INDEX

Ables/645

1. ALTERNATING CURRENT

An alternating current is that which changes continuously in magnitude and periodically in direction. It can be represented by a sine curve or a cosine curve i.e.

$I = I_0 \sin \omega t$ or $I = I_0 \cos \omega t$

Here, I_0 is peak value of current and I is instantaneous value of current.

$\omega = \frac{2\pi}{T} = 2\pi v$ where T is period of a.c. and v is frequency of a.c. The alternating emf can similarly be represented as

$E = E_0 \sin \omega t$ or $E = E_0 \cos \omega t$

1.1 MEAN OR AVERAGE VALUE

Mean or average value of alternating current over any half cycle is that value of steady current, which would send the same amount of charge through a circuit in the time of half cycle (i.e. T/2) as is sent by A.C. through the same circuit in the same time.

Thus $(I_m \text{ or } I_{av})_{0 \to T/2} = 2/\pi\, I_0 = 0.637\, I_0$

and $(I_m \text{ or } I_{av})_{T/2 \to T} = -2/\pi\, E_0 = -\,0.637\, I_0$

Over a complete cycle $(0 \to T)$, I_m or $I_{av} = 0$.

Similarly, for alternating emf, we can write mean value as

$(E_m \text{ or } E_{av})_{0 \to T/2} = 2/\pi\, E_0 = 0.637\, E_0$

$(E_m \text{ or } E_{av})_{T/2 \to T} = -\,2/\pi\, E_0 = 0.637\, E_0$

Over a complete cycle $(0 \to T)$, E_m or $E_{av} = 0$.

1.2 THE ROOT MEAN SQUARE (R.M.S.) VALUE

The root mean square (r.m.s.) value of alternating current is defined as that value of steady current, which would generate the same amount of heat in a given resistance in a given time, as is done by the alternating current, when passed through the same resistance for the same time. The r.m.s. value of a.c. is also called effective value or virtual value of a.c. It is represented by I_{rms}, I_{eff} or I_v

It can be shown that

$$I_v = \frac{I_0}{\sqrt{2}} = 0.707\, I_0$$

Similarly $$E_v = \frac{E_0}{\sqrt{2}} = 0.707\, E_0$$

All a.c. instruments measure virtual values of a.c. The behavior of an ohmic resistance R in a.c. circuit is the same as in d.c. circuit. Through R, alternating e.m.f. and alternating current are in same phase.

1.3 PURELY RESISTIVE CIRCUIT

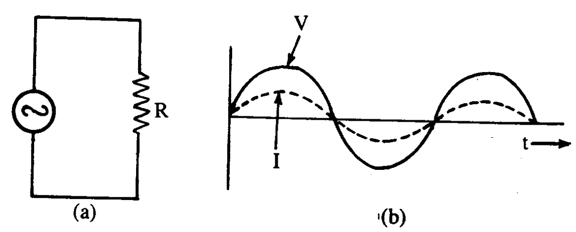
Phase Resistive Circuit

Let $V = V_0 \sin \omega t$

$$I = \frac{V}{R} = \frac{V_0}{R} \sin \omega t$$

$= I_0 \sin \omega t$

It is clear that both voltage and current are in same phase.



1.4 PURELY INDUCTIVE CIRCUIT

1. Phase relation for V and I, inductive Reactance

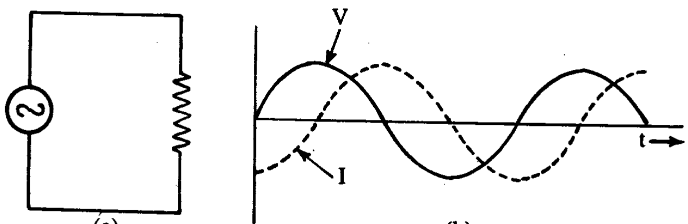
Let $V = V_0 \sin \omega t$

The circuit equation is

$$V - L\frac{dI}{dt} = 0$$

which leads to

$$I = I_0 \sin(\omega t - \pi/2)$$



(a) (b)

where $I_0 = \frac{V_0}{\omega L} \Rightarrow V_{rms} = (\omega L)\, I_{rms}$

We conclude that -

2. The current lags behind the voltage in phase by $\frac{\pi}{2}$, and

3. The quantity ωL is a measure of the effective opposition offered to the flow of an alternating current by an inductor. It is denoted by X_L and is called inductive reactance :

$$X_L = \omega L$$

It may be noted that $X_L \propto \omega$. Thus inductance offers larger opposition to a.c. of higher frequency than to a.c. of lower frequency.

4. **Power :** It can be shown that the average power consumed in a cycle is zero.

$$\overline{P} = 0$$

Since the current flows without any power loss, it is called wattless current. During one quarter cycle, when the current increases, energy is stored in the inductance in the form of magnetic energy and during the next quarter, when the current decreases, this energy is transferred back to the source. An inductance coil with a high value of reactance and low resistance has, therefore, the property of opposing alternating current without any significant power loss. Such a coil is called a choke coil.

1.5 PURELY CAPACITIVE CIRCUIT

1. Phase Relation for V and I. Capacitive Reactance

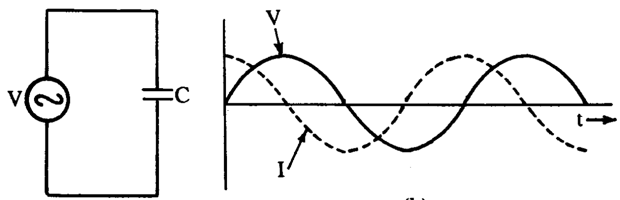
Let $V = V_0 \sin \omega t$

The circuit equation is

$$V - \frac{Q}{C} = 0$$

Which leads to

$$I = I_0 \sin(\omega t + \pi/2)$$



(a) (b)

where $I_0 = (\omega C)\, V_0 \Rightarrow V_{rms} = \left(\frac{1}{\omega C}\right) I_{rms}$

2. The current leads the voltage in phase by $\frac{\pi}{2}$, and

3. The quantity $\left(\frac{1}{\omega C}\right)$ is a measure of the effective opposition offered to the flow of an alternating current by a capacitor. It is denoted by X_C and is called capacitive reactance :

$$X_C = \left(\frac{1}{\omega C}\right)$$

Note that $X_C \propto \frac{1}{\omega}$ Thus a capacitor offers smaller opposition to a.c. of higher frequency than to a.c. of lower frequency. In d.c. $\omega = 0$ and therefore $X_C = \infty$.

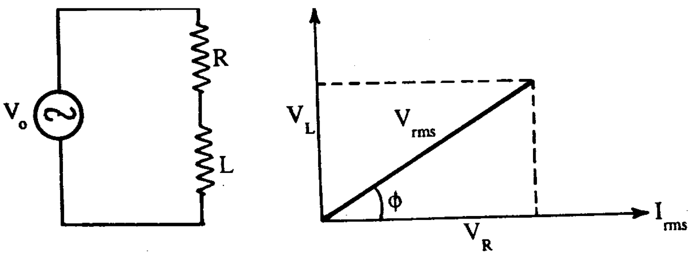
4. **Power :** It can be show that

$\overline{P} = 0$

During one quarter cycle, energy is stored in the capacitor in the form of electrostatic field. During the next quarter, this energy is delivered back to the source.

1.6 THE LR SERIES CIRCUIT

Let V_R, V_L and V_{rms} be the effective voltage across R, L and the source respectively.



(a) Circuit (b) Phase Diagram

Then

$$V_{rms} = \sqrt{V_R^2 + V_L^2} = I_{rms}\sqrt{R^2 + X_L^2}$$

The total opposition to the current, called impedance, is given by

$$Z = \frac{V_{rms}}{I_{rms}} = \sqrt{R^2 + X_L^2} = \sqrt{R^2 + \omega^2 L^2}$$

The phase angle by which the applied voltage leads the current is

$$\phi = \tan^{-1}\left(\frac{X_L}{R}\right) = \tan^{-1}\left(\frac{\omega L}{R}\right)$$

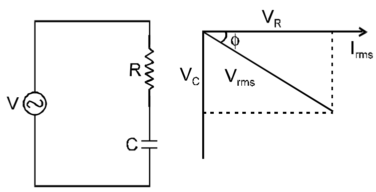
1.7 THE RC SERIES CIRCUIT

Here we get

$$V_{rms} = \sqrt{V_R^2 + V_C^2}$$

$$Z = \sqrt{R^2 + X_C^2} = \sqrt{R^2 + \frac{1}{\omega^2 C^2}}$$

$$\phi = \tan^{-1}\left(\frac{X_C}{R}\right) = \tan^{-1}\left(\frac{1}{\omega CR}\right)$$

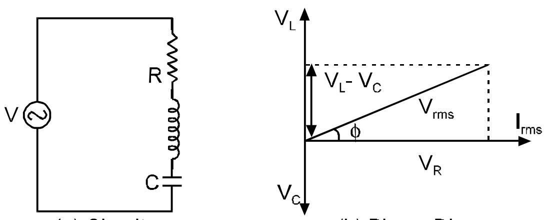


(a) Circuit (b) Phase Diagram

In this case current leads the applied voltage by angle ϕ.

