024}{14}\right)$

$= 14.86 \times \angle \tan^{-1}\frac{5.024}{14} = 14.86 \angle \tan^{-1}\theta_1$

$Z_2 = R_2 + j X_{L_2} = 14 + j(\omega \times 32 \times 10^{-3})$

$= 14 + j(2 \times 3.14 + 50 \times 32 \times 10^{-3})$

$= 14 + j(10.048)$

$= \sqrt{14^2 + 10^2} \times \angle \tan^{-1}\left(\frac{10.048}{14}\right)$

$= 17.208 \times \angle + \tan^{-1}\frac{10.048}{14}$

$= 14.2 \times \angle \tan^{-1}\theta_2$

Current in branch ①,

$$I_1 = \frac{V}{Z_1} = \frac{230\angle 0^\circ}{14.86\angle \tan^{-1}\theta_1} = 15.47\angle \tan^{-1}\theta_1$$

$$= 15.47\angle -19.7^\circ$$

=

Current in branch ②,

$$I_2 = \frac{V}{Z_2} = \frac{230\angle 0^\circ}{17.2\angle \tan^{-1}\theta_2} = 13.37\angle -35.6^\circ$$

=

Total current:

$$I = I_1 + I_2 = 15.47\angle -19.7 + 13.37\angle -35.6^\circ$$

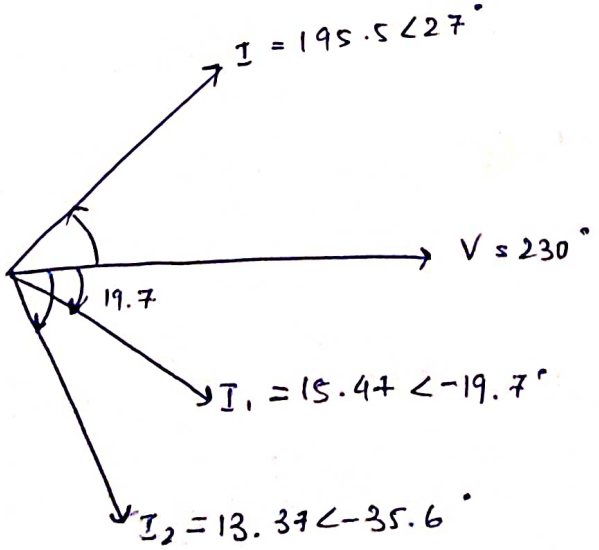
$$= 15.45\left(\cos(19.7^\circ) - j\sin(19.7)\right) + 13.37\left(\cos(35.6) - j\sin(35.i)\right)$$

$$= 25.48 - j(13.04)$$

$$= \sqrt{25.48 + (13.04)^2} \angle \tan^{-1}\left(\frac{13.04}{25.48}\right)^\circ$$

$$= 195.5\angle \tan^{-1}(0.51) \Rightarrow \text{Line current} = 195.5\angle 27^\circ$$

PHASOR DIAGRAM

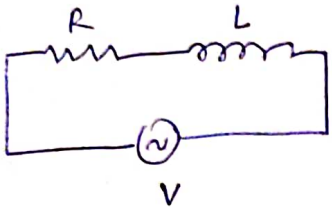


3 $L = 30 \times 10^{-3} H$

$R = 5 \Omega$

$V = 230 V$

$f = 50 Hz$



Inductive reactance

$X_L = \omega L = 2\pi f L$

$= 2 \times 3.14 \times 50 \times 30 \times 10^{-3}$

$\simeq 9.42 \Omega$

Impedance, $Z = \sqrt{R^2 + X_L^2} = \sqrt{5^2 + (9.42)^2} = 10.66 \Omega$

$I = \frac{V}{Z} = \frac{230}{10.66} = 21.578 A$

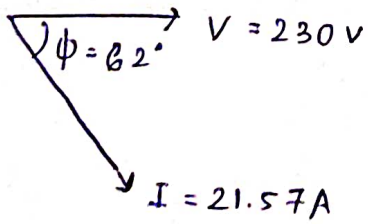
$\phi = \tan^{-1}\left(\frac{9.42}{5}\right) = 62^\circ$

Power factor $\Rightarrow \cos\phi = \cos 62 = 0.47$

Power consumed $\Rightarrow P = VI\cos\phi$

$= 230 \times 21.52 \times 0.44$

$= 2331.7 W$



4 $Z_1 = 15 \angle 40^\circ$

$V = 230V \angle 0^\circ$

$f = 50Hz$

$\omega = 2\pi f$

$V_1 = 120 \angle 30$

From KVL, $V_1 + V_2$

$V_2 = V - V_1$

$= 230 \angle 0^\circ - 120 \angle 30^\circ$

$= 230(\cos 0 + j \sin 0) - 120(\cos 30 + j \sin 30)$

$= 230 - 120 \times 0.866 - j(120 \times 0.5)$

$= 126.1 - j\,60^\circ$

$= \sqrt{125.1^2 + 60^2} \angle \tan^{-1}\left(\frac{60}{126.1}\right)$

$= 139.6 \angle -(25.9)$

For series circuit,

$$I = \frac{V_1}{Z} = \frac{V_2}{Z_2} = \frac{V}{Z_1 + Z_2} = \frac{120 \angle 30^\circ}{15 \angle 40^\circ} = 8 \angle -10^\circ A$$

and, $$Z_2 = \frac{V_2}{I} = \frac{139.6 \angle -25.4}{8 \angle -10} = 17.45 \angle -15.4$$

$= 17.45(\cos(-15.4) - j \sin(-15.4))$

$= 17.45 \times 0.964 - j(17.45 \times 0.265)$

$Z_2 = [16.82 - j(4.6)]\ \Omega$

Since $Z_2 = R - jX_C$

$R = 16.84$ and $X_C = 4.63 = \frac{1}{2\pi fc} = \frac{1}{314 \times c}$

$$C = \frac{1}{314 \times 4.63} = 687.8 \mu C$$