EXERCISE-1

SECTION (A) : AVERAGE, PEAK AND RMS VALUE

A 1. r.m.s. value of current $i = 3 + 4 \sin(\omega t + \pi/3)$ is:

(A) 5 A (B) $\sqrt{17}$ A (C) $\frac{5}{\sqrt{2}}$ A (D) $\frac{7}{\sqrt{2}}$ A

A 2. A coil of inductance 5.0 mH and negligible resistance is connected to an alternating voltage V = 10 sin (100 t). The peak current in the circuit will be :
(A) 2 amp (B) 1 amp (C) 10 amp (D) 20 amp

A 3. The peak value of an alternating e.m.f E given by $E = E_0 \cos \omega t$ is 10 volt and frequency is 50 Hz. At time t = (1/600) sec, the instantaneous value of e.m.f is :

(A) 10 volt (B) $5\sqrt{3}$ volt (C) 5 volt (D) 1 volt

A* 4. The voltage of an AC source varies with time according to the equation, $V = 100 \sin 100 \pi t \cos 100 \pi t$. Where t is in second and V is in volt. Then :
(A) the peak voltage of the source is 100 volt
(B) the peak voltage of the source is $(100/\sqrt{2})$ volt
(C) the peak voltage of the source is 50 volt
(D) the frequency of the source is 50 Hz

A 5. An alternating voltage is given by : $e = e_1 \sin \omega t + e_2 \cos \omega t$. Then the root mean square value of voltage is given by :

(A) $\sqrt{e_1^2 + e_2^2}$ (B) $\sqrt{e_1 e_2}$ (C) $\sqrt{\frac{e_1 e_2}{2}}$ (D) $\sqrt{\frac{e_1^2 + e_2^2}{2}}$

A 6. An AC voltage is given by :

$$E = E_0 \sin \frac{2\pi t}{T}$$

Then the mean value of voltage calculated over time interval of T/2 seconds :
(A) is always zero (B) is never zero (C) is $(2e_0/\pi)$ always (D) may be zero

A 7. Average value of A.C. current in a half time perios may be :
(A) positive (B) negative (C) zero (D) none

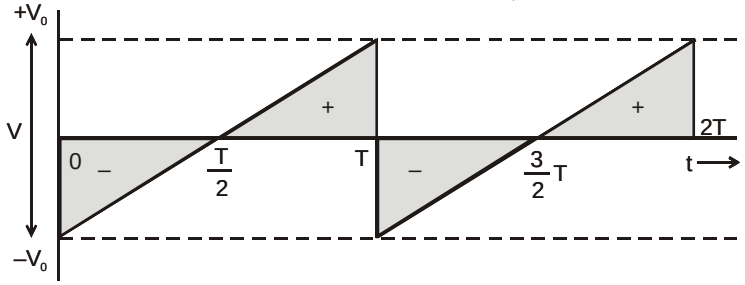
A 8. If the frequency of the source e.m.f. in an AC circuit is n, the power varies with a frequency :
(A) n (B) 2 n (C) n/2 (D) zero

A 9. An AC voltage of $V = 220\sqrt{2} \sin\left(2\pi 50 t + \frac{\pi}{2}\right)$ is applied across a DC voltmeter, its reading will be:

(A) $220\sqrt{2}$ V (B) $\sqrt{2}$ V (C) 220 V (D) zero

A 10. The current in a discharging LR circuit is given by $i = I_0 e^{-t/T}$ where τ is the time constant of the circuit calculate the rms current for the period t = 0 to $t = \tau$.

A 11. Find the rms value for the saw-tooth voltage of peak value V_0 from t=0 to t=2T as shown in figure.