1.8 THE LCR SERIES CIRCUIT

1. We get, in the general case of an LCR series circuit,



(a) Circuit (b) Phase Diagram

$V_{rms} = \sqrt{V_R^2 + (V_L - V_C)^2}$

$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$

and $\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right) = \tan^{-1}\left(\frac{\omega L - \frac{1}{\omega C}}{R}\right)$

2. **Power in LCR Circuit :** It can be shown that

$$\overline{P} = V_{rms} I_{rms} \cos\phi = V_{rms} I_{rms} \frac{R}{Z} = V_R I_{rms}$$

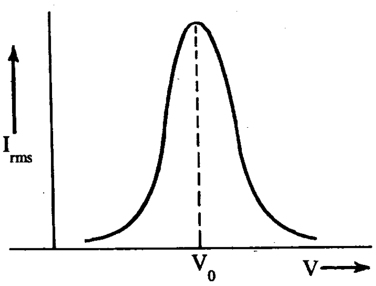
$\cos\phi$ is called the power factor of the LCR circuit.

3. **Resonance in LCR Series Circuit :**

From the expression for Z it is clear that X_L and X_C tend to cancel the effects of each other. At a particular angular frequency ω_0 of the source,

$$X_L = X_C \text{ or } \omega_0 L = \frac{1}{\omega_0 C}$$

In that case the impedance becomes minimum, equal to R and, therefore, the current will be maximum. The circuit is then said to be in resonance. The resonant frequency is



$$v_0 = \frac{1}{2\pi\sqrt{LC}}$$

The variation of current with the frequency of the applied voltage is shown in the figure. If the applied voltage consists of a number of frequency components, the current will be large for the component having frequency v_0. This behavior of the LCR circuit is used in radio tuning.

The tuning circuit of a radio receiver contains an LCR circuit, usually having a variable C. It is varied till the resonant frequency of the circuit is equal to the particular frequency from some radio station. Then the current corresponding to this signal is maximum and the receiver responds to it.

Q-Factor - The Q of an LCR series circuit is defined as

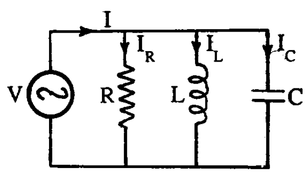
$$Q = \frac{\omega_0 L}{R}$$

It is an indicator of the sharpness of the current peak - higher the value of Q, sharper is the peak.

1.9 THE LCR PARALLEL CIRCUIT

In this case the voltage V across each element is the same. The currents are related as

$$I = \sqrt{I_R^2 + (I_C - I_I)^2}$$



$$= \sqrt{\left(\frac{V}{R}\right)^2 + \left(\omega CV - \frac{V}{\omega L}\right)^2}$$

$$= V\sqrt{\frac{1}{R^2} + \left(\omega C - \frac{1}{\omega L}\right)^2}$$

1.10 WATTLESS CURRENT

Average power associated over a complete cycle in a non inductive circuit (containing R, L, C with $X_L = X_C$) or pure resistive circuit is

$$P = E_v I_v$$

On the contrary, average power associated over a complete cycle with a pure inductor or pure capacitor is zero. Hence current through L and through C is said to be Wattless or Idle current.

In an inductor, energy stored during growth of current is $\frac{1}{2} L I_0^2$. This is spent in maintaining the current during decay.

In a capacitor, energy stored during charging is $\frac{1}{2} CV^2 = \frac{1}{2} QV = \frac{1}{2} \frac{Q^2}{C}$.

This is spent during discharging of the condenser.

In an LCR circuit, average power associated over a complete cycle is $P = E_v I_v \cos\theta$.

where θ is phase angle between alternating voltage and alternating current in the circuit, $\cos\theta = \frac{P}{E_v} I_v$ = true power/apparent power, is called power factor of the a.c. circuit. The value of power factor varies from 0 to 1.

2. A.C. & D.C. DEVICES

2.1 A.C. Generator or Alternator:

An a.c. generator/alternator produces alternating current energy from mechanical energy of rotation of a coil. It is based on the phenomenon of EMI. The form of emf induced is

$$e = e_0 \sin \omega t$$

where $e_0 = NAB\,\omega$, maximum. emf induced. Here, N is total number of turns in the coil, A is face area of the coil, B is strength of magnetic field applied and ω is angular velocity of the armature coil.

2.2 D.C GENERATOR OR DYNAMO

A d.c generator/dynamo produces direct current energy from mechanical energy of rotation of a coil. Its principle and working are same as those of a.c generator. There is only a little change in the design of the generator. Slip Ring arrangement used in a.c generator is replaced by Split Ring arrangement in d.c generator.

2.3 D.C MOTOR

1. A d.c motor converts direct current energy from a battery into mechanical energy of rotation. It is based on the fact that when a coil carrying current is held in a magnetic field, it experiences a torque, which rotates the coil. The efficiency of d.c motor is given by.

$$\eta = \frac{E}{V} = \frac{\text{back emf}}{\text{emf of battery}}$$

The efficiency becomes maximum, when $E = \frac{V}{2}$

2. **A motor starter** is a variable resistance, which protects the motor from damage, when it is switched on.

2.4 CHOKE COIL

A choke coil is a pure inductor used for controlling current in an a.c circuit. Through pure L, phase difference between E and i is $\theta = 90°$.

Average power consumed/cycle = $E_v I_v \cos 90 = 0$.

$$\text{As } I_0 = \frac{E_0}{X_L} = \frac{E_0}{\omega_L} = \frac{E_0}{2\pi\nu L}$$

for reducing low frequency alternating current, choke coils with laminated soft iron cores are used, and for reducing high freq. alternating currents, air cored chokes are used.

2.5 TRANSFORMER

A transformer is an electrical device, which is used for changing alternating voltages.

It is based on the phenomenon of mutual induction. If n_p is number of turns in primary and n_s is number of turns in secondary, then

$$= \frac{E_s}{E_p} = \frac{I_p}{I_s} = \frac{n_s}{n_p} = K$$

For a step up transformer, K >1 and for a step down transformer, K < 1. The main use of transformer is in transmission of a.c. over long distances, at extremely high voltages. This reduces the energy losses in transmission.

Efficiency of transformer = $\frac{\text{Output power}}{\text{Input power}}$ n = $\frac{E_s I_s}{E_p I_p}$

EXERCISE # 1

Q.1 **An alternating e.m.f. 10 cos 100 t volts is connected in series with a resistance of 10 ohms and inductance of 100 mH. What is the phase difference between voltage and current**

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{4}$

(C) $\frac{\pi}{3}$ (D) $\frac{\pi}{2}$

TOPIC SKILLS **:** **To calculate phase difference between i and v in a.c. circuit.**

Q.2 **The equation of AC voltage is E = 200 sin $(\omega t + \pi/6)$ and the A.C. current is I = 10 sin $(\omega t - \pi/6)$. The impedance of the circuit is ? Also find the out of the average power dissipated.**

(A) 550 Ω, 22 W (B) 22 Ω, 1100 W

(C) 22 Ω, 550 W (D) None of these

TOPIC SKILLS **:** **Average power and Impedance of ac circuits.**

Q.3 **A coil takes 2A and 200 W from an A.C. source of 220 V, 50 Hz. Calculate the inductance of the coil.**

(A) 0.21 H (B) 0.31 H

(C) 0.11 H (D) 0.41 H

TOPIC SKILLS **:** **RL a-c circuits.**

Q.4 **An A.C. source is in series with R and L. If respective potential drops are 200 V and 150 V, what is the applied voltage ?**

(A) 100 V (B) 150 V

(C) 200 V (D) 250 V

TOPIC SKILLS **:** **RL a-c circuits.**

Q.5 **Calculate the power factor of L–C–R circuit at resonance ?**

(A) 0.2 (B) 0.5

(C) 1.0 (D) 1.5

TOPIC SKILLS **:** **Concept of power factor in L.C. circuits**

Q.6 **A 100-V A.C. source of frequency of 500 Hertz is connected to a series LCR circuit with L = 8.1 mH, C = 12.5 μF and R = 10Ω. Find the potential-difference across the resistance.**

(A) 25 V (B) 50 V

(C) 100 V (D) 200 V

TOPIC SKILLS **:** **Series LCR circuits.**

Q.7 **A capacitor discharges through an inductance of 0.1 H and a resistance of 100Ω. If the frequency of discharge is 1000 Hz, calculate the capacitance.**

(A) 0.25 f (B) 0.50 μf

(C) 0.25 μf (D) 0.45 μf

TOPIC SKILLS **:** **Parallel LCR circuits**

Q.8 **An alternating e.m.f. of frequency 50 Hz is applied to a series circuit of resistance 20 Ω, inductance 100 mH and capacitance 30 μF. Does the current lag or lead the applied e.m.f. and by what angle ?**

