Alternating Current

Question1

A coil of inductive reactance $\frac{1}{\sqrt{3}} \Omega$ and a resistance 1Ω are connected in series to a $200 \mathrm{~V}, 50 \mathrm{~Hz}$ AC source. The time lag between voltage and current is

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Options:

A.

$\frac{1}{1200} \mathrm{~s}$

B.

$\frac{1}{600} \mathrm{~s}$

C.

$\frac{1}{400} \mathrm{~s}$

D.

$\frac{1}{800} \mathrm{~s}$

Answer: B

Solution:

First, find the angle by which the current lags the voltage. This angle is called ϕ.

Find $\tan \phi$:

The formula is $\tan \phi=\frac{X_L}{R}$, where X_L is the inductive reactance and R is resistance.

Here, $X_L=\frac{1}{\sqrt{3}} \Omega$ and $R=1 \Omega$.

So, $\tan\phi = \frac{\frac{1}{\sqrt{3}}}{1} = \frac{1}{\sqrt{3}}$.

We know that $\tan\frac{\pi}{6} = \frac{1}{\sqrt{3}}$. So, $\phi = \frac{\pi}{6}$.

Find the time period T of the AC supply:

The frequency $f = 50$ Hz, so $T = \frac{1}{f} = \frac{1}{50}$ seconds.

Find the time lag Δt:

The time lag is given by $\Delta t = \frac{\phi}{2\pi} \times T$.

Put the values in: $\Delta t = \frac{\frac{\pi}{6}}{2\pi} \times \frac{1}{50}$.

Simplify it: $\Delta t = \frac{1}{12} \times \frac{1}{50} = \frac{1}{600}$ seconds.

Question2

In a series LCR circuit, the voltages across the capacitor, resistor and inductor are in the ratio $2:3:6$, if the voltage of the AC source in the circuit is 240 V , then the voltage across the inductor is

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Options:

A.

240 V

B.

144 V

C.

96 V

D.

288 V

Answer: D

Solution:

The voltages across the capacitor (V_C), resistor (V_R), and inductor (V_L) have the ratio 2:3:6.

This means $V_C = 2k$, $V_R = 3k$, and $V_L = 6k$ for some number k.

The total voltage across the circuit is given by: $V = \sqrt{V_R^2 + (V_L - V_C)^2}$ This formula is used because in an LCR circuit, resistor voltage is in phase with supply, while inductor and capacitor voltages are 180° out of phase with each other.

We are told the source voltage is 240 V: $240 = \sqrt{(3k)^2 + (6k - 2k)^2}$

Simplifying inside the square root: $(3k)^2 = 9k^2 (6k - 2k)^2 = (4k)^2 = 16k^2$ So, $240 = \sqrt{9k^2 + 16k^2} = \sqrt{25k^2} = 5k$

Now solve for k: $5k = 240 \implies k = \frac{240}{5} = 48$

Now, calculate the voltage across the inductor: $V_L = 6k = 6 \times 48 = 288 \text{ V}$

Question3

If the voltage and current in an AC circuit are respectively $50 \sin(50t) \text{V}$ and $50 \sin\left(50t + \frac{\pi}{4}\right) \text{mA}$, then the power dissipated in the circuit is nearly

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Options:

A.

1.296 W

B.

0.648 W

C.

0.884 W

D.

1.768 W

Answer: C

Solution:

The formula to find the average (real) power in an AC circuit is:

$P = V_{\text{rms}} \times I_{\text{rms}} \times \cos\phi$where ϕ is the phase difference between voltage and current.

The voltage is $50\sin(50t)$, so its maximum (peak) value is 50 V.

The current is $50\sin\left(50t + \frac{\pi}{4}\right)$, so its peak value is $50 \text{ mA} = 50 \times 10^{-3}$ A.

The phase difference ϕ between voltage and current is $\frac{\pi}{4}$.

To get the RMS (root mean square) values from the peak values, divide by $\sqrt{2}$:

$V_{\text{rms}} = \frac{50}{\sqrt{2}}$

$I_{\text{rms}} = \frac{50\times10^{-3}}{\sqrt{2}}$

Now, put these values into the power formula:

$P = \frac{50}{\sqrt{2}} \times \frac{50\times10^{-3}}{\sqrt{2}} \times \cos\left(\frac{\pi}{4}\right)$

$\cos\left(\frac{\pi}{4}\right)$ is $\frac{1}{\sqrt{2}}$.