SECTION (B) : POWER CONSUMED IN AN AC CIRCUIT

B 1. The average power delivered to a series AC circuit is given by (symbols have their usual meaning) :
(A) $E_{rms} I_{rms}$ (B) $E_{rms} I_{rms} \cos \phi$ (C) $E_{rms} I_{rms} \sin \phi$ (D) zero

B 2. Energy dissipates in LCR circuit in :

(A) L only (B) C only (C) R only (D) all of these

B 3. The potential difference V across and the current I flowing through an instrument in an AC circuit are given by :

$V = (5 \cos \omega t)$ volt

$I = (2 \sin \omega t)$ A

The power dissipated in the instrument is :

(A) zero (B) 5 watt (C) 10 watt (D) 2.5 watt

B 4. A coil has an inductance of $\frac{2.2}{\pi}$ H and is joined in series with a resistance of 220 Ω. When an alternating e.m.f. of 220 V at 50 cps is applied to it, then the wattless component of the rms current in the circuit is

(A) 5 ampere (B) 0.5 ampere (C) 0.7 ampere (D) 7 ampere

B 5. A direct current of 2 A and an alternating current having a maximum value of 2 A flow through two identical resistances. The ratio of heat produced in the two resistances in the same time interval will be

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

B 6. A resistor and an inductor are connected to an AC supply of 120 volt and 50 Hz. The current in the circuit is 3 ampere. If the power consumed in the circuit is 108 watt, then the resistance in the circuit is :

(A) 12 ohm (B) 40 ohm (C) $\sqrt{(52 \times 28)}$ ohm (D) 360 ohm

B 7. What is the rms value of an alternating current which when passed through a resistor produces heat, which is thrice that produced by a current of 2 ampere in the same resistor in the same time interval?

(A) 6 ampere (B) 2 ampere (C) $2\sqrt{3}$ ampere (D) 0.65 ampere

B 8. A resistor and a capacitor are connected to an AC supply of 200 volt, 50 Hz in series. The current in the circuit is 2 ampere. If the power consumed in the circuit is 100 watt, then the resistance in the circuit is :

(A) 100 ohm (B) 25 ohm (C) $\sqrt{125 \times 75}$ ohm (D) 400 ohm

B 9. The impedance of a series circuit consists of 3 ohm resistance and 4 ohm reactance. The power factor of the circuit is :

(A) 0.4 (B) 0.6 (C) 0.8 (D) 1.0

B 10. An electric bulb and a capacitor are connected in series with an AC source. On increasing the frequency of the source, the brightness of the bulb :

(A) increase (B) decreases

(C) remains unchanged (D) sometimes increases and sometimes decreases

B 11. By what percentage the impedance in an AC series circuit should be increased so that the power factor changes from (1/2) to (1/4) (when R is cosntant) ?

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

B 12*. Average power consumed in an A.C. series circuit is given by (symbols have their usual meaning) :

(A) $E_{rms}\ I_{rms} \cos\phi$ (B) $(I_{rms})^2 R$ (C) $\frac{E_0^2 R}{2(|z|)^2}$ (D) $\frac{I_0^2 |z| \cos\phi}{2}$

B 13. An electric bulb is designed to operate at 12 volts DC. If this bulb is connected to an AC source and gives normal brightness. What would be the peak voltage of the source ?

B 14. A resistor of resistance 100 Ω is connected to an AC source $\varepsilon = (12V) \sin (250\ \pi\ s^{-1})t$. Find the power consumed by the bulb.

B 15. In an ac circuit the instantaneous values of current and applied voltage are respectively i = 2(Amp) sin $(250\ \pi\ s^{-1})t$ and $\varepsilon = (10V) \sin ((250\ \pi\ s^{-1})t + \frac{\pi}{3})$. Find the instantaneous power drawn from the source at $t = \frac{2}{3}$ ms and its average value.