(A) lag by 75° (B) leads by 75°

(C) lags by 35° (D) leads by 35°

TOPIC SKILLS **:** **Parallel LCR circuits**

ANSWER-KEY

Que.	1	2	3	4	5	6	7	8
Ans.	B	C	B	D	C	C	C	B

EXERCISE#2

Notes

Q.1 **If maximum flux linked with a coil is ϕ_0 and the coil rotates with angular velocity ω, then the peak value of induced emf will be.**

(A) $\frac{\phi_0}{\omega}$

(B) $\phi_0\omega$

(C) $\frac{\phi_0}{2\omega}$

(D) $\frac{2\phi_0\omega}{\pi}$

Q.2 **The armature coil of an ac generator has 20 turns and its area is 0.127 m^2. At which speed should it be rotated in a magnetic field of 0.2 Wb/m^2, So that maximum voltage of 160 volt may be induced in it**

(A) 30 rev/s
(B) 40 rev/s
(C) 50 rev/s
(D) 100 rev/s

Q.3 **If a coil of N turns and area A is rotating in a uniform magnetic field B with an angular velocity ω, then the rms value of induced emf in the coil will be.**

(A) $\omega BN\sqrt{2}$

(B) $\frac{BN}{A\omega\sqrt{2}}$

(C) $\frac{\omega BAN}{\sqrt{2}}$

(D) $\frac{\omega N}{AB}$

Q.4 **The phase different between the alternating current and voltage represented by the following equations.**

$I = I_0 \sin\omega t$, $E = E_0 \cos(\omega t + \pi/3)$, will be.

(A) $\frac{\pi}{3}$

(B) $\frac{4\pi}{3}$

(C) $\frac{\pi}{2}$

(D) $\frac{5\pi}{6}$

Notes

Q.5 **If N lamps each of p watt are connected in series. Then the effective power of each lamp will be.**

(A) P/N
(B) PN^2
(C) P/N^2
(D) PN

Q.6 **The equation of current in an ac circuit is.**
$I = 4 \sin (100\pi t + \pi/3)$
Root-mean-square value of current will be.

(A) 2 A
(B) 4 A
(C) 2.83 A
(D) 5.66 A

Q.7 **In an ac circuit the reactance of a coil is 20 ohm and the inductance of the coil is 50 mH. The angular frequency of the current will be.**

(A) 50 rad/s
(B) 60 rad/s
(C) 100 rad/s
(D) 400 rad/s

Q.8 **The reactance of a capacitor is X_1 at the frequency n_1 and X_2 at the frequency n_2. Then the ratio of X_1 and X_2 will be.**

(A) 1 : 1
(B) $n_1 : n_2$
(C) $n_2 : n_1$
(D) $n_{12} : n_{22}$

Q.9 **An ac source of E = 283 sin (100 t) volt is connected to a 1 μF capacitor through an ac ammeter. The reading of the ammeter will be.**

(A) 10 mA
(B) 20 mA
(C) 40 mA
(D) 80 mA

Q.10 **In an ac circuit the phase of current is ahead of the phase of voltage by $\pi/3$. The elements of circuit are.**

(A) R and L
(B) R only
(C) L and C
(D) R and C

Q.11 **A 0.21 henry inductor and a 12 ohm resistor are connected in series to a 220 V, 50 Hz ac source. The phase difference between the current and the source voltage will be.**

(A) $\tan^{-1}(1.5)$
(B) $\tan^{-1}(5.5)$
(C) $\tan^{-1}(2.5)$
(D) $\tan^{-1}(4.5)$

Notes

Q.12 A coil of resistance R and inductance L is connected to a cell of emf E volt. The current flowing through the coil will be.

(A) E/R

(B) E/L

(C) $\frac{E}{\sqrt{L^2+R^2}}$

(D) $\frac{\sqrt{EL}}{\sqrt{L^2+R^2}}$

Q.13 A coil when connected to a dc source of 12 V carries a current of 4 A. If this coil is connected to an ac source of 12 V and 50 rad/s, then it carries a current of 2.4 A. The inductance of the coil is.

(A) 48 H

(B) 4 H

(C) 12.5 H

(D) 8×10^{-2} H

Q.14 What will be the capacitance of the capacitor required for operating a bulb of 10 W, 30 V, if it is connected to a source of ac voltage of 220 V (rms) and frequency 50 Hz.

(A) 10^{-6} F

(B) 2.87×10^{-6} F

(C) 4.87×10^{-6} F

(D) 4.87×10^{-4} F

Q.15 In a series L–C–R circuit the rms voltages across the various elements are V_L = 90 V, V_C = 60 V and V_R = 40 V. The voltage applied in the circuit is.

(A) 50 V

(B) 70 V

(C) 110 V

(D) 190 V

Q.16 In an LCR circuit, the voltages across the components are V_L, V_C and V_R respectively. The voltage of source will be.

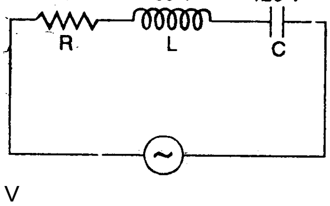
(A) $[V_R + V_L + V_C]$

(B) $[V_R^2 + V_L^2 + V_C^2]^{1/2}$

(C) $[V_R^2 + (V_L + V_C)^2]^{1/2}$

(D) $[V_R^2 + (V_L - V_C)^2]^{1/2}$

Q.17 In the circuit shown the potential differences across R, L and C are as given, then the emf of source will be.



(A) 190 V

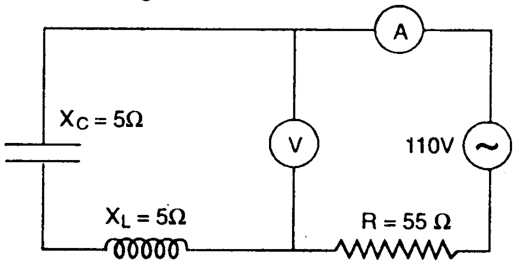
(B) 70 V

(C) 100 V

(D) 40 V

Notes

Q.18 The reading of ammeter in the circuit shown will be.



(A) 2 A
(B) 2.4 A
(C) Zero
(D) 1.7 A

Q.19 If θ is the phase difference between the current and the voltage in an L–C–R circuit. The correct relation is.

(A) $\tan\theta = \frac{\omega L - 1/\omega C}{R}$

(B) $\sin\theta = \frac{\omega L - 1/\omega C}{R}$

(C) $\cos\theta = \frac{\omega L - 1/\omega C}{R}$

(D) None of the above

Q.20 The inductance of the motor of a fan is 0.1 H. In order to provide maximum power at 50 Hz what is to be connected in series with the motor ?

(A) A resistor of 15 ohm.
(B) A resistor of 30 ohm
(C) A capacitor of 100 μF
(D) A capacitor of 50 μF

Q.21 In an ac circuit 6 ohm resistor, an inductor of 4 ohm and a capacitor of 12 ohm are connected in series with an ac source of 100 volt (rms). The average power dissipated in the circuit will be.

(A) 600 W
(B) 500 W
(C) 400 W
(D) 200 W

Q.22 Two coils A and B are connected in series with a source of 220 V (rms) and 50 Hz. The resistance of the coil A is 4 ohm and the inductance of coil B is 0.02 H. If the power dissipated in the circuit is 3 kW and power factor is 0.75, then the resistance of coil B will be.

(A) 5.075 ohm
(B) 50.75 ohm
(C) 0.58 ohm
(D) 0.40 ohm

Notes

Q.23 **The resistance and the inductive reactance of a choke coil are 6 ohm and 8 ohm respectively. It power factor will be.**

(A) 0.6
(B) 0.8
(C) 0.4
(D) 0.2

Q.24 **The power factor of a choke coil at 100 Hz is 0.707. If the frequency of ac is made 50 Hz the power factor will become.**

(A) 0.894
(B) 0.707
(C) 0.577
(D) 0.324

Q.25 **By how much percentage the impedance be increased in an ac circuit keeping the resistance constant so that the power factor changes from 1/2 to 1/4.**

(A) 100%
(B) 200%
(C) 50%
(D) 25%

Q.26 **In an ac circuit the phase difference between the current and the voltage is $\pi/2$. If the current in the circuit is 1A (rms) and voltage is 100 volt (rms), then the power dissipated in the circuit will be.**

(A) 10 W
(B) 100 W
(C) 1000 W
(D) Zero

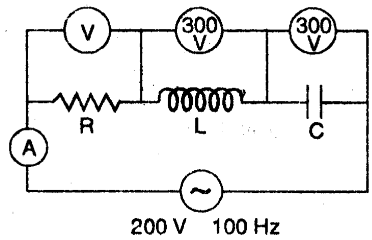
Q.27 **The current in an LCR circuit is given by**

$I = 20 \sin (100\pi t + \pi/3)$ A.

The voltage across the inductance L of 0.1 H at t = 0 will be.

(A) 31.4 V
(B) 3.14 V
(C) 1.57 V
(D) 314 V

Q.28 **In the series circuit shown in the figure the voltmeter reading will be.**



(A) 300 V
(B) 900 V
(C) 200 V
(D) 100 V

Notes

Q.29 Which of the following statements is correct ? In the state of resonance of a series L–C–R circuit.