So,

$P = \frac{50}{\sqrt{2}} \times \frac{50}{\sqrt{2}} \times 10^{-3} \times \frac{1}{\sqrt{2}}$

Multiply the numbers:

$= \frac{50\times50\times10^{-3}}{\sqrt{2}\times\sqrt{2}\times\sqrt{2}}$

$\sqrt{2} \times \sqrt{2} \times \sqrt{2} = 2\sqrt{2}$

$= \frac{2500\times10^{-3}}{2\sqrt{2}}$

$= \frac{2.5}{2\sqrt{2}}$

This is approximately equal to 0.884 W.

Question4

In a series resonant LCR circuit, for the power dissipated to become half of the maximum power dissipated, the current amplitude is

Options:

A.

$\frac{1}{\sqrt{2}}$ times its maximum value.

B.

$1/2$ times its maximum value.

C.

twice its maximum value.

D.

$\sqrt{2}$ times its maximum value.

Answer: A

Solution:

Given:

In a **series LCR circuit at resonance**, the **power dissipated** is maximum.

We need to find:

For the **power dissipated** to become **half of its maximum value**, what is the **current amplitude**?

Step 1: Relation between Power and Current

The average power dissipated in an AC circuit is given by:

$P = I_{\text{rms}}^2 \ R$

At resonance, the impedance is purely resistive ($Z = R$), and the current is maximum ($I = I_{\text{max}}$).

So maximum power is:

$P_{\text{max}} = I_{\text{rms,max}}^2 \quad R = \left(\frac{I_{\text{max}}}{\sqrt{2}}\right)^2 R = \frac{I_{\text{max}}^2 \quad R}{2}$

But we only need **relative power**, so we can use $P \propto I^2$.

Step 2: Condition for half power

We are told $P = \frac{1}{2} P_{\max}$

So:

$I^2 R = \frac{1}{2} I_{\max}^2 R$

Simplify:

$I = \frac{I_{\max}}{\sqrt{2}}$

✅ **Final Answer:**

Option A: $\frac{1}{\sqrt{2}}$ times its maximum value.

So the current amplitude becomes $1/\sqrt{2}$ times its maximum value when the power is half of the maximum.

Question5

If a resistor of resistance 4Ω, a capacitor of capacitive reactance 6Ω and an inductor of inductive reactance 9Ω are connected in series with an AC source, then the impedance of the circuit is

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Options:

A.

19Ω

B.

11Ω

C.

7Ω

D.

5Ω

Answer: D

Solution:

Impedance,

$$Z=\sqrt{R^2+\left(X_L-X_C\right)^2}$$
$$=\sqrt{4^2+(9-6)^2}=\sqrt{16+9}=5\Omega$$

Question6

A resistor of 450Ω and an inductor are connected in series to an AC source of frequency $\frac{75}{\pi}$ Hz. If the power factor of the circuit is 0.6 , then the inductance connected in the circuit is

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Options:

A.

6 mH

B.

4 H

C.

4 mH

D.

6 H

Answer: B

Solution:

Power factor

$$\cos \phi=\frac{R}{Z}$$
$$0.6=\frac{R}{\sqrt{R^2+X_L^2}}$$
$$\Rightarrow \quad 0.36=\frac{R^2}{R^2+(2\pi f L)^2}$$

$$\Rightarrow \quad 0.36=\frac{(450)^2}{(450)^2+\left(2\pi\times\frac{75}{\pi}L\right)^2}$$

$$\Rightarrow \quad 0.36=\frac{(450)^2}{450^2+(150L)^2}$$

Solving, we get

$L=4\mathrm{H}$

Question7

For better tuning of a series LCR circuit in a communication system, the preferred combination is

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Options:

A.

$R=20\Omega : L=15\mathrm{H} : \mathrm{C}=35\mu\,\mathrm{F}$

B.

$R=15\Omega : L=40\mathrm{H} : \mathrm{C}=20\mu\,\mathrm{F}$

C.

$R=25\Omega : L=15\mathrm{H} : C=45\mu\,\mathrm{F}$

D.