B 16. A 2000 Hz, 20 volt source is connected to a resistance of 20 ohm, an inductance of $0.125/\pi$ H and a capacitance of $500/\pi$ nF all in series. Calculate the time in which the resistance (thermal capacity = 100 joule/^oC) will get heated by 10^o C

SECTION (C) : AC SOURCE WITH R, L, C CONNECTED IN SERIES

C 1. A 0.21-H inductor and a 88-Ω resistor are connected in series to a 220-V, 50-Hz AC source. The current in the circuit and the phase angle between the current and the source voltage are respectively. Use $\pi = 22/7$.
(A) 2 A, $\tan^{-1} 3/4$ (B) 14.4 A, $\tan^{-1} 7/8$ (C) 14.4 A, $\tan^{-1} 8/7$ (D) 3.28 A, $\tan^{-1} 2/11$

C 2. An LCR series circuit with 100 Ω resistance is connected to an AC source of 200 V and angular frequency 300 radians per second. When only the capacitance is removed, the current lags behind the voltage by 60°. When only the inductance is removed, the current leads the voltage by 60º. Then the current and power dissipated in LCR circuit are respectively
(A) 1A, 200 watt. (B) 1A, 400 watt. (C) 2A, 200 watt. (D) 2A, 400 watt.

C 3. In an AC series circuit, the instantaneous current is zero when the instantaneous source voltage is maximum. Connected to the source may be a
(A) pure inductor (B) pure capacitor (C) pure resistor
(D) combination of an inductor and a capacitor

C 4. A pure resistive circuit element X when connected to an AC supply of peak voltage 200 V gives a peak current of 5 A which is in phase with the voltage. A second circuit element Y, when connected to the same AC supply also gives the same value of peak current but the current lags behind by 90°. If the series combination of X and Y is connected to the same supply, what will be the rms value of current ?

(A) $\frac{10}{\sqrt{2}}$ amp (B) $\frac{5}{\sqrt{2}}$ amp (C) $\frac{5}{2}$ amp (D) 5 amp

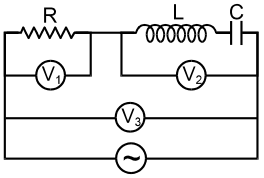
C 5. In an AC circuit the potential differences across an inductance and resistance joined in series are respectively 16 V and 20 V. The total potential difference across the circuit is
(A) 20 V (B) 25.6 V (C) 31.9 V (D) 53.5 V

C 6. An AC voltage source $V = 200\sqrt{2}\sin 100t$ is connected across a circuit containing an AC ammeter(it reads RMS value) and capacitor of capacity 1 μF. The reading of ammeter is :
(A) 10 mA (B) 20 mA (C) 40 mA (D) 80 mA

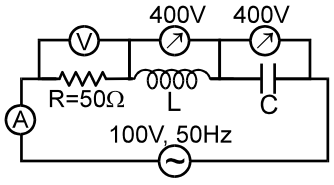
C 7. When 100 V DC is applied across a solenoid, a steady current of 1 A flows in it. When 100 V AC is applied across the same solenoid, the current drops to 0.5 amp. If the frequency of the AC source is $150\sqrt{3}/\pi$ Hz, the impedance and inductance of the solenoid are :
(A) 200 Ω and 1/3 H (B) 100 Ω and 1/16 H
(C) 200 Ω and 1.0 H (D) 1100 Ω and 3/117 H

C 8. If in a series LCR AC circuit, the rms voltage across L, C and R are V_1, V_2 and V_3 respectively, then the voltage of the source is always :
(A) equal to $V_1 + V_2 + V_3$ (B) equal to $V_1 - V_2 + V_3$
(C) more than $V_1 + V_2 + V_3$ (D) none of these is true

C 9. A resistor R, an inductor L, a capacitor c and voltmeters V_1, V_2 and V_3 are connected to an oscillator in the circuit as shown in the adjoining diagram. When the frequency of the oscillator is increased, upto resonance frequency, the voltmeter reading (at resonance frequency) is zero in the case of :
(A) voltmeter V_1 (B) voltmeter V_2
(C) voltmeter V_3 (D) all the three voltmeters



C 10. In the series LCR circuit, the voltmeter and ammeter readings are :



(A) V = 100 volt, I = 2 amp (B) V = 100 volt, I = 5 amp
(C) V = 1000 volt, I = 2 amp (D) V = 300 volt, I = 1 amp

C 11. An electric bulb is designed to consume 55 W when operated at 110 volts. It is connected to a 220 V, 50 Hz line through a choke coil in series. What should be the inductance of the coil for which the bulb gets correct voltage ?