(A) Current is minimum
(B) The phase different between the current and the emf is $\pi/2$
(C) The impedance is equal to R
(D) The power factor is minimum

Q.30 In a series resonant L–C–R circuit, if Lis increased by 25% and C is decreased by 20%, then the resonant frequency will.

(A) Increase by 10%
(B) Decrease by 10%
(C) Remain unchanged
(D) Increase by 2.5%

Q.31 The impedance of an LCR circuit at the resonant frequency of 50 Hz is 8W and the impedance at 100 hz is 10W. The inductance in the circuit is of.

(A) $\frac{1}{25\pi}$ H
(B) $\frac{1}{50\pi}$ H
(C) $\frac{1}{100\pi}$ H
(D) $\frac{1}{200\pi}$ H

Q.32 In a circuit C = 2µF, L = 1 mH and R = 10 ohm. When the current in the circuit is maximum, at that time the ratio of the energies stored in the capacitor and the inductor will be.

(A) 1 : 1
(B) 1 : 2
(C) 2 : 1
(D) 1 : 5

Q.33 In an LCR circuit R = 100 ohm. When capacitance C is removed, the current lags behind the voltage by $\pi/3$. When inductance L is removed, the current leads the voltage by π... The impedance of the circuit is.

(A) 50 ohm
(B) 100 ohm
(C) 200 ohm
(D) 400 ohm

Q.34 If the maximum value of current in a series L–C–R circuit is I_m, then the current through the circuit at half-power points is.

(A) $I_m\sqrt{2}$
(B) $I_m/\sqrt{2}$
(C) $2I_m$
(D) $I_m/2$

Notes

Q.35 In an LCR circuit L = 1 mH and R = 10 ohm. The band-width will be.

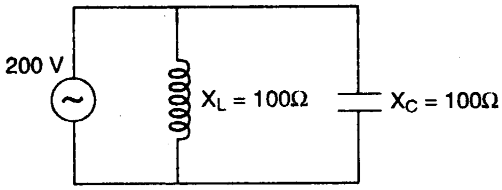
(A) $2\pi \times 10^2$ Hz

(B) $\frac{10^4}{2\pi}$ Hz

(C) $\frac{10^6}{\pi}$ Hz

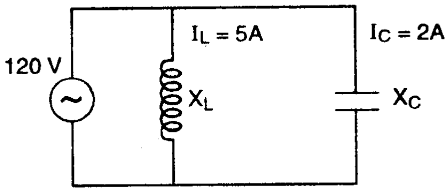
(D) 10^8 Hz

Q.36 The impedance of the circuit, shown in the figure will be.



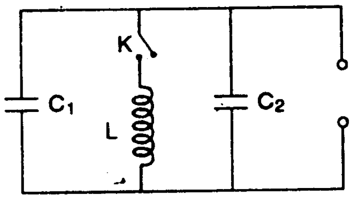
(A) Zero
(B) 100 ohm
(C) 200 ohm
(D) Infinite

Q.37 The impedance of the circuit shown in the figure is.



(A) 10 ohm
(B) 20 ohm
(C) 30 ohm
(D) 40 ohm

Q.38 In the given circuit, L = 2.5 mH, C_1 = 2.0 μF anc C_2 = 3.0μF. After charging the capacitors battery is removed from the circuit and the key K is pressed. The frequency of current oscillations in the circuit will be.



(A) 712 Hz
(B) 895 Hz
(C) 1425 Hz
(D) 8945 Hz

Notes

Q.39 **In an ac circuit, V and I are given by V = 100 sin (100 t) volts, I = 100 sin $\left(100t + \frac{\pi}{3}\right)$ mA. The power dissipated in circuit is**

(A) 10^4 watt
(B) 10 watt
(C) 2.5 watt
(D) 5 watt

Q.40 **A sinusoidal ac current flows through a resistor of resistance R. If the peak current is I_p, then the power dissipated is**

(A) $I_p^2 R\cos\theta$

(B) $\frac{1}{2}I_p^2 R$

(C) $\frac{4}{\pi}I_p^2 R$

(D) $\frac{1}{\pi}I_p^2 R$

Q.41 **The r.m.s. value of an ac of 50 Hz is 10 amp. The time taken by the alternating current in reaching from zero to maximum value and th peak value of current will be**

(A) 2×10^{-2} sec and 14.14 amp
(B) 1×10^{-2} sec and 7.07 amp
(C) 5×10^{-3} sec and 7.07 amp
(D) 5×10^{-3} sec and 14.14 amp

Q.42 **If a current I given by $I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$ flows in an ac circuit across which an ac potential of $E = E_0 \sin \omega t$ has been applied, then the power consumption P in the circuit will be**

(A) $P = \frac{E_0 I_0}{\sqrt{2}}$

(B) $P = \sqrt{2}E_0 I_0$

(C) $P = \frac{E_0 I_0}{2}$

(D) P = 0

Q.43 **An alternating current is given by the equation $i = i_1 \cos \omega t + i_2 \sin \omega t$. The r.m.s. current is given by**

(A) $\frac{1}{\sqrt{2}}(i_1 + i_2)$

(B) $\frac{1}{\sqrt{2}}(i_1 + i_2)^2$

(C) $\frac{1}{\sqrt{2}}(i_1^2 + i_2^2)^{1/2}$

(D) $\frac{1}{2}(i_1^2 + i_2^2)^{1/2}$

Notes

Q.44 If $i = t^2$ $0 < t < T$ then r.m.s. value of current is

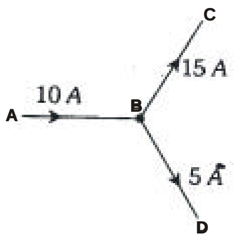
(A) $\frac{T^2}{\sqrt{2}}$

(B) $\frac{T^2}{2}$

(C) $\frac{T^2}{\sqrt{5}}$

(D) None of these

Q.45 Some thing miss



(A) Yes
(B) No
(C) Cannot be predicted
(D) Insufficient data to reply

Q.46 The average power dissipated in a pure inductor of inductance L when an ac current is passing through it, is

(A) $\frac{1}{2}LI^2$

(B) $\frac{1}{4}LI^2$

(C) $2Li^2$

(D) Zero

(Inductance of the coil L and current I)

Q.47 A resonant ac circuit contains a capacitor of capactitance 10^{-6} F and an inductor of 10^{-4} H. The frequency of electrical oscillations will be

(A) 10^5 Hz
(B) 10 Hz

(C) $\frac{10^5}{2\pi}$Hz

(D) $\frac{10}{2\pi}$Hz

Q.48 Same current is flowing in two alternating circuits. The first circuit contains only inductance and the other contains only a capacitor. If the frequency of the e.m.f. of ac is increased, the effect on the value of the current will be

Notes

(A) Increases in the first circuit and decreases in the other
(B) Increases in both the circuits
(C) Decreases in both the circuits
(D) Decreases in the first circuit and increases in the other

Q.49 An alternating voltage E = 200$\sqrt{2}$ sin (100t) is connected to a 1 microfarad capacitor through an ac ammeter. The reading of the ammeter shall be
(A) 10 mA
(B) 20 mA
(C) 40 mA
(D) 80 mA

Q.50 A 10 ohm resistance, 5 mH coil and 10 μF capacitor are joined in series. When a suitable frequency alternating current source is joined to this combination, the circuit resonates. If the resistance is halved, the resonance frequency
(A) Is halved
(B) Is doubled
(C) Remains unchanged
(D) In quadrupled

Q.51 L, C and R represent physical quantities inductance, capacitance and resistance respectively. The combination representing dimension of frequency is
(A) LC
(B) $(LC)^{-1/2}$
(C) $\left(\frac{L}{C}\right)^{-1/2}$
(D) $\frac{C}{L}$

Q.52 In the non-resonant circuit, what will be the nature of the circuit for frequencies higher than the resonant frequency
(A) Resistive
(B) Capacitive
(C) Inductive
(D) None

Q.53 When 100 volts dc is supplied across a solenoid, a current of 1.0 amperes flows in it. When 100 volts ac is applied across the same coil, the current drops to 0.5 ampere. If the frequency of ac source is 50 Hz, then the impedance and inductance of the solenoid are
(A) 200Ω and 0.55 henry
(B) 100Ω and 0.86 henry
(C) 200Ω and 1.0 henry
(D) 100Ω and 0.93 henry

Notes

Q.54 In an LR-circuit, the inductive reactance is equal to the reistance R of the circuit. An e.m.f. $E = E_0\cos(\omega t)$ applied to the circuit. The power consumed in the circuit is

(A) $\frac{E_0^2}{R}$

(B) $\frac{E_0^2}{2R}$

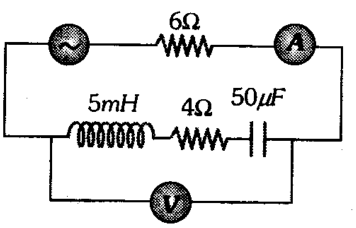
(C) $\frac{E_0^2}{4R}$

(D) $\frac{E_0^2}{8R}$

Q.55 A bulb and a capacitor are connected in series to a source of alternating current. If its frequency is increased, while keeping the voltage of the soruce constant, then

