



DPP - 1

SOLUTION

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1. As, Dc meter used to read the average value, so in AC, the average value for one cycle will be zero.
2. $I = I_1 \cos \omega t + I_2 \sin \omega t$

$$(I^2)_{\text{mean}} = I_1^2 \overline{\cos^2 \omega t} + I_2^2 \overline{\sin^2 \omega t} + 2I_1 I_2 \overline{\cos \omega t \cdot \sin \omega t}$$

$$= I_1^2 \cdot \frac{1}{2} + I_2^2 \cdot \frac{1}{2} + 2I_1 I_2 \times 0$$

$$I_{\text{r.m.s.}} = \frac{(I_1^2 + I_2^2)^{1/2}}{2}$$

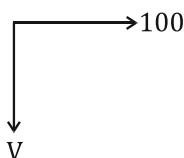
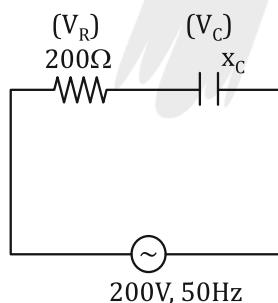
$$3. V = \frac{V_0}{T/4} t \quad V = \frac{4V_0}{T} t$$

The average value of voltage in one complete cycle will be zero in the given case.

4. Root mean square value,

$$\langle V \rangle = \sqrt{\frac{\int_0^{T/4} V_0^2 dt}{\int_0^T dt}} = \sqrt{\frac{V_0^2 \left(\frac{T}{4}\right)}{T}} = \sqrt{\frac{V_0^2}{4}} = \frac{V_0}{2}$$

$$5. P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P}$$



$$R = \frac{100 \times 10^2}{50} = R = 200\Omega$$



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$$V_R^2 + V_C^2 = V^2$$

$$(100)^2 + V_C^2 = (200)^2$$

$$V^2 = 40000$$

$$V_C^2 = 30000$$

$$i = \frac{100}{200} = \frac{1}{2};$$

$$V_C = I \times X_C$$

$$V_C = 100\sqrt{3}$$

$$X_C = 200\sqrt{3}$$

$$200\sqrt{3} = \frac{1}{\omega C}$$

$$C = \frac{1}{2\pi \times 50 \times 200\sqrt{3}} = \frac{50 \times 10^{-6}}{\pi \sqrt{3}}$$

$$\Rightarrow X = 3$$

6. $P = Vi$

$$5 = 25i$$

$$i = \frac{1}{5}$$

$$V_R = iR$$

$$(220 - 25) = \frac{1}{5} R$$

$$R = 195 \times 5 = 975\Omega$$

7. $E = 200 \cos(314t) = 200 \sin\left(314t + \frac{\pi}{2}\right) \dots (i)$

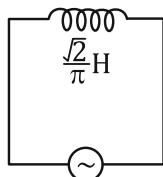
$$I = \sin\left(314t + \frac{\pi}{4}\right) \dots (ii)$$



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$$E \text{ leads } I \text{ by } \left(\frac{\pi}{2} - \frac{\pi}{4}\right) = \frac{\pi}{4}$$

8. Here, $L = \frac{\sqrt{2}}{\pi} H$; $\omega = 100\pi$;



$$X_L = \omega L = 100\pi \times \frac{\sqrt{2}}{\pi}$$

$$X_L = 100\sqrt{2}\Omega \because E_0 = i_0 X_L$$

$$\text{or } i_0 = \frac{440}{100\sqrt{2}} A; i_0 = 2.2\sqrt{2} A$$

Since ammeter is ac ammeter, it will read rms value of current,

$$\therefore i_{rms} = \frac{2.2\sqrt{2}}{\sqrt{2}} = 2.2 A$$

9. Considering sinusoidal AC.

Phase at maximum value = $\pi/2$

Phase at rms value = $3\pi/4$

Thus phase change = $3\pi/4 - \pi/2 = \pi/4$

Now $\omega = 2\pi f$

$$= 2\pi \times 50$$

$$= 100\pi$$

$$\text{time taken } t = \frac{\theta}{\omega} = \frac{\pi/4}{100\pi} = \frac{1}{400} s$$

$$t = 2.5 \times 10^{-3} = 2.5 \text{ ms}$$



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10. In case of capacitor the current lags by $\pi/2$ by emf.
11. In purely inductive circuit, Inductive reactance, $X_L = 2\pi fL$, where f is the frequency.
If f is halved then X_L also gets halved.

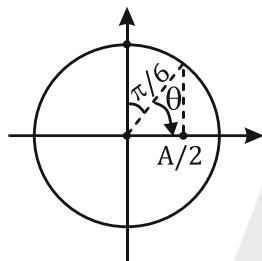
$$\text{Current, } I = \frac{E}{X_L} = \frac{E}{2\pi fL}$$

If f is halved then, current will get doubled.

12. $V(t) = 220 \sin(100\pi t)$ volt

$$I(t) = \frac{220}{5} \sin(100\pi t) \text{ volt}$$

$$= 44 \sin(100\pi t) \text{ volt}$$



Comparing with $I = I_0 \sin(\theta)$,

$$I = \frac{I_0}{2} \text{ when } \theta = 30^\circ$$

$$I = I_0 \text{ when } \theta = 90^\circ$$

$$\therefore \text{phase to be covered } \theta = 60^\circ = \frac{\pi}{3}$$

Time taken,

$$t = \frac{\theta}{\omega} = \frac{\frac{\pi}{3}}{100\pi} = \frac{1}{300} \text{ sec}$$

$$= 3.3 \text{ ms.}$$

13. R and L cause phase difference to lie between 0 and $\pi/2$ but never 0 and $\pi/2$ at extremities.