C 12. In a series LCR circuit with an AC source R = 300 Ω, C = 20 μF, L = 1.0 henry, E_{rms} = 50 V and $\nu = 50/$

πHz. Find (a) the rms current in the circuit and (b) the rms potential differences across the capacitor, the resistor and the inductor.

C 13. Consider the situation of the previous problem find the average electric field energy stored in the capacitor and the average magnetic field energy stored in the coil .

C 14. A circuit has a coil of resistance 50 ohms and inductance $\frac{3}{\pi}$ henry. It is connected in series with a condenser of $\frac{40}{\pi}$ μF and AC supply voltage of 200 V and 50 cycles/sec. Calculate

(i) the impedance of the circuit,
(ii) the p.d. across inductance coil and condenser.

C 15. An inductor $2/\pi$ Henry, a capacitor $100/\pi$ μF and a resistor 75 Ω are connected in series across a source of EMF V = 10 sin 100 π t. (a) find the impedance of the circuit.(b) find the energy dissipated in the circuit in 20 minutes.

SECTION (D) : RESONANCE

D 1*. Power factor may be equal to 1 for :
(A) pure inductor (B) pure capacitor (C) pure resistor (D) An LCR circuit

D 2. The value of power factor cosϕ in series LCR circuit at resonance is :
(A) zero (B) 1 (C) 1/2 (D) 1/2 ohm

D 3. A series LCR circuit containing a resistance of 120 ohm has angular resonance frequency 4×10^3 rad s^{-1}. At resonance, the voltage across resistance and inductance are 60V and 40 V respectively. The values of L and C are respectively :
(A) 20 mH, 25/8 μF (B) 2mH, 1/35 μF (C) 20 mH, 1/40 μF (D) 2mH, 25/8 nF

D 4. In an LCR circuit, the capacitance is made one-fourth, when in resonance. Then what should be the change in inductance, so that the circuit remains in resonance ?
(A) 4 times (B) 1/4 times (C) 8 times (D) 2 times

D 5. A resistor R, an inductor L and a capacitor C are connected in series to an oscillator of frequency n. If the resonant frequency is n_r, then the current lags behind voltage, when :
(A) n = 0 (B) $n < n_r$ (C) $n = r_r$ (D) $n > n_r$

D 6. A series circuit consists of a resistance, inductance and capacitance. The applied voltage and the current at any instant are given by

$E = 141.4 \cos (5000\ t - 10^o)$

and $I = 5 \cos (5000\ t - 370^o)$

The inductance is 0.01 henry. Calculate the value of ***capacitance and resistance***.

D 7. An inductance of 2.0 H, a capacitance of 18μ F and a resistance of 10k Ω are connected to an AC source of 20 V with adjustable frequency (a) What frequency should be chosen to maximise the current(RMS) in the circuit ? (b) What is the value of this maximum current (RMS) ?

D 8. An inductor-coil a capacitor and an AC source of rms voltage 24 V are connected in series. When the frequency of the source is varied a maximum rms current of 6.0 A is observed. If this inductor coil is connected to a battery of emf 12 V and internal resistance 4.0 Ω, what will be the steady current ?

D 9. A wave of wavelength 300 metre can be transmitted by a transmission centre. A condenser of capacity 2.5 μF is available. Calculate the inductance of the required coil for a resonant circuit.Use π^2=10.

SECTION (E) : TRANSFORMER

E 1. A power (step up) transformer with an 1 : 8 turn ratio has 60 Hz, 120 V across the primary; the load in the secondary is 10^4 Ω. The current in the secondary is
(A) 96 A (B) 0.96 A (C) 9.6 A (D) 96 mA

E 3. A transformer is used to light a 140 watt, 24 volt lamp from 240 V AC mains. The current in the main cable is 0.7 amp. The efficiency of the transformer is :
(A) 48% (B) 63.8% (C) 83.3% (D) 90%

E 4. In a step-up transformer the voltage in the primary is 220 V and the current is 5A. The secondary voltage is found to be 22000 V. The current in the secondary (neglect losses) is
(A) 5 A (B) 50 A (C) 500 A (D) 0.05 A

E 5. The core of a transformer is laminated to reduce

(A) eddy current loss (B) hysteresis loss (C) copper loss (D) magnetic loss

E 1 A transformer has 50 turns in the primary and 100 in the secondary. If the primary is connected to a 220 V DC supply, what will be the voltage across the secondary ?