(A) Bulb will give more intense light
(B) Bulb will give less intense light
(C) Bulb will give light of same intensity as before
(D) Bulb will stop radiating light

Q.56 In the circuit shown in the figure, the ac source gives a voltage V = 20 cos (2000t). Neglecting source resistance, the voltmeter and ammeter reading will be



(A) 0V, 0.47A
(B) 1.68V, 0.47A
(C) 0V, 1.4A
(D) 5.6 V, 1.4A

Q.57 A telephone wire of length 200 km has a capacitance of 0.014 μF per km. If it carries an ac of freuquency 5 kHz, what should be the value of an inductor requried to be connected in series so that the impendance of the circuit is minimum

(A) 0.35 mH
(B) 35 mH
(C) 3.5 mH
(D) Zero

Notes

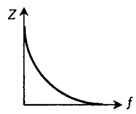
Q.58 Match the following

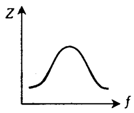
Currentsr.m.s. values

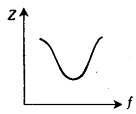
(1) $x_0\sin\omega t$	(i) x_0
(2) $x_0\sin\omega t\ \text{con}\,\omega t$	(ii) $\frac{x_0}{\sqrt{2}}$
(3) $x_0\sin\omega t + x_0\cos\omega t$	(iii) $\frac{x_0}{(2\sqrt{2})}$

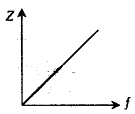
(A) 1.(i), 2.(ii), 3(iii)
(B) 1.(ii), 2.(iii), 3(i)
(C) 1.(i), 2.(iii), 3.(i)
(D) None of these

Q.59 Which of the following curves represents the variation of impendance (Z) with frequency f in series LCR circuit

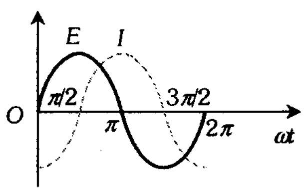
(A) 

(B) 

(C) 

(D) 

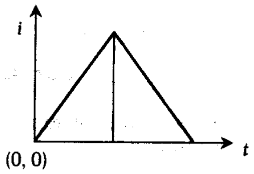
Q.60 The figure shows variation of R, X_L and X_C with frequency f in a series L,C,R circuit. Then for what frequency point, the circuit is inductive

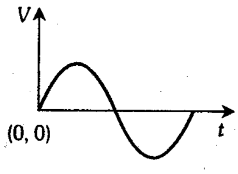


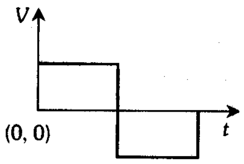
(A) A
(B) B
(C) C
(D) All points

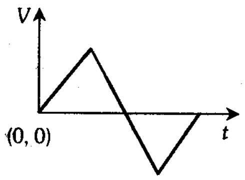
Notes

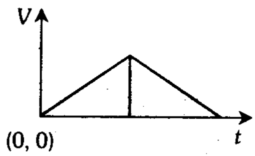
Q.61 **The current 'i' in inductance coil varies with time 't' according to following graph. Which one of the following plots shows the variations of voltage in the coil**



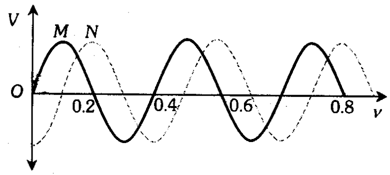
(A)


(B)


(C)


(D)


Q.62 **Two sinusoidal voltages of the same frequency are shown in the diagram. What is the frequency, and the phase relationship between the voltages**



(A) 0.4 $-\pi/4$
(B) 2.5 $-\pi/2$
(C) 2.5 $+\pi/2$
(D) 2.5 $-\pi/4$

Notes

Q.63 **The equation of AC voltage is E = 200 sin $(\omega t + \pi/6)$ and the A.C. current is I = 10 sin $(\omega t - \pi/6)$. The impedance of the circuit is ? Also find the out of the average power dissipated.**

(A) 550 Ω, 22 W
(B) 22 Ω, 1100 W
(C) 22 Ω, 550 W
(D) None of these

Q.64 **A solenoid has an inductance of 10 H and resistance 2Ω. It is connected to 10 V battery. How long will it take for the magnetic energy to reach 1/4th of its maximum value.**

(A) 3.465 ms
(B) 2.465 s
(C) 3.645 s
(D) 3.465 s

Q.65 **An alternating e.m.f. of frequency 50 Hz is applied to a series circuit of resistance 20 Ω, inductance 100 mH and capacitance 30 μF. Does the current lag or lead the applied e.m.f. and by what angle?**

(A) lag by 75°
(B) leads by 75°
(C) lags by 35°
(D) leads by 35°

Q.66 **A leakage parallel plate capacitor is filled completely with a material having dielectric constant K = 5 and electrical conductivity $\sigma = 7.4 \times 10^{-12} \Omega^{-1}$ m^{-1}. If the charge on the plate at instant t = 0 is g = 8.85 μC, then calculate the leakage current at the instant t = 12.5.**

(A) 0.1 μA
(B) 0.2 μA
(C) 0.3 μA
(D) 0.4 μA

Q.67 **The armature of dc motor has 20Ω resistance. It draws current of 1.5 ampere when run by 220 volts dc supply. The value of back e.m.f. induced in it will be**

(A) 150 V
(B) 170 V
(C) 180 V
(D) 190 V

Q.68 **The number of turns in the coil of an ac generator is 5000 and the area of the coil is 0.25 m^2. The coil is rotated at the rate of 100 cycles/sec in a magnetic field of 0.2 W/m^2. The peak value of the emf generated is nearly**

(A) 786 kV
(B) 440 kV
(C) 220 kV
(D) 157.1 kV

Q.69 A step-down transformer is connected to main supply 200 V to operate a 6V, 30 W bulb. The current in primary is

(A) 3A
(B) 1.5 A
(C) 0.3 A
(D) 0.15 A

Q.70 A transformer with efficiency 80% works at 4 kW and 100 V. If the secondary voltage is 200 V, then the primary and secondary currents are respectively

(A) 40 A, 16A
(B) 16A, 40A
(C) 20A, 40A
(D) 40A, 20A

Q.71 A choke soil is preferred to a rheostat in ac circuit as

(A) It consumes almost zero power
(B) It increases current
(C) It increases power
(D) It increases voltage

Notes

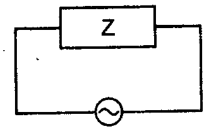
ANSWER-KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	C	C	D	C	C	D	C	B	D	B	A	D	C	A
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	D	C	A	A	C	A	A	A	A	A	D	D	C	C	C
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	A	D	B	B	B	D	D	C	C	B	D	D	C	C	A
Que.	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans.	D	C	D	B	C	B	B	A	C	A	D	A	B	C	C
Que.	61	62	63	64	65	66	67	68	69	70	71				
Ans.	B	B	C	D	B	B	D	D	D	A	A				

Notes

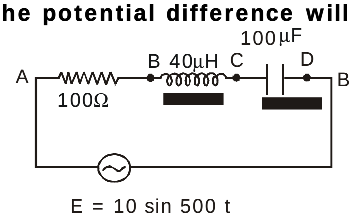
EXERCISE#3

Q.1 **In a black box of unknown elements (L, C or R or any other combination) an AC voltage $E = e_0 \sin(\omega t + \phi)$ is applied and current in the Circuit was found to be $i = i_0 \sin(\omega t + \phi + \pi/4)$.**
Then the unknown elements in the box may be:



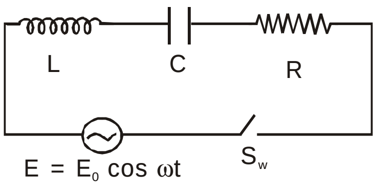
(A) only capacitor
(B) inductor and resistor both
(C) either capacitor, resistor, and inductor or only capacitor and resistor
(D) only resistor

Q.2 **At steady state, the potential difference will be always zero across-**



(A) A and B
(B) B and C
(C) B and D
(D) A and D

Q.3 **In an LCR, AC circuit, the switch is closed at t = 0. What will be current in the circuit at $t = 0^+$ (Just after closing the switch)-**



(A) $\dfrac{E_0}{\sqrt{R^2 + \left(L\omega - \dfrac{1}{C\omega}\right)^2}}$

(B) $\dfrac{E_0}{R}$

(C) Zero

(D) None of these

Notes

Q.4 Voltage V(t) is supplied to a block box, and current i(t) is flowing through it.

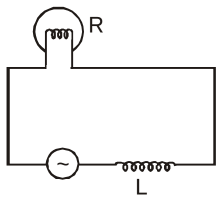
$170 \sin\left(6280t + \frac{\pi}{3}\right) \longrightarrow$ [Black Box] $\longrightarrow 8.5 \sin\left(6280t + \frac{\pi}{2}\right)$

V(t) **i(t)**

What type of elements can be in the block box.

