SHORT QUESTIONS

Q-16.1:- A sinosoidal current has rms (effective) value of 10A. What is the maximum or peak value?

Answer:- $I_{rms} = 10A$

$I_o = ?$

As $I_{rms} = \frac{I_o}{\sqrt{2}} = 0.707\, I_o$

So

$$I_o = \frac{I_{rms}}{0.707} = \frac{10A}{0.707} = \underline{14.14\,A}$$

Q-16.2 Name the device that will

(a)- permit flow of direct current but opposes the flow of alternating current

(b)- permit flow of alternating current but not the direct current.

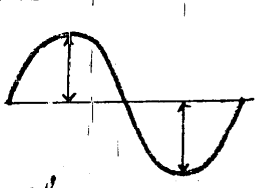
Answer

(a)- **Inductor**: It permits flow of direct current due to which constant magnetic field is produced in it. It opposes the flow of A.C. because due to variable current a changing magnetic field is produced, so coil having self inductance will oppose the growth of current at first and afterwards will opposes its decay.

(b)- **Capacitor**: It permits flow of A.C due to its charging and discharging process but opposes D.C due to insulator between its plates when it is fully charged.

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

Answer During one cycle source attains its maximum value (peak value) twicely. The given source has 50 cycles $\bar{s}'$. i-e $f = 50H_z$



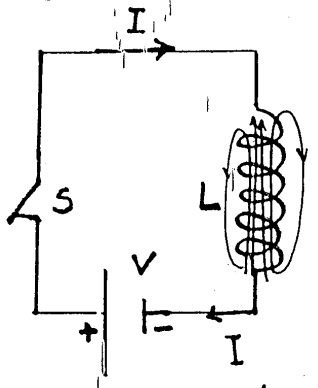
Therefore incandescent lamp reach the maximum brilliance twicely in a cycle.

So in one second it will reach the maximum brilliance

$= 2f = 2 \times 50 = 100$ times.

Q-16.4. A circuit contains an iron - cored inductor, a switch and a D.C. source arranged in series. The switch is closed and after an interval reopened. Explain why a spark jumps across the switch contacts.

Solution:- When switch S is closed then circuit completes and a steady current flows through inductor due to which magnetic field is produced in iron cored coil. So energy $U_m = \frac{1}{2} L I^2$ is stored in the core of inductor. When switch S is reopened, the circuit will be open. The energy stored in the inductor is lost which appears as a spark across the switch contacts.



Q-16.5 How does doubling the frequency affect the reactance of

(a)- an inductor (b)- a capacitor ?

Answer

(a)- For an inductor $X_L = \omega L = 2\pi f L$

If frequency is doubled i.e

$$f' = 2f$$

then $$X_L' = 2\pi f' L = 2\pi (2f) L = 2(2\pi f L)$$

i.e $$X_L' = 2 X_L$$

Hence reactance is also doubled.

(b)- For a capacitor $X_c = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

If frequency is doubled i.e $f' = 2f$

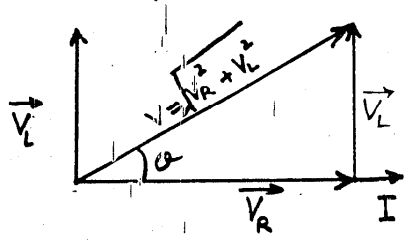
then $$X_c' = \frac{1}{2\pi f' c} = \frac{1}{2\pi (2f) C} = \frac{1}{2} \times \frac{1}{2\pi f C}$$

$$X_c' = \frac{1}{2} \times \frac{1}{\omega C} = \frac{1}{2} X_c$$

Hence reactance is halved.

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

Answer:- In a R-L circuit voltage is leading the current by an angle 'θ' or current is lagging behind the voltage by an angle 'θ' as shown vectorially in the figure.



$$\theta = \tan^{-1}\left(\frac{V_L}{V_R}\right) = \tan^{-1}\left(\frac{IX_L}{IR}\right)$$

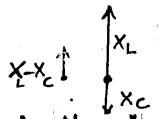
$$\theta = \tan^{-1}\left(\frac{\omega L}{R}\right)$$

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

Answer When a choke coil is connected in series with an electric lamp in an A.C. circuit, then due to self inductance, choke coil (inductor) offeres a high opposition in the flow of A.C through the circuit. (i-e having greater reactance) so bulb becomes dim.

But when a variable capacitor is added in series in this circuit, then impedance of the circuit becomes

$$Z = X_L - X_C$$
$$= \omega L - \frac{1}{\omega C}$$



By adjusting capacitance (i.e decreasing C), the impedance will decrease, greater will be the current and more brightly the bulb will glow.

Therefore by a variable capacitor lamp can glow with normal brilliance.

Q-16.8. Explain the conditions under which electromagnetic waves are produced from a source.

Answer:- Electromagnetic waves can be produced by oscillating a charged particle by an alternating voltage source.

An oscillating L-C-circuit may be connected to a transmitting antenna to radiate em waves.

Q.16.9 How the reception of a particular radio station is selected on your radio set?

Answer A particular radio station will be tuned if the frequency of local oscillator (L-C circuit) is the same as that of the frequency of electromagnetic waves emitted by that particular station.

$$f = \frac{1}{2\pi\sqrt{LC}} \quad \Rightarrow \quad f \propto \frac{1}{\sqrt{C}}$$

The frequency of the L-C circuit can be changed by changing the capacitance of the variable capacitor. When this frequency will be equal to the frequency of incoming wave from a station to be toned, resonance will take place and maximum response will be achieved.

Q-16.10 What is meant by A.M. and F.M.

Answer:- **A.M.** It stands for the amplitude modulation. In amplitude modulation, amplitude of the carrier wave is varied but frequency is kept constant.

F.M. It stands for the frequency modulation. In it frequency of the carrier wave is changed but amplitude remains constant.

Example-16.7 Find the capacitance required to construct a resonance circuit of frequency 1000 kHz with an inductor of 5 mH.

Solution:- $f_r = 1000 \times 10^3\ Hz$, $L = 5 \times 10^{-3}\ H$, $C = ?$

Resonance Frequency $= f_r = \frac{1}{2\pi\sqrt{LC}}$

$$f_r^2 = \frac{1}{4\pi^2 (LC)}$$

$$C = \frac{1}{4\pi^2 f_r^2 L} = \frac{1}{4\times(3.14)^2 \times (1000\times10^3)^2 \times 5\times10^{-3}\ H}$$

$$C = 5.09 \times 10^{-12}\ F$$

$$C = 5.09\ pF$$