E 2. In a transformer ratio of secondary turns (N_2) and primary turns (N_1) i.e. $\frac{N_2}{N_1} = 4$. If the voltage applied in primary is 200 V, 50 Hz, find (a) voltage induced in secondary (b) If current in primary is 1A, find the current in secondary if the transformer is (i) ideal and (ii) 80% efficient and there is no air loss.

SECTION (F) : MISCELLANEOUS

*** Marked are more than one correct options.**

F 1. A capacitor is a perfect insulator for :
(A) direct current (B) alternating current
(C) direct as well as alternating current (D) None of the above

F 2. A choke coil sould have :
(A) high inductance and high resistance (B) low inductance and low resistance
(C) high inductance and low resistance (D) low inductance and high resistance

F 3. A choke coil 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

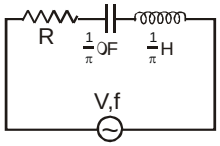
F 4. With increase in frequency of an AC supply, the inductive reactance :
(A) decreases (B) increases directly proportional to frequency
(C) increases as square of frequency (D) decreases inversely with frequency

F 5. With increase in frequency of an AC supply, the capacitive reactance :
(A) varies inversely with frequency (B) varies directly with frequency
(C) varies directly as square of frequency (D) remains constant

F 6. An AC ammeter is used to measure current in a circuit. When a given direct constant current passes through the circuit, the AC ammeter reads 3 ampere. When another alternating current passes through the circuit, the AC ammeter reads 4 ampere. Then the reading of this ammeter if DC and AC flow through the circuit simultaneously, is :
(A) 3 ampere (B) 4 ampere (C) 7 ampere (D) 5 ampere

F 7. In an a.c. circuit consisting of resistance R and inductance L, the voltage across R is 60 volt and that across L is 80 volt. The total voltage across the combination is
(A) 140 V (B) 20 V (C) 100 V (D) 70 V

F 8. In the AC circuit shown below, the supply voltage has constant rms value V but variable frequency f. At resonance, the circuit :



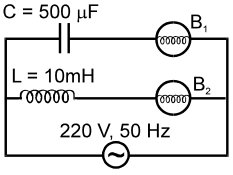
(A) has a current I given by $I = \frac{V}{R}$

(B) has a resonance frequency 500 Hz

(C) has a voltage across the capacitor which is 180^0 out of phase with that across the inductor

(D) has a current given by $I = \frac{V}{\sqrt{R^2 + \left(\frac{1}{\pi} + \frac{1}{\pi}\right)^2}}$

F 9. In the circuit shown in figure, if both the bulbs B_1 and B_2 are identical :



(A) their brightness will be the same (B) B_2 will be brighter than B_1

(C) as frequency of supply voltage is increased the brightness of bulb B_1 will increase and that of B_2 will decrease.

(D) only B_2 will glow because the capacitor has infinite impedance

F 10*. An AC source rated 100 V (rms) supplies a current of 10 A (rms) to a circuit. The average power

delivered by the source :
(A) must be 1000 W (B) may be 1000 W
(C) may be greater than 1000 W (D) may be less than 1000 W

F 11. An inductor coil having some resistance is connected to an AC source. Which of the following quantities have zero average value over a cycle ?
(A) current (B) induced emf in the inductor
(C) joule heat (D) magnetic energy stored in the inductor

F 12*. A town situated 20 km away from a power house at 440 V, requires 600 KW of electric power at 220 V. The resistance of line source carrying power is 0.4 Ω per km. The town gets power from the line through a 3000 V–220 V step-down transformer at a substitution in the town. Which of the following is/are correct
(A) The loss in the form of heat is 640 kW (B) The loss in the form of heat is 1240 kW
(C) Plant should supply 1240 kW (D) Plant should supply 640 kW