(A) L and R in series
(B) R and C in series
(C) L and C is series
(D) A resonant LCR circuit in series.

Q.5 A choke coil is needed to operate an arc lamp at 160 V (rms) and 50 Fz. The lamp has an effective resistance of 5Ω when running at 10A. What is the inductance required in the choke coil ?



(A) 4.84×10^{-2} H
(B) 3.0×10^{-3} H
(C) 2×10^{-4} H
(D) Zero.

Q.6 An A.C. source of angular frequency ω is fed across a resistor R and a capacitor C in series. The current registered is I. If now the frequency of source is changed to $\frac{\omega}{3}$ (but maintaining the same voltage), the current in the circuit is found to be halved. The ratio of reactance to resistance at the original frequency ω will be-

(A) $\sqrt{\frac{3}{5}}$

(B) $\sqrt{\frac{5}{3}}$

(C) $\frac{3}{5}$

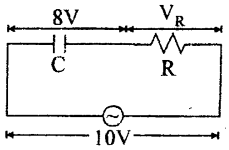
(D) $\frac{5}{3}$

Q.7 Let f = 50 Hz, and C = 100 μF in an AC circuit containing capacitor only. If the current in the circuit is 1.57 sin (2π + t) A. The expression for the instantaneous voltage across the capacitor will be -

(A) $E = 50 \sin(100\pi t - \pi/2)$
(B) $E = 100 \sin(50\pi t)$
(C) $E = 50 \sin 100\pi t$
(D) $E = 50 \sin(100\pi t + \pi/2)$

Notes

Q.8 **In a series CR circuit shown in figure, the applied voltage is 10 V and the voltage across capacitor is found to be 8V. Then the voltage across R, and the phase difference between current and the applied voltage will respectively by**



(A) 6V, $\tan^{-1}\left(\frac{4}{3}\right)$

(B) 3V, $\tan^{-1}\left(\frac{3}{4}\right)$

(C) 6V, $\tan^{-1}\left(\frac{5}{3}\right)$

(D) None of the above

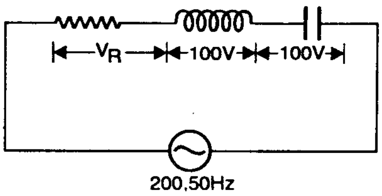
Q.9 **The reactance of a circuit is zero. It is possible that the circuit contain :**

(A) an inductor and a capacitor
(B) an inductor but no capacitor
(C) a capacitor but no inductor
(D) neither an inductor nor a capacitor

Q.10 **The phase difference between current and voltage in an AC circuit is $\pi/4$ radian. If the frequency of AC is 50 Hz, then the phase difference is equivalent to the time difference :**

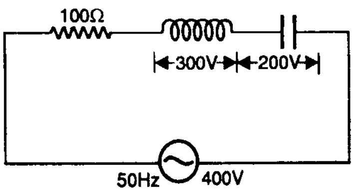
(A) 0.78 s
(B) 15.7 ms
(C) 0.25 s
(D) 2.5 ms

Q.11 **In the circuit shown in figure value of V_R is :**



(A) 400 V
(B) 200 V
(C) 300 V
(D) Zero

Q.12 **In the circuit shown in figure current in the circuit is :**



(A) 1.27 A
(B) 2.23 A
(C) 4.26 A
(D) 3.87 A

Notes

Q.13 **In a series LCR the voltage across resistance, capacitance and inductance is 10V each. If the capacitance is short circuited, the voltage across the inductance will be :**

(A) $\frac{10}{\sqrt{2}}$ V

(B) 10V

(C) $10\sqrt{2}$ V

(D) 20V

Q.14 **The current through an inductor of 1H is given by : i = 3t sin t**

The voltage across the inductor of 1H is :

(A) 3 sin t + 3 cos t

(B) 3 cos t + t sin t

(C) 3 sin t + 3t cos t

(D) 3t cos t + sin t

Q.15 **The average value of voltage for one cycle for the function :**

$V = V_0 \sin \omega t$ for $0 \le t \le \frac{\pi}{\omega}$

$= V_0 \sin \omega t$ for $\frac{\pi}{\omega} \le t \le \frac{2\pi}{\omega}$ is :

(A) $\frac{V_0}{\sqrt{2}}$

(B) $\left(\frac{2}{\pi}\right) V_0$

(C) $\frac{V_0}{2}$

(D) Zero

Q.16 **An ac source producing emf $V = v_0 [\sin \omega t + \sin 2\omega t]$ is connected in series with a capacitor and a resistor. The current found in the circuit is**

$i = i_1 \sin(\omega t + \phi_1) + i_2 \sin(2\omega t + \phi_2)$. **Then-**

(A) $i_1 = i_2$

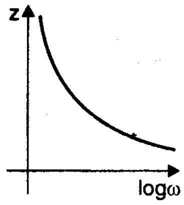
(B) $i_1 < i_2$

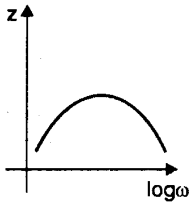
(C) $i_1 > i_2$

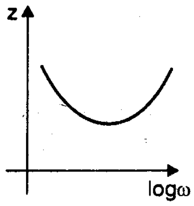
(D) i_1 may be less than, equal to or greater than i_2

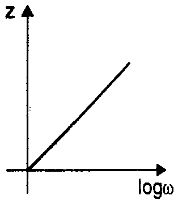
Notes

Q.17 Which of the following plots may represent the impedance of a series LCR combination :

(A)


(B)


(C)


(D)


Q.18 An alternating current is given by : i = (3 sin ω t + 4 cos ω t) A
The rms current will be-

(A) $\frac{7}{\sqrt{2}}$ A

(B) $\frac{1}{\sqrt{2}}$ A

(C) $\frac{5}{\sqrt{2}}$ A

(D) Information is insufficient to find the rms current

Notes

Q.19 In a purely resistive A.C. circuit, the current

(A) Lags behinds the e.m.f in phase

(B) Is in phase with e.m.f.

(C) Leads the e.m.f. in phase

(D) Leads the m.m.f. in half the cycle and lags behind it in the other half.

Q.20 An alternating $V = V_0 \sin wt$ is applied across a circuit. As a result, the current $I = I_0 \sin (wt - \pi/2)$ flows in it. The power consumed in the circuit per cycle is

(A) Zero

(B) 0.5 V_0I_0

(C) 0.707 V_0I_0

(D) 1.414 V_0I_0

Q.21 An alternating potential $V = V_0 \sin\omega t$ is applied across a circuit. As a result, the current $I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$ flows in it. The power consumed in the circuit per cycle is

(A) Zero

(B) 0.5 V_0I_0

(C) 0.707 V_0I_0

(D) 1.414 V_0I_0

Q.22 An AC voltage source of variable angular frequency w and fixed amplitude V_0 is connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When w is increased –

(A) The bulb glows dimmer

(B) The bulb glows brighter

(C) Total impedance of the circuit is unchanged

(D) Total impedance of the circuit increases

Assertion - Reason Type Questions

The following questions consist of two statements one labelled Assertion (A) and the another labelled Reason (R). Select the correct answers to these questions from the codes given below :

(A) Both A and R are true and R is the correct explanation of A.

(B) Both A and R are true but R is not correct explanation of A

(C) A is true but R is false

(D) A is false but R is true.

(E) A and R both are false.

Q.23 Asseration : Average value of A.C. over a complete cycle is always zero.

Reason : Average value of A.C. is always defined over half cycle.

Q.24 Asseration : An emf $E = E_0 \sin\omega t$ is applied in a circuit and a current $i = i_0 \cos\omega t$ results. Then the average power delivered by the source is zero.

Reason : If the average value of E and i are separately zero, the power consumed will be zero.

Notes

Q.25 **Asseration :** An alternating current is given by $i = i_1 \sin\omega t + i_2 \cos\omega t$. Then rms current is $\frac{|i_1 + i_2|}{\sqrt{2}}$

Reason : The rms current is given by $\frac{i_0}{\sqrt{2}}$, where $i_0 = |i_1 + i_2|$

Q.26 **Assertion :** In series LCR circuit resonance can take place.

Reason : Resonance takes place if inductance and capacitive reactances are equal and opposite.

Q.27 **Asseration :** The DC and AC both can be measured by a hot wire instrument.

Reason : The hot wire instrument is based on the principle of heating effect of current.

Q.28 **Asseration :** Soft iron is used as a core of transformer.

Reason : Area of hysteresis is loop for soft iron is small.

Q.29 **Asseration :** An electric motor will maximum efficient when back emf is equal to applied emf.

Reason : Efficiency of electric motor is depends on magnitude of back emf.

Q.30 **Asseration :** An alternating current does not show any magnetic effect.

Reason : Alternating current varies with time.