$R=15\Omega : L=20\mathrm{H} : C=45\mu\,\mathrm{F}$

Answer: B

Solution:

For better tunning of a series LCR circuit in a communication system. Quality factor ' Q ' should be high.

i.e.

$Q=\frac{1}{R}\sqrt{\frac{L}{C}}$

So, for high value of Q, value of R and C should be minimum and value L should be maximum.

Question8

In an LCR series circuit, if the potential differences across inductor, capacitor and resistor are $60 \mathrm{~V}, 30 \mathrm{~V}$ and 40 V respectively, then the AC voltage applied to the circuit is

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Options:

A.

50 V

B.

70 V

C.

130 V

D.

60 V

Answer: A

Solution:

AC voltage applied to the circuit,

$$\begin{aligned} V & =\sqrt{V_R^2+\left(V_L-V_C\right)^2} \\ & =\sqrt{40^2+(60-30)^2} \\ & =\sqrt{1600+900}=\sqrt{2500} \\ & =50 \mathrm{~V} \end{aligned}$$

Question9

The resonant frequency of an LC circuit is f_0. If a dielectric slab of constant 16 is inserted completely between the plates of the capacitor, then the resonant frequency is

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Options:

A.

$\frac{f}{2}$

B.

26

C.

$\frac{6}{4}$

D.

$4f$

Answer: C

Solution:

Resonance frequency

$f_0 = \frac{1}{2\pi\sqrt{LC}}$

When dielectric material is introduced, then new capacitance,

$C' = C_0K = 16C_0 = 16C$

$\therefore$ New resonance frequency

$$f_0' = \frac{1}{2\pi\sqrt{LC'}} = \frac{1}{2\pi\sqrt{L \times 16C}}$$
$$= \frac{1}{4} \times \frac{1}{2\pi\sqrt{LC}} = \frac{f_0}{4}$$

Question10

An alternating current is given by $i = (3 \sin \omega t + 4 \cos \omega t)$A. The rms current will be

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Options:

A. $\frac{7}{\sqrt{2}}$ A

B. $\frac{1}{\sqrt{2}}$ A

C. $\frac{5}{\sqrt{2}}$ A

D. $\frac{3}{\sqrt{2}}$ A

Answer: C

Solution:

The rms value is found from

writing $i(t) = A \sin \omega t + B \cos \omega t$ with $A = 3$, $B = 4$,

using

$i_{\text{rms}} = \sqrt{\langle i^2 \rangle} = \sqrt{\frac{A^2+B^2}{2}} = \frac{\sqrt{3^2+4^2}}{\sqrt{2}} = \frac{5}{\sqrt{2}}\text{ A}$.

So the correct choice is Option C: $\frac{5}{\sqrt{2}}$ A.

Question11

A 50 Hz AC circuit has a 10 mH inductor and a 2Ω resistor in series. The value of capacitance to be placed in series in the circuit to make the circuit power factor as unity is

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Options:

A. 1.014×10^{-6} F

B. 1.014×10^{-3} F

C. 2.6×10^{-3} F

D. 4.125×10^{-3} F

Answer: B

Solution:

Given:

Frequency, $f = 50\,\text{Hz}$

Inductance, $L = 10\,\text{mH} = 10 \times 10^{-3}\,\text{H}$

Resistance, $R = 2\,\Omega$

First, calculate the inductive reactance (X_L) using the formula:

$X_L = 2\pi f L$

Substituting the given values:

$X_L = 2\pi \times 50 \times 10 \times 10^{-3} = \pi$

For the circuit to have a unit power factor, the inductive reactance (X_L) must equal the capacitive reactance (X_C). Therefore,

$X_C = X_L$

The formula for capacitive reactance is:

$X_C = \frac{1}{2\pi f C}$

Setting $X_C = X_L$, we have:

$\pi = \frac{1}{2\pi \times 50 \times C}$

Solving for C:

$C = \frac{1}{2(\pi^2) \times 50}$

$C = \frac{1}{2 \times 9.8696 \times 50}$

$C = \frac{1}{973.036}$

$C = 1.014 \times 10^{-3}\,\text{F} = 1.014\,\text{mF}$

Thus, the required capacitance is $1.014 \times 10^{-3}\,\text{F}$.