F 13. 11 kW of electric power can be transmitted to a distant station at (i) 220 V or (ii) 22000 V. Which of the following is correct
(A) first mode of transmission consumes less power
(B) second mode of transmission consumes less power
(C) first mode of transmission draws less current
(D) second mode of transmission draws less current

F 14. In a series LCR circuit with an AC source(E_{rms} = 50 V and $\nu = 50/\pi$ Hz), R = 300 Ω, C = 0.02 mF, L = 1.0 H, Which of the following is correct
(A) the rms current in the circuit is 0.1 A
(B) the rms potential difference across the capacitor is 50 V
(C) the rms potential difference across the capacitor is 14.1 V
(D) the rms current in the circuit is 0.14 A

F 15. A circuit is set up by connecting L = 100 mH, C = 5 μF and R =100 Ω in series. An alternating emf of $(150\sqrt{2})$ volt, $\frac{500}{\pi}$ Hz is applied across this series combination. Which of the following is correct
(A) the impedance of the circuit is 141.4 Ω
(B) the average power dissipated across resistance 225 W
(C) the average power dissipated across inductor is zero.
(D) the average power dissipated across capacitor is zero.

F 16*. In a series RC circuit with an AC source(peak voltage E_0 = 50 V and f = $50/\pi$ Hz), R = 300 Ω,C = 25 μF. Then :
(A) the peak current is 0.1 A (B) the peak current is 0.7 A
(C) the average power dissipated is 1.5 W (D) the average power dissipated is 3 W

F 17. A coil of inductance 5.0 mH and negligible resistance is connected to an oscillator giving an output voltage E = (10V) sin ωt. Which of the following is correct
(A) for ω = 100 s^{-1} current is 20 A (B) for ω = 500 s^{-1} current is 4 A
(C) for ω = 1000 s^{-1} current is 2 A (D) for ω = 1000 s^{-1} current is 4 A

F 18. A pure inductance of 1 henry is connected across a 110 V, 70Hz source. Then correct option are (Use $\pi = 22/7$):
(A) reactance of the circuit is 440 Ω (B) current of the circuit is 0.25 A
(C) reactance of the circuit is 880 Ω (D) current of the circuit is 0.5 A

EXERCISE-2

1. An LCR series circuit with 100 Ω resistance is connected to an AC source of 200 V and angular frequency 300 radians per second. When only the capacitance is removed, the current lags behind the voltage by 60°. When only the inductance is removed, the current leads the voltage by 60º. Calculate the current and power dissipated in LCR circuit. **[REE - 90]**

2. A 100 volt AC source of frequency 500 hertz is connected to a LCR circuit with L = 8.1 millihenry, C = 12.5 microfarad and R = 10 ohm, all connected in series. Find the potential difference across the resistance. **[REE - 91]**

3. The current in a coil of self inductance 2.0 Henry is increasing according to $i = 2 \sin t^2$ ampere. Find the amount of energy spend during the period when the current changes from zero to 2 ampere. **[REE- 91]**

4. The current in a circuit containing a capacitance C and a resistance R in series leads over the applied voltage of frequency $\frac{\omega}{2\pi}$ by. **[REE - 91]**

(A) $\tan^{-1}\left(\frac{1}{\omega CR}\right)$ (B) $\tan^{-1}(\omega CR)$ (C) $\tan^{-1}\left(\omega\frac{1}{R}\right)$ (D) $\cos^{-1}(\omega CR)$

5. 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 **[REE - 92]**

(A) zero (B) $0.5\ V_0I_0$ (C) $0.707\ V_0I_0$ (D) $1.414\ V_0I_0$

6. In a purely resistive AC circuit, the current **[REE - 92]**
(A) Lags behind the EMF in phase
(B) Is in phase with the e.mf.
(C) Leads the EMF in phase
(D) Leads the EMF in half the cycle and lags behind it in the other half.