Q.31 **Asseration :** The alternating current lags behind the emf by a phase angle of $\pi/2$, when AC flows through an inductor.

Reason : The inductive reactance increases as the frequency of AC source decreases.

Q.32 **Asseration :** A capacitor of suitable capacitance can be used in an A.C. circuit in place of the choke coil.

Reason : A capacitor blocks D.C. and allows A.C. only.

Q.33 **Asseration :** Transformer does not work for constant DC.

Reason : Transformer works on mutual induction hence on varying current.

Q.34 **Asseration :** At resonance, LCR circuit have a minimum current.

Reason : At resonance, in LCR circuit, the current and emf are in phase with each other.

Q.35 **Asseration :** Transformer-cores are made of soft iron core instead of steel.

Reason : Soft iron has high permeability without appreciable hysteresis which causes very less dissipation of energy.

Notes

Q.36 **Asseration :** Capacitor serves as a block for D.C. and offers an easy path to A.C.

Reason : Capacitive reactance is inversely proportional to frequency.

Q.37 **Asseration :** An electrical motor converts mechanical energy into electrical energy.

Reason : An electrical motor works on the principle of mutual inductions.

Q.38 **Asseration :** When variable frequency a.c. source is connected to a capacitor, displacement current increases with increase in frequency.

Reason : As frequency increases conduction current also increases.

Q.39 **Assertion :** In parallel LCR circuit, resonance can take place.

Reason : Resonance takes place if inductive and capacitive reactances are equal and opposite

Q.40 **Assertion :** In an anti-resonance circuit or rejector circuit, alternating voltage and current have a phase difference of 180^0

Reason : In a resonance circuit alternating voltage and current are in the same phase.

Q.41 **Assertion :** Impedance of primary and secondary in a transformer is directly proportional to number of turns in these coils.

Reason : More the turns, more is the resistance.

Q.42 **Assertion :** An inductive coil has a resistance of 100 ohm. When an a.c. signal of frequency of 1000 Hz is fed to the coil, the applied voltage leads the current by 45^0 The inductance of coil is 16 mH.

Reason : $\tan\theta = \frac{\omega L}{R}$

Q.43 **Assertion :** In a transformer, current reduces in the ratio of increase of alternating voltage.

Reason : Energy conservation.

Q.44 **Assertion :** A resistance is connected to an ac source. Now a inductor is included in the circuit. The average power absorbed by the resistance will be change.

Reason : By including an inductor or capacitor in the circuit power factor will be change.

Q.45 **Assertion :** In LCR series circuit, the applied Instantaneous voltage is not equal to the algebric sum of the instaneous voltage across the different elements of the circuit.

Reason : The voltage across different element in the circuit are not in same phase, only their phaser sum equal to the applied voltage.

Notes

Q.46 The overall efficiency of a transformer is 90%. The transformer is rated for an output of 9000 watt. The primary voltage is 1000 volt. The ratio of turns in the primary to the secondary coil is 5 : 1. The iron losses at full load are 700 watt. The primary voltage is 1000 volt. The primary coil has a resistance of 1 ohm.

Column I		Column II	
(A)	Copper loss in primary coil	(p)	200
(B)	Copper loss in secondary coil	(q)	100
(C)	Current in primary coil	(r)	46
(D)	Current in secondary coil	(s)	10

Q.47 In L-C-R series circuit suppose w_r is the resonance frequency, then match the following Columns :

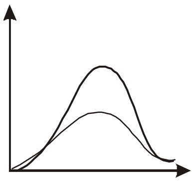
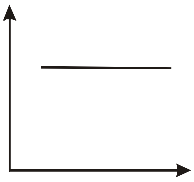
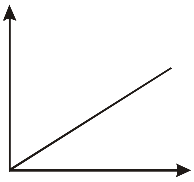
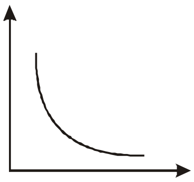
Column I		Column II	
(A)	If $\omega > \omega_r$	(p)	current will lead the voltage
(B)	If $\omega = \omega_r$	(q)	voltage will lead the current
(C)	If $\omega = 2\omega_r$	(r)	$X_L = X_C$
(D)	$\omega < \omega_r$	(s)	current and voltage are in phase

Q.48 A resistance R, inductance L and a capacitor C are connected in series with AC supply. The resistance R is 16W and for a given frequency, the inductive reactance of L is 24 W and capacitive reactance of C is 12W. If the current in the circuit is 5 amp. Column II gives data for the quantities given in column I match them correctly.

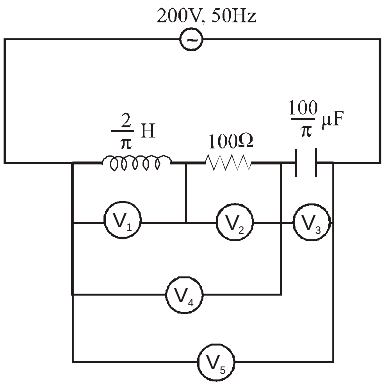
Column I		Column II	
(A)	Potential difference across L	(p)	100 volt
(B)	Potential difference across R	(q)	120 volt
(C)	Potential difference across C	(r)	60 volt
(D)	Voltage of AC supply	(s)	80 volt

Notes

Q.49 **Match the following questions for a series LCR circuit**

Column I		Column II
(A) Which of the graph shows X_C versus ω	(p)	
(B) Which of the graph shows X_L versus ω	(q)	
(C) Which of the graph shows peak value of voltage verses ω	(r)	
(D) Which graph shows average power versus ω	(s)	

Q.50 **For the circuit shown column II give data for quantities given in column I match them correctly.**



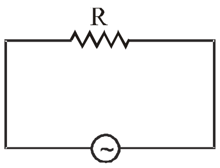
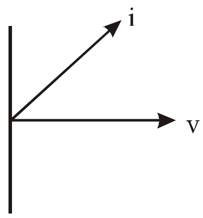
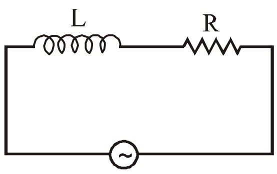
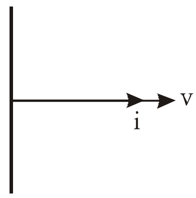
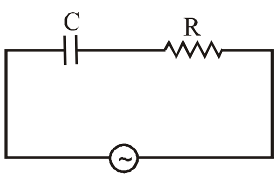
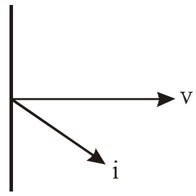
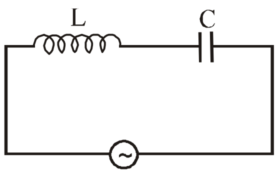
Column I	Column II
(A) Reactance of circuit	(p) $100\sqrt{2}$
(B) Impedance of circuit	(q) 100
(C) Current	(r) 200
(D) V_2 reading	(s) $\sqrt{2}$

Notes

Q.51 **An ac generator has emf** $E = E_m \sin(\omega_d t - \pi/4)$**, where E_m = 30.0 V and** $\omega_d = 350 \text{ rad/s}$**. The current produced in a connected circuit is** $i(t) = I \sin(\omega_d t - 3\pi/4)$**, where I = 620 mA.**

	Column I		**Column II**
(A)	Time after t = 0 does the generator emf first reach a maximum.	(p)	11.2
(B)	Time after t = 0 does the current first reach a maximum	(q)	6.73
(C)	Inductance	(r)	13.8
(D)	Capacitance	(s)	0

Q.52 **Match the phasor diagram for circuit shown ($X_c > X_L$) in column II.**

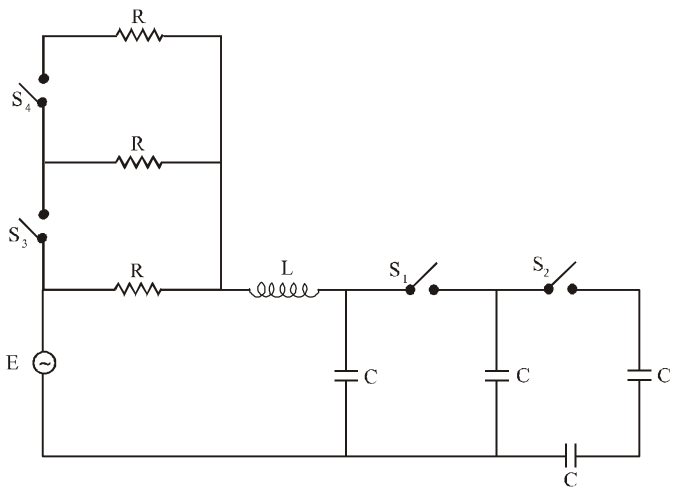
	Column I		**Column II**
(A)		(p)	
(B)		(q)	
(C)		(r)	
(D)		(s)	

Notes

Q.53 **A series RLC circuit is driven by an alternating source at a frequency of 400 Hz and an emf amplitude of 90.0 V. The resistance is 20.0 W, the capacitance is 12.1 μF, and the inductance is 24.2 mH.**