Question12

A resistor of resistance R, inductor of inductive reactance $2R$ and a capacitor of capacitive reactance X_C are connected in series to an AC source.If the series $L - C - R$ circuit is in resonance, then the power factor of the circuit and the value, X_C are respectively

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Options:

A. 0.5 and $4R$

B. 1 and $2R$

C. 0.5 and $2R$

D. 1 and $4R$

Answer: B

Solution:

Given an $L - C - R$ circuit in resonance, let's analyze it:

Provided Values:

Inductive Reactance (X_L): $2R$

Resistance (R): R

Resonance Condition:

In a resonant circuit, the inductive reactance is equal to the capacitive reactance. Therefore:

$X_L = X_C$

$X_C = 2R$

Power Factor:

The power factor of a circuit is calculated as:

$P = \frac{\text{Resistance}}{\text{Impedance (Z)}}$

The impedance in an $L - C - R$ circuit, when in resonance and when $X_L = X_C$, is:

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

Since $X_L = X_C$ in resonance:

$Z = \sqrt{R^2 + (2R - 2R)^2} = R$

Thus, the power factor is:

$P = \frac{R}{R} = 1$

Therefore, when the circuit is in resonance, the capacitive reactance $X_C = 2R$, and the power factor is 1.

Question13

An inductor and a resistor are connected in series to an AC source of voltage $144 \sin \left(100\pi t + \frac{\pi}{2}\right) \mathrm{V}$. If the current in the circuit is $6 \sin \left(100\pi t + \frac{\pi}{6}\right) \mathrm{A}$, then the resistance of the resistor is

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Options:

A. 24Ω

B. 36Ω

C. 12Ω

D. 18Ω

Answer: C

Solution:

Given:

The voltage expression: $V = 144 \sin \left(100\pi t + \frac{\pi}{2}\right) \mathrm{V}$

The current expression: $I = 6 \sin \left(100\pi t + \frac{\pi}{6}\right) \mathrm{A}$

Analysis

Standard Form Comparison:

The standard forms of voltage and current are:

$V = V_0 \sin(\omega t + \phi_v)$

$I = I_0 \sin(\omega t + \phi_i)$

Phase Difference:

Comparing the given equations, we identify the phases:

Voltage phase: $\phi_v = \frac{\pi}{2}$

Current phase: $\phi_i = \frac{\pi}{6}$

The phase difference, ϕ, between voltage and current is:

$\phi = \phi_v - \phi_i = \frac{\pi}{2} - \frac{\pi}{6} = \frac{\pi}{3} = 60^\circ$

Impedance Calculation:

The impedance Z of the circuit is given by:

$Z = \frac{V_0}{I_0} = \frac{144}{6} = 24\,\Omega$

Resistance Calculation:

The relationship between impedance Z, resistance R, and the phase angle ϕ is given by:

$\frac{R}{Z} = \cos\phi$

Solving for R, we have:

$R = \cos(60^\circ) \times Z = \frac{1}{2} \times 24 = 12\,\Omega$

Therefore, the resistance of the resistor is $12\,\Omega$.

Question14

A resistance of 20Ω is connected to a source of an alternating potential $V = 200\sin(10\pi t)$. If t is the time taken by the current to change from the peak value to rms value, then t is (in seconds)

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Options:

A. 25×10^{-1}

B. 2.5×10^{-4}

C. 25×10^{-2}

D. 2.5×10^{-2}

Answer: D

Solution:

Given:

Resistance: $R = 20\,\Omega$

Alternating potential: $V = 200\sin(10\pi t)$

The expression for the alternating current I can be derived as follows:

$I = \frac{V}{R} = \frac{200\sin(10\pi t)}{20} = 10\sin(10\pi t)$

We know that the root mean square (RMS) current is related to the peak current by the equation:

$I_{\text{RMS}} = \frac{I_{\text{peak}}}{\sqrt{2}}$

Thus, the RMS current is also expressed as:

$I_{\text{RMS}} = I_{\text{peak}} \sin(10\pi t)$

Setting the RMS and the peak relation,

$\frac{I_{\text{peak}}}{\sqrt{2}} = I_{\text{peak}} \sin(10\pi t)$

This simplifies to:

$\frac{1}{\sqrt{2}} = \sin(10\pi t)$

The sine of $\frac{\pi}{4}$ is known to be $\frac{1}{\sqrt{2}}$, so:

$\sin\left(\frac{\pi}{4}\right) = \sin(10\pi t) \Rightarrow 10\pi t = \frac{\pi}{4}$

Solving for t:

$t = \frac{1}{40} \Rightarrow t = 2.5 \times 10^{-2}\text{ s}$

Question15

A full wave rectifier circuit is operating from 50 Hz mains. The fundamental frequency in the ripple output will be

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Options:

A. 50 Hz

B. 70.7 Hz

C. 100 Hz

D. 25 Hz

Answer: C

Solution:

In a full-wave rectifier, both the positive and negative halves of the AC input are used, effectively doubling the frequency of the output ripple compared to the mains frequency. Here's a step-by-step explanation:

The mains frequency is 50 Hz.

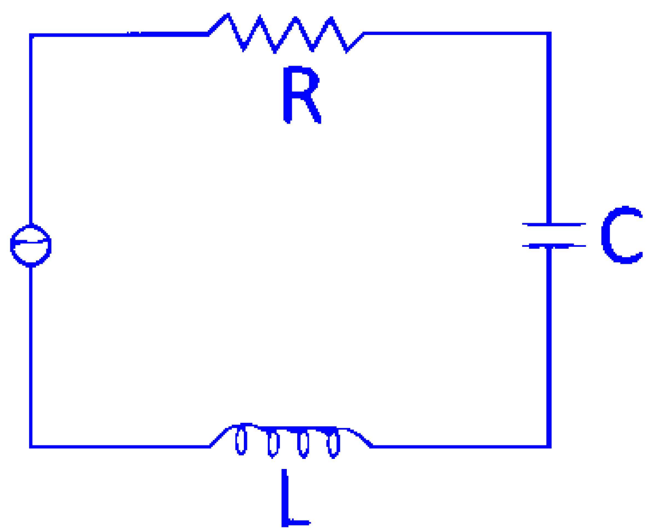
The full-wave rectifier inverts the negative half cycle, so the ripple frequency becomes:

$f_{\text{ripple}} = 2 \times 50\,\text{Hz} = 100\,\text{Hz}.$

Therefore, the fundamental frequency in the ripple output is 100 Hz, which is Option C.

Question16

A series $L-C-R$ circuit is shown in the figure. Where the inductance of 10 H , capacitance 40μ F and resistance 60Ω are connected to a variable frequency 240 V source. The current at resonating frequency is



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Options:

A. 4 A

B. $2A$

C. 5.4 A

D. 5.8 A

Answer: A

Solution:

In the given LCR circuit, the components have the following values:

Inductance, $L = 10\,\text{H}$

Capacitance, $C = 40\,\mu\text{F} = 4 \times 10^{-5}\,\text{F}$

Resistance, $R = 60\,\Omega$

The circuit is connected to a variable frequency source of 240 V.

To find the resonant frequency (ω_r), we use the formula:

$$\omega_r = \frac{1}{\sqrt{LC}}$$

Substituting the given values:

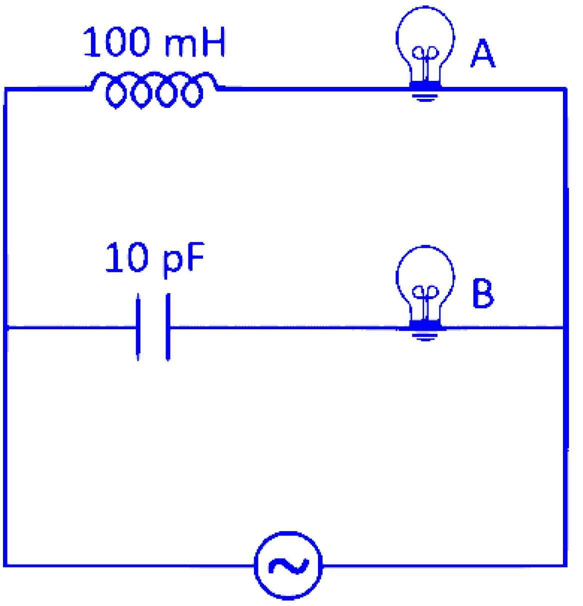
$$\omega_r = \frac{1}{\sqrt{10\times4\times10^{-5}}} = \frac{1}{2\times10^{-2}} = 50\,\text{rad/s}$$

At resonance, the impedance Z of the circuit is minimized to the resistance R only. Thus, the current I at resonant frequency can be calculated by:

$$I = \frac{V}{Z} = \frac{V}{R} = \frac{240}{60} = 4\,\text{A}$$

Question17

In the figure. If A and B are identical bulbs, which bulb glows brighter.



