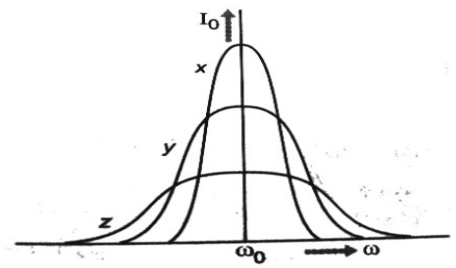
1.	What is the resistance offered by a capacitor for the steady current? (a) one (b) zero (c) Infinity (d) depends on the average value
2.	To reduce the resonant frequency in an LCR series circuit with a generator (a) the generator frequency should be reduced (b) another capacitor should be added in parallel to the first (c) the iron core of the inductor should be removed (d) Dielectric in the capacitor should be removed.
3.	An alternating current generator has an internal resistance R_g and an internal reactance X_g. It is used to supply power to a passive load consisting of a resistance R_g and an internal reactance X_L. For maximum power to be delivered from the generator to the load, the value of X_L is equal to (a) zero (b) X_g (c) $-X_g$ (d) R_g
4.	An inductor of reactance 1Ω and a resistor of 2Ω are connected in series to the terminals of a 6 V (rms) AC source. The power dissipated in the circuit is (a) 8 W (b) 12 W (c) 14.4 W (d) 18 W
5.	When an AC is connected to a capacitor what happens? (a) voltage is leading the current by 90° (b) voltage and current are in phase with each other (c) voltage and current are out of phase (d) current leads the voltage by 90°
	Short Answer Type Qs (2 & 3 Marks)
6.	A lamp is connected in series with a capacitor. Predict your observations for dc and ac connections. What happens in each case if capacitance of the capacitor is reduced?
7.	When a circuit element 'P'is connected across an AC source, a current of $\sqrt{2}\mathbf{A}$ flows through it and this current is in phase with the applied voltage. When another element 'Q' is connected across the same AC source, the same current flows in the circuit but it leads the voltage by $\frac{\pi}{2}$ radians. (a) Name the circuit elements 'P' and 'Q'. (b) Find current that flows in the circuit when series combination of P and Q is connected across same AC voltage.

8. At an airport, a person is made to walk through the door way of a metal detector, for security reasons. If she / he is carrying anything made of metal, the metal detector emits a sound. On what principle does this detector work?

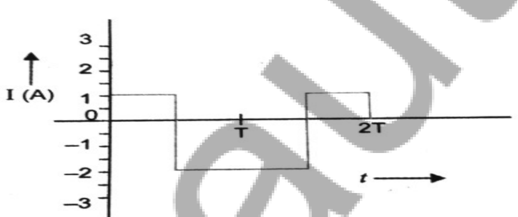
9. Three students X,Y and Z performed an experiment to study the variation of alternating current with angular frequency obtained the following graphs They all used the same value of the inductance and same AC sources having same rms value



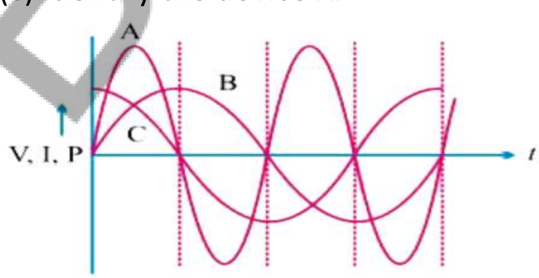
(a) What can be concluded (qualitatively) about the value of Capacitance and Resistance used by them?
(b) Comment on the nature of the impedance of the setup at the frequency ω_0.

10. Can the instantaneous power output of an ac source ever be negative? Can the average power output be negative?

11. The alternating current in a circuit is described by the graph shown in Fig. Show rms current in this graph.



12. A device 'X' is connected to an AC source. The variation of voltage, current and power in one complete cycle is shown in figure.
(a) Which curve shows power consumption over a full cycle?
(b) What is the average power consumption over a cycle?
(c) Identify the device X.