7. A current of 4 A flows in a coil when connected to a 12 V d.c. source. If the same coil is connected to a 12 V, 50 rad/s, AC source, a current of 2.4 A flows in the circuit. Determine the inductance of the coil. Also, find the power developed in the circuit if a 2500 μF condenser is connected in series with coil. **[REE - 93]**

8. The current and voltage in an AC circuit are respectively given by $I = I_0 \cos \omega t$, $V = V_0 \sin \omega t$. The power consumed in the circuit is - **[REE - 93]**

(A) zero (B) $\frac{V_0I_0}{2}$ (C) $\frac{V_0I_0}{\sqrt{2}}$ (D) $\sqrt{2}\,V_0I_0$

9. If a resistance of 30Ω, a capacitor reactance 20 Ω, and an inductor of inductive reactance 60Ω are connected in series to a 100 V, 50 Hz power source, then - **[REE - 94]**
(A) A current of 2.0 A flows (B) A current of 3.33 A flows
(C) Power factor of the circuit is zero (D) Power factor of the circuit is 3/5

10. A series LCR circuit containing a resistance of 120 ohm has angular resonance frequency 4×10^5 rad s^{-1}. At resonance, the voltage across resistance and inductance are 60V and 40 V respectively. Find the values of L and C. At what frequency the current in the circuit lags the voltage by 45º? **[REE - 95]**

11. In a circuit, an inductance of 0.1 Henry and a resistance of 1Ω are connected in series with an AC source of voltage V = 5 sin 10 t. The phase difference between the current and applied voltage will be
(A) π (B) 2π (C) π/4 (D) 0 **[REE - 96]**

12. An inductive reactance, X_L = 100 Ω, a capacitive reactance, X_C = 100 Ω, and a resistance R = 100 Ω, are connected in series with a source of 100 sin (50 t) volts. Which of the following statements are correct? **[REE - 96]**
(A) The maximum voltage across the capacitor is 100 V.
(B) The net impedance of the circuit is 100 Ω.
(C) The maximum voltage across the inductance is 100 V.
(D) The maximum voltage across the series is 100 V.

13. A series LCR circuit is operated at resonance. Then **[REE - 97]**
(A) Voltage across R is minimum (B) Impedance is minimum
(C) Power transferred is maximum (D) Current amplitude is minimum

14. A box P and a coil Q are connected in series with an AC source of variable frequency. The EMF. of source is constant at 10 V. Box P contains a capacitance of 1 μF in series with a resistance of 32 Ω. Coil Q has a self inductance 4.9 mH and a resistance of 68 Ω. The frequency is adjusted so that the maximum current flows in P and Q. Find the impedance of P and Q at this frequency. Also find the voltage across P and Q respectively. **[REE - 98]**

15. An inductor 20×10^{-3} Henry, a capacitor 100 μF and a resistor 50Ω are connected in series across a source of EMF V = 10 sin 314 t. Find the energy dissipated in the circuit in 20 minutes. If resistance is

removed from the circuit and the value of inductance is doubled, then find the variation of current with time in the new circuit. **[REE - 99]**

16. The electric current in an AC circuit is given by $i = i_0 \sin \omega t$. What is the time taken by the current to change from its maximum value to the rms value? **[REE - 99]**

17. An alternating EMF of angular frequency ω is applied across an inductance. The instantaneous power developed in the circuit has an angular frequency. **[REE - 99]**

(A) $\frac{\omega}{4}$ (B) $\frac{\omega}{2}$ (C) ω (D) 2ω

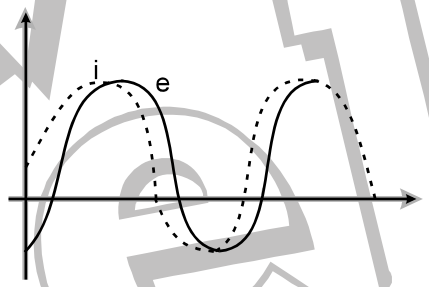
18. A bulb and a capacitor are connected in series to a source of alternating current. If its frequency is increased, while keeping the voltage of the source constant, then. [**REE - 99]**