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Options:

A. A

B. B

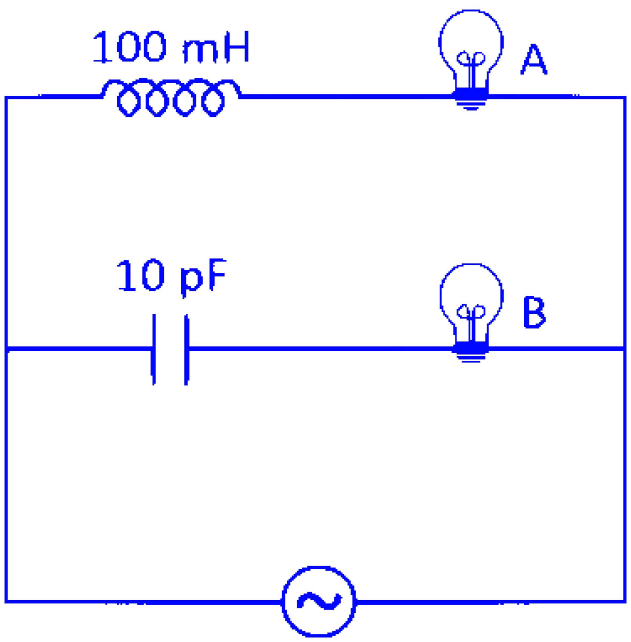
C. Both with equal brightness

D. Both do not glow

Answer: A

Solution:

We know that, $X_C = 1/\omega C$ and $X_L = \omega L$



According to figure,

$C = 10\text{pF} = 10 \times 10^{-12}$ F
$L = 100\text{mH} = 0.1\text{H}$

Here, $C \ll L$

So, $X_C \gg X_L$

$\therefore \quad i_A \gg i_B$

Hence, bulb A will glow brighter.

Question18

An $R - L - C$ circuit consists of a 150Ω resistor, 20μF capacitor and a 500 mH inductor connected in series with a 100 V AC supply. The angular frequency of the supply voltage is 400rads^{-1}. The phase angle between current and the applied voltage is

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Options:

A. $\tan^{-1}(0.8)$

B. $\tan^{-1}(0.25)$

C. $\tan^{-1}(0.6)$

D. $\tan^{-1}(0.5)$

Answer: D

Solution:

To determine the phase angle ϕ between the current and the applied voltage in an $R-L-C$ circuit, we need to use the following relationship:

$\tan\phi = \frac{X_L - X_C}{R}$

where:

- X_L is the inductive reactance
- X_C is the capacitive reactance
- R is the resistance

Given:

- Resistance, $R = 150\Omega$
- Capacitance, $C = 20\mu\text{F} = 20 \times 10^{-6}\text{F}$
- Inductance, $L = 500\text{mH} = 500 \times 10^{-3}\text{H}$
- Angular frequency, $\omega = 400\text{rad s}^{-1}$

The inductive reactance X_L is calculated as:

$X_L = \omega L$

Substituting the values:

$X_L = 400 \times 500 \times 10^{-3}$

$X_L = 200\,\Omega$

The capacitive reactance X_C is calculated as:

$X_C = \frac{1}{\omega C}$

Substituting the values:

$X_C = \frac{1}{400 \times 20 \times 10^{-6}}$

$X_C = 125\,\Omega$

Now, we can find the phase angle using the equation:

$\tan\phi = \frac{X_L - X_C}{R}$

Substituting the values:

$\tan \phi = \frac{200-125}{150}$

$\tan \phi = \frac{75}{150}$

$\tan \phi = 0.5$

Therefore, the phase angle ϕ is:

$\phi = \tan^{-1}(0.5)$

So, the correct answer is:

Option D $\tan^{-1}(0.5)$

Question19

Capacitive reactance of a capacitor in an AC circuit is $3 \mathrm{k}\Omega$. If this capacitor is connected to a new AC source of double frequency, the capacitive reactance will become.