13. A coil of 0.01 henry inductance and 1 ohm resistance is connected to 200 volt, 50 Hz ac supply. Find the impedance of the circuit and time lag between max. Alternating voltage and current.

Long Answer Type Qs (5 Marks)

14. An electrical device draws 2kW power from AC mains (Voltage 223V (rms) $= \sqrt{50,000\text{V}}$). The current differs (lags) in phase by φ(tanφ=$-\frac{-3}{4}$) as compared to voltage. Find

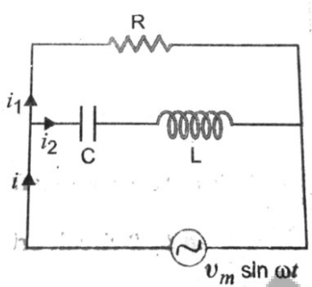
(a) R,

(b) X_c- X_L, and

(c) L_M.

Another device has twice the values for R, X_c and X_L how are the answers affected?

15. Consider the LCR circuit shown in Fig. Find the net current i and the phase of i. show that i=$\frac{V}{Z}$. Find the impedance Z for this circuit.

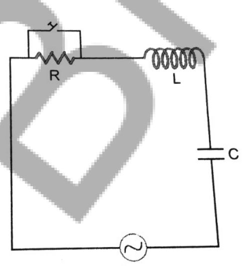


16. In the LCR circuit shown in Fig., the AC driving voltage is V= V_m sinωt.

(i) Write down the equation of motion for q (t).

(ii) At t=t_0, the Voltage source stops and R is short circuited. Now write down how much energy is stored in each of L and C.

(iii) Describe subsequent motion of charges.



	HINTS AND ANSWER
1.	(c)
2.	(b)
3.	(c)
4.	(c)
5.	(d)
6.	**Conceptual** Reducing C will increase reactance and the lamp will shine less brightly than before.
7.	$\sqrt{2}A$
8.	**Conceptual** The metal detector works on the principle of resonance in ac circuits. When you walk through a metal detector, you are, in fact, walking through a coil of many turns. The coil is connected to a capacitor tuned so that the circuit is in resonance. When you walk through with metal in your pocket, the impedance of the circuit changes – resulting in significant change in current in the circuit. This change in current is detected and the electronic circuitry causes a sound to be emitted as an alarm.
9.	(A) **Conceptual** Since the resonant frequency is same, the capacitive value are also same we have $R_x < R_y < R_z$ Maximum current for X > Maximum current for Y > Maximum current for Z. (B) The impedance at the resonant frequency ω_0 is purely resistive in nature.
10.	**Expression type Question** No, the average power out of an AC source cannot be negative.
11.	1.6A
12.	**Conceptual** (A) We know thatPower = P = VIthat is curve of power will be having maximum amplitude, equals to multiplication of amplitudes of voltage (V) and current (I) curve. So, the curve will be represented by A. (B) As shown by shaded area in the diagram, the full cycle of the graph consists of one positive and one negative symmetrical area.Hence, average power over a cycle is

	zero. (C) As the average power is zero, hence the device may be inductor (L) or capacitance (C) or the series combination of L and C.
13.	0.004 second
14.	(A) 20Ω (B) -15Ω (C) 12.6 A For Another Device has double the value or R_1, X_c and X_L then, (A) 40Ω (B) -30Ω (C) 6.3 A.
15.	**Expression type Question** $\phi = \tan^{-1}\frac{R}{X_L - X_C}$ $\frac{1}{Z} = \left\{\frac{1}{R^2} + \frac{1}{(L\omega - 1/\omega C)^2}\right\}^{1/2}$
16.	(A) $L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{C} = V_m \sin \omega t$ This is the required equation of variation (motion) of charge. (B) $= \frac{1}{2C\omega^2}\left[\frac{V_m}{\sqrt{R^2 + (X_C - X_L)^2}}\right]^2 \cos^2(\omega t_0 + \phi$ (C) The circuit becomes an LC oscillator when R is short circuited. The capacitor will go on discharging and all energy will go to L back and forth.