(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

20. In an AC circuit, the power factor - **[REE - 2000]**

(A) is zero when the circuit contains an ideal resistance only
(B) is unity when the circuit contains an ideal resistance only
(C) is zero when the circuit contains an ideal inductance only
(D) is unity when the circuit contains an ideal inductance only

21. When an AC source of emf $e = E_0 \sin (100\ t)$ is connected across a circuit, the phase difference between the emd e and the current i in the circuit is observed to be $\frac{\pi}{4}$, as shown in the diagram. If the circuit consists possibly only of R-C or R-L or L-C series, find the relationship between the two elements. **[JEE 2003]**



(A) $R = 1k\Omega$, $C = 10\ \mu F$ (B) $R = 1k\Omega$, $C = 1\ \mu F$
(C) $R = 1k\Omega$, $L = 10\ H$ (D) $R = 1k\Omega$, $L = 1H$

ANSWER

EXERCISE 1

SECTION (A) :

A 1. B **A 2.** D **A 3.** B

A* 4. C **A 5.** D **A 6.** D

A 7. ABC **A 8.** B **A 9.** D

A 10. $\frac{I_o}{e}\sqrt{(e^2-1)/2}$ **A 11.** $\frac{V_0}{\sqrt{3}}$

SECTION (B) :

B 1. B **B 2.** C **B 3.** A

B 4. B **B 5.** C **B 6.** A

B 7. C **B 8.** B **B 9.** B

B 10. A **B 11.** B **B 12*.** ABCD

B 13. $12\sqrt{2}$ volts **B 14.** 0.72 W

B 15. 10 W, 5 W **B 16.** 50 sec

SECTION (C) :

C 1. A **C 2.** D **C 3.** ABD

C 4. C **C 5.** B **C 6.** B

C 7. A **C 8.** D **C 9.** B

C 10. A **C 11.** $\frac{2.2\sqrt{3}}{\pi}$ =1.2 H

C 12. (a) 0.1 A (b) 50 V, 30 V, 10 V (Note that the sum of the rms potential differences across the three elements is greater that the rms voltage of the source.)

C 13. 25 mJ, 5mJ

C 14. Z = $50\sqrt{2}$ ohm, V_C = $500\sqrt{2}$ volt and V_L= $600\sqrt{2}$ volt

C 15. 125 Ω, 288 J

SECTION (D) :

D 1*. CD **D 2.** B **D 3.** A

D 4. A **D 5.** D **D 6.** 4 μF

D 7. (a) $\frac{250}{3\pi}$ Hz (b) 2 mA

D 8. 1.5 A **D 9.** 1×10^{-8} henry

SECTION (E) :

E 1. D **E 2.** C **E 3.** D

E 4. A **E 5** zero

E 6. (a) 800 V (b) (i) 0.25 A (ii) 0.2 A.

SECTION (F) :

F 1. A **F 2.** C **F 3.** A

F 4. B **F 5.** A **F 6.** D

F 7. C

*** Marked are more than one correct options.**

F 8 ABC **F 9.** BC **F 10*.** BD

F 11. AB **F 12*.** AC **F 13.** BD

F 14. AB **F 15.** ABCD **F 16*.** AC

F 17. ABC **F 18.** AB

EXERCISE 2

1. 2A; 400 watt. **2.** 100 volt

3. 4 joule **4.** A

5. A **6.** B

7. 08 H; 17.28 watt **8.** A

9. A, D

10. 2×10^{-4} Henry; $\frac{1}{32}$ μF; 8×10^{5} rad/s

11. C **12.** ABCD

13. B, C

14. P=76.96 Ω ,Q=97.59 Ω, P = 7.6 V; Q = 9.8 V, impedance = 100 Ω

15. 952 J; 0.52 cos 314 t

16. T/8 or $\frac{\pi}{4\omega}$ **17.** D

18. A **19.** B, C

20. A