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Options:

A. $1.5 \mathrm{k}\Omega$

B. $3 \mathrm{k}\Omega$

C. $6 \mathrm{k}\Omega$

D. $5.2 \mathrm{k}\Omega$

Answer: A

Solution:

Given capacitive reactance,

$X_{C_1} = 3 \mathrm{k}\Omega$

we know that,

$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

$$\Rightarrow X_C \propto \frac{1}{f} \Rightarrow \frac{X_{C_2}}{X_{C_1}} = \frac{f_1}{f_2}$$
$$= \frac{f_1}{2f_1} = \frac{1}{2} \quad (\because f_2 = 2f_1)$$
$$\Rightarrow X_{C_2} = \frac{X_{C_1}}{2}$$
$$= \frac{3\mathrm{k}\Omega}{2} = 1.5\mathrm{k}\Omega$$

Question20

A coil of inductance 0.1 H and resistance 110Ω is connected to a source of 110 V and 350 Hz . The phase difference between the voltage maximum and the current maximum is

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Options:

A. $\tan^{-1}(1.5)$

B. $\tan^{-1}(0.5)$

C. $\tan^{-1}(1.73)$

D. $\tan^{-1}(2)$

Answer: D

Solution:

Given, Inductance, $L = 0.1$ H

Resistance, $R = 110\Omega$;

Potential difference, $V = 110$ V

Frequency, $f = 350$ Hz

Phase difference between maximum voltage and maximum current is given as

$$\tan \phi = \frac{X_L}{R}$$
$$= \frac{2\pi f L}{R} = \frac{2 \times \frac{22}{7} \times 350 \times 01}{110} = 2$$
$$\Rightarrow \quad \tan \phi = 2$$
$$\Rightarrow \quad \phi = \tan^{-1}(2)$$

Question21

A 20 V AC is applied to a circuit consisting ofa resistor and a coil with negligibleresistance. If the voltage across the resistor is12 V, the voltage across the coil is

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Options:

A. 16 V

B. 10 V

C. 8 V

D. 6 V

Answer: A

Solution:

Given, $V_{\text{rms}} = 20$ V

Voltage across resistance $= 12$ V

Let voltage across inductor be V_L

As we know that,

$$V^2 = V_R^2 + V_L^2$$
$$\Rightarrow \quad V_L^2 = V^2 - V_R^2 = (20)^2 - (12)^2$$
$$= 400 - 144 = 256 \text{ V}$$
$$V_L = 16 \text{ V}$$

Question22

A bulb of resistance 280Ω is supplied with a 200 V AC supply. What is the peak current?

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Options:

A. Nearly 1 A

B. Nearly 2 A

C. Nearly 1.4 A

D. Nearly 2.8 A

Answer: A

Solution:

Given, resistance of bulb, $R = 280\Omega$

Supply voltage $V_{\text{rms}} = 200$ V

As, $V_{\text{rms}} = \frac{V_0}{\sqrt{2}}$ = root mean square speed

$\Rightarrow \quad V_0 = \sqrt{2} V_{\text{rms}}$

where, V_0 is peak voltage,

As, $V = IR$

$\therefore \quad I_0 = \frac{V_0}{R} = \frac{\sqrt{2} \times 200}{280} = \frac{5\sqrt{2}}{7} = 1.010$ A

Which is nearly 1A.

Question23

A resonant frequency of a current is f. If thecapacitance is made four times the initialvalue, then the resonant frequency willbecome

Options:

A. $\frac{f}{2}$

B. $2f$

C. f

D. $\frac{f}{4}$

Answer: A

Solution:

Given,

Initial resonance frequency, $f_i = f$

Initial capacitance and inductance be $C_1 = C$ and $L_1 = L$

Final capacitance and inductance one $C_2 = 4C$ and $L_2 = L$

Let final frequency be f'.

Since, $\omega = \frac{1}{\sqrt{LC}} = 2\pi f$

where, ω and f and angular frequency and frequency.

$$\therefore \quad f \propto \frac{1}{\sqrt{LC}} \Rightarrow \frac{f}{f'} = \sqrt{\frac{L'C'}{LC}} = \frac{\sqrt{L4C}}{\sqrt{LC}} = \sqrt{4} = 2$$
$$\therefore \quad f' = \frac{f}{2}$$