Column I	Column II
(A) rms potential across resistor	(p) 60.9
(B) rms potential across capacitor	(q) 37
(C) rms potential across inductor	(r) 113
(D) average power of the circuit	(s) 68.6

Q.54 **For circuit shown column II gives value of equivalent capacitance for operation in column I match them correctly.**
Let E = 12 V, C = 2μF, L = 2mH, R = 12 ohm



Column I	Column II
(A) S_1 close	(p) 8 μF
(B) S_2 close	(q) 6 μF
(C) S_3 close	(r) 5 μF
(D) S_4 close	(s) 4 μF

Q.55 **For circuit shown in Q.39 column II gives value of equivalent resistance for operation in column I match them correctly.**
Let E = 12 V, C = 2μF, L = 2mH, R = 12 ohm

Column I	Column II
(A) S_1 close	(p) 12
(B) S_2 close	(q) 6
(C) S_3 close	(r) 4
(D) S_4 close	(s) 2

Q.56 **For circuit shown in Q.39 column II gives value of equivalent impedance (z) for operation in column I match them correctly.**
Let E = 12 V, C = 2μF, L = 2mH, R = 12 ohm

Column I	Column II
(A) S_1 close	(p) 19.9
(B) S_2 close	(q) 22.5
(C) S_3 close	(r) 19.4
(D) S_4 close	(s) 12

Notes

Q.57 **For circuit shown in Q.39 column II gives value of equivalent current for operation in column I match them correctly.**

Let E = 12 V, C = 2μF, L = 2mH, R = 12 ohm

Column I	Column II
(A) S_1 close	(p) 0.605
(B) S_2 close	(q) 0.535
(C) S_3 close	(r) 0.603
(D) S_4 close	(s) 0.619

ANSER-KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Ans.	C	C	C	B	A	A	D	A	A,D	D	B	D	A	C	B	
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Ans.	B	C	C	B	A	A	B	B	C	E	A	A	A	D	B	
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	
Ans.	C	D	A	D	A	A	D	A	D-q	D	D	A	B	A	A	
Ans.	46				47				48				49			
Que.	A-q	B-p	C-s	D-r	A-q	B-r,s	C-q	D-p	A-q	B-s	C-r	D-p	A-s	B-r	C-r	D-p
Ans.	50				51				52				53			
Que.	A-q	B-p	C-s	D-p	A-q	B-p	C-r	D-s	A-q	B-r	C-p	D-s	A-q	B-p	C-r	D-s
Ans.	54				55				56				57			
Que.	A-s	B-r	C-r	D-r	A-p	B-p	C-q	D-r	A-p	B-q	C-q	D-r	A-p	B-q	C-r	D-s

EXERCISE#4

Notes

Q.1 A choke coil has- [AIIMS 1999]

(A) Low inductance and high resistance
(B) High inductance and low resistance
(C) Low inductance and low resistance
(D) High inductance and high resistance

Q.2 In an AC circuit the potential difference across an inductance and resistance joined in series are respectively 16V and 20V. The total potential difference across the circuit is- [AFMC 1998]

(A) 20.0 V
(B) 25.6 V
(C) 31.9 V
(D) 53.5 V

Q.3 Quality factor of L-C-R circuit having resistance (R) and inductance (L) at resonance frequency (w) is given by- [AFMC 2000]

(A) $\frac{\omega L}{R}$

(B) $\frac{R}{\omega L}$

(C) $\left(\frac{\omega L}{R}\right)^{1/2}$

(D) $\left(\frac{\omega L}{R}\right)^{2}$

Q.4 The value of the current through a coil of inductance 1H and of negligible resistance when connected through an A.C. source of 200 V and 50 Hz is- [AFMC 2000]

(A) 0.637 A
(B) 1.637 A
(C) 2.637 A
(D) 3.637 A

Q.5 Transformer ratio 1 : 25 and input voltage 220 V then ratio of input power and output will be- [AIEEE-2002]

(A) 1 : 1
(B) 2 : 1
(C) 1 : 2
(D) 1 : 4

Q.6 The power factor of an A.C. circuit having resistance (R) and inductance (L) connected in series and an angular velocity w is- [AIEEE-2002]

(A) $\frac{R}{\omega L}$

(B) $\frac{R}{(R^2+\omega^2L^2)^{1/2}}$

(C) $\frac{\omega L}{R}$

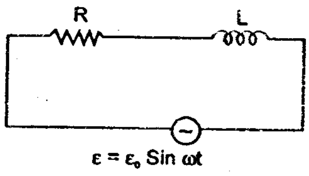
(D) $\frac{R}{(R^2-\omega^2L^2)^{1/2}}$

Notes

Q.7 In a transformer, number of turns in the primary are 140 and that in the secondary are 280. If current in primary is 4A then that in the secondary is [AIEEE 2002]

(A) 4A
(B) 2A
(C) 6A
(D) 10A

Q.8 Power factor of the circuit is- [AIEEE-2003]



(A) $\frac{R}{\omega L}$

(B) $\frac{R}{\sqrt{R^2 + \omega^2 L^2}}$

(C) $\frac{R}{R^2 + \omega^2 L^2}$

(D) None of these

Q.9 In an oscillating LC circuit the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is- [AIEEE-2003]

(A) $\frac{Q}{\sqrt{3}}$

(B) $\frac{Q}{\sqrt{2}}$

(C) Q

(D) $\frac{Q}{2}$

Q.10 The core of any transformer is laminated so as to- [AIEEE-2003]

(A) Make it light weight
(B) Make it robust and strong
(C) Increase the secondary voltage
(D) Reduce the energy loss due to eddy current

Q.11 Alternating current can not be measured by dc ammeter because [AIEEE 2004]

(A) ac cannot pass through dc ammeter
(B) Average value of complete cycle is zero
(C) ac is virtual
(D) ac changes its direction

Q.12 In a LCR circuit capacitance is changed from C to 2C. For the resonant frequency to remain unchanged, the inductance should be change from L to [AIEEE 2004]

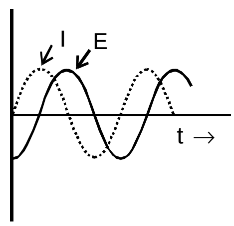
Notes

(A) 4L
(B) 2L
(C) L/2
(D) L/4

Q.13 **In an LCR series ac circuit, the voltage across each of the components, L, C and r is 50V. the voltage across the LC combination will be** **[AIEEE 2004]**

(A) 50 V
(B) $50\sqrt{2}$ V
(C) 100 V
(D) 0 V(zero)

Q.14 **When an AC source of e.m.f. $E = E_0 \sin(100t)$ is connected across a circuit, the phase difference between the e.m.f. E and the current I in the circuit is observed to be $\pi/4$, as shown in the fig. If the circuit consists possibly only of R-Cor R-L or L-C in series, what will be the relation between the two elements of the circuit ?** **[IIT JEE 2003]**



(A) R = 1 kΩ, C = 10 μF
(B) R = 1 kΩ, C = 1 μF
(C) R = 1 kΩ, L = 10 H
(D) R = 1 kΩ, C = 1 H

Q.15 **In an a.c. circuit the voltage applied is $E = E_0 \sin \omega t$. The resulting current in the circuit is $I = I_0 \sin\left(\omega t - \frac{\pi}{2}\right)$. The power consumption in the circuit is given by** **[AIEEE 2007]**

(A) $P = \frac{E_0 I_0}{\sqrt{2}}$
(B) P = Zero
(C) $P = \frac{E_0 I_0}{2}$
(D) $P \sqrt{2} E_0 I_0$

Q.16 **In a purely resistive A.C. circuit, the current** **[REE 1992]**

(A) Lags behinds the e.m.f in phase
(B) Is in phase with e.m.f.
(C) Leads the e.m.f. in phase
(D) Leads the m.m.f. in half the cycle and lags behind it in the other half.

Notes

Q.27 **An alternating V = V_0 sin wt is applied across a circuit. As a result, the current I = I_0 sin (wt – π /2) flows in it. The power consumed in the circuit per cycle is** **[REE 1992]**

(A) Zero

(B) 0.5 V_0I_0

(C) 0.707 V_0I_0

(D) 1.414 V_0I_0

Q.18 **An alternating potential V = V_0 sin ω t is applied across a circuit. As a result, the current I = I_0 sin $\left(\omega t - \frac{\pi}{2}\right)$ flows in it. The power consumed in the circuit per cycle is** **[IIT 1996]**

(A) Zero

(B) 0.5 V_0I_0

(C) 0.707 V_0I_0

(D) 1.414 V_0I_0

Q.19 **An AC voltage source of variable angular frequency w and fixed amplitude V_0 is connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When w is increased – [IIT 2010]**

(A) The bulb glows dimmer

(B) The bulb glows brighter

(C) Total impedance of the circuit is unchanged

(D) Total impedance of the circuit increases

ANSWERKEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	B	A	A	A	B	B	C-r	B	D	B	C	A	A	B
Que.	16	17	18	19											
Ans.	B	A	A	B											