CHAPTER NO. 16 (ALTERNATING CURRENT)

Question 16.1:- A sinusoidal current has rms value of 10 A. What is the maximum or peak value?

Answer:- RMS value of current = I_{rms} = 10 A

Maximum or peak value of current = $I_o = \sqrt{2}\ I_{rms}$

$I_o = \sqrt{2}\ (10) = 1.4 \times 10 = 14$ A

Maximum or peak value of current = 14 A (correct up to two significant figures)

Question 16.2:- Name the device that will (a) permit flow of direct current but oppose the flow of alternating current (b) permit flow of alternating current but not the direct current.

Answer:- (a) An inductor (choke coil) is a device that permits the flow of direct current but opposes the flow of alternating current.

(b) A capacitor is a device that permits the flow of alternating current but opposes the flow of direct current.

Question 16.3:- How many times per second will an incandescent lamp reach maximum brilliance when connected to a 50 Hz source?

Answer:- The brilliance of an incandescent lamp will become maximum two times in an alternating cycle i.e. once for positive half cycle and once for negative half cycle.

Number of maximum brilliance by lamp per cycle = 2

Number of cycles in 50 Hz source per second = f = 50

Number of maximum brilliance by lamp per second = 2 f = 50 x 2 = 100 times per second

Question 16.4:- A circuit contains an iron-cored inductor, a switch and a DC source arranged in series. The switch is closed and after an interval reopened. Explain why a park jumps across the switch contacts?

Answer:- When switch in a series circuit containing a DC source and an iron-cored inductor is closed, a current is established in the inductor and it stores energy in its magnetic field according to the relation $U_m = \frac{1}{2} L I^2$. When the switch is reopened, the energy stored by the inductor is utilized in exciting and ionizing the molecules of air near the switch which produce a spark later on de-excitation.

Question 16.5:- How does doubling the frequency affect the reactance of (a) an inductor (b) a capacitor.

Answer:- (a) The reactance of an inductor is given as $X_L = 2\pi fL$.

When frequency if doubled i.e. f' = 2f so $X_L' = 2\pi f'L = 2\pi(2f)L = 2(2\pi fL) = 2X_L$

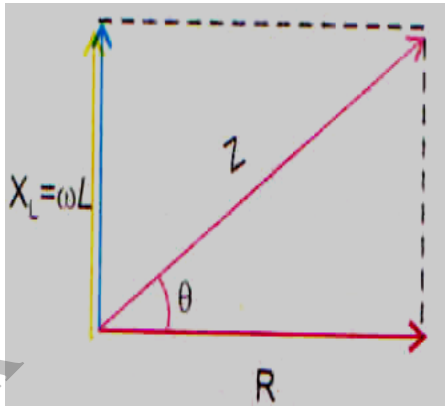
The reactance of inductor is doubled on doubling the frequency.

(b) The reactance of a capacitor is given as $X_C = \frac{1}{2\pi fC}$

When frequency if doubled i.e. f' = 2f so $X_C' = \frac{1}{2\pi f'C} = \frac{1}{2\pi(2f)C} = \frac{X_C}{2}$

The reactance of capacitor is halved on doubling the frequency.

Question 16.6:- In a R-L circuit, will the current lag or lead the voltage? Illustrate your answer by a vector diagram.



Answer:- In an RL series circuit, the potential drop across the resistor R will be IR and in phase with the current of the circuit I. The potential drop across inductor will be $IX_L = I(\omega L)$ and will lead the current of the circuit by 90°. The phase difference between voltage and current will be given by the relation $\theta = \tan^{-1}(\frac{X_L}{R}) = \tan^{-1}(\frac{\omega L}{R})$.

The voltage will lead the current by a phase $\theta = \tan^{-1}(\frac{X_L}{R}) = \tan^{-1}(\frac{\omega L}{R})$.

Question 16.7:- A choke coil placed in series with an electric lamp in an AC circuit causes the lamp to become dim. Why is it so? A variable capacitor added in series in this circuit may be adjusted until the lamp glows with normal brilliance. Explain, how this is possible?

Answer:- When an incandescent lamp is connected across an AC source of voltage V, the current passing through it is I = V/R where R is the resistance of filament. The lamp glows with normal brilliance.

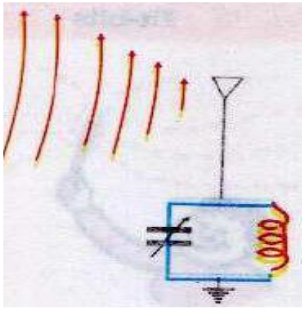
When a choke coil is connected in series with the lamp, the impedance of the circuit increases as $Z = \sqrt{R^2 + X_L{}^2}$. The current passing through the lamp I = V/Z decreases and it becomes dim.

When a variable capacitor is added in series with lamp and inductor, the impedance of the circuit becomes $Z = \sqrt{R^2 + (X_L - X_C)2}$, by changing the capacitance of the capacitor we can tune the circuit such that $X_L = X_C$ and Z = R reduces to same normal value. The current passing through the lamp is again I = V/R and it glows with normal brilliance again.

Question 16.8:- Explain the conditions under which electromagnetic waves are produced from a source?

Answer:- When an alternating voltage of certain frequency across the ends of a metallic antenna, an oscillating electric field forces the electron in the metallic wire to oscillate back and forth, which accelerates it. According to Maxwell's electromagnetic theory, a changing electric field produces a changing magnetic field in the region around it and a changing magnetic field produces a changing electric field around it. Thus a complete package of electromagnetic wave is radiated out in space by the antenna.

Question 16.9:- How the reception of a particular radio station is selected on your radio set?



Answer:- A particular radio station can be selected on a radio set by tuning it. The frequency of desired radio station is tuned to the frequency of oscillating LC circuit in the receiving antenna by varying the value of capacitance and resonance is achieved. The current of desired radio signal becomes maximum in the receiving circuit and can be amplified.

Question 16.10:- What is meant by A.M. and F.M.?

Answer:- A.M. means amplitude modulation. In this modulation technique, amplitude of the carrier wave (high frequency radio wave) is increased or diminished as the amplitude of the superposing modulating signal (low frequency audio wave) increases or decreases but the frequency of carrier wave remains constant.

F.M. means frequency modulation. In this modulation technique, frequency of the carrier wave (high frequency radio wave) is increased or diminished as the amplitude of the superposing modulating signal (low frequency audio wave) increases or decreases but amplitude of carrier wave remains constant.