CHAPTER-7
Alternating Current
ASSIGNMENT-3
MULTIPLE CHOICE QUESTION

Q1. An inductance of 1 mH a condenser of 10 μF and a resistance of 50 Ω are connected in series. The reactance of inductor and condensers are same. The reactance of either of them will be

(a) 100 Ω (b) 30 Ω (c) 3.2 Ω (d) 10 Ω

Q2. An ac circuit consists of an inductor of inductance 0.5 H and a capacitor of capacitance 8 μF in series. The current in the circuit is maximum when the angular frequency of ac source is

a) 500 rad/sec (b) 2×10^5 rad/sec (c) 4000 rad/sec (d) 5000 rad/sec

Q3. An inductive circuit contains a resistance of 10 ohm and an inductance of 2.0 henry. If an ac voltage of 120 volt and frequency of 60 Hz is applied to this circuit, the current in the circuit would be nearly

(a) 0.32 amp (b) 0.16 amp (c) 0.48 amp (d) 0.80 amp

Q4. The power factor of an ac circuit having resistance (R) and inductance (L) connected in series and an angular velocity ω is

(a) $R/\omega L$ (b) $R/(R^2+\omega^2 L^2)^{\frac{1}{2}}$ (c) $\omega L / R$ (d) $R/(R^2-\omega^2 L^2)^{\frac{1}{2}}$

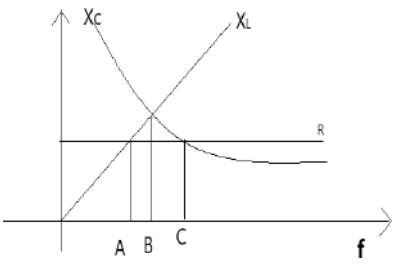
Q5. A telephone wire of length 200 km has a capacitance of 0.014 μF per km. If it carries an ac of frequency 5 kHz, what should be the value of an inductor required to be connected in series so that the impedance of the circuit is minimum

(a) 0.35 mH (b) 35 mH (c) 3.5 mH (d) Zero

Q6. An LCR series circuit with a resistance of 100 ohm is connected to an ac source of 200 V (r.m.s.) and angular frequency 300 rad/s. When only the capacitor is removed, the current lags behind the voltage by 60 °. When only the inductor is removed the current leads the voltage by 60 °. The average power dissipated is

(a) 50 W (b) 100 W (c) 200 W (d)400W

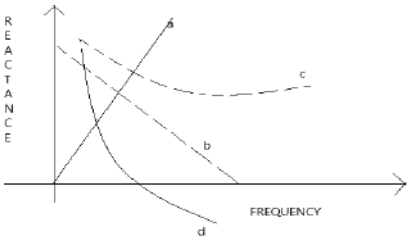
Q7. The figure shows variation of R, X_L and X_C with frequency f in a series L, C, R circuit. Then for what frequency point, the circuit is inductive



(a) A (b) B (c) C
(d) All points

Q8. Which of the following plots may represent the reactance of a series LC combination

(a) a (b) b (c) c (d) d



Q9. A loss free transformer has 500 turns on its primary winding and 2500 in secondary. The meters of the secondary indicate 200 volts at 8 amperes under these conditions. The voltage and current in the primary is

(a) 100 V, 16 A (b) 40 V, 40 A (c) 160 V, 10 A (d) 80 V, 20 A

Q10. A power transformer is used to step up an alternating e.m.f. of 220 V to 11 kV to transmit 4.4 kW of power. If the primary coil has 1000 turns, what is the current rating of the secondary? Assume 100% efficiency for the transformer

(a) 4 A (b) 0.4 A (c) 0.04 A (d) 0.2 A

SHORT ANSWER TYPE I (2MARKS EACH)

Q11.An alternating voltage $E = E_0 \sin \omega t$ is applied to a circuit containing a resistor R connected in series with a unknown box. The current in the circuit is found to be $I = I_o \sin (\omega t + \pi/4)$.

(i) State whether the element in the unknown box is a capacitor or inductor.

(ii) Draw the corresponding phasor diagram and find the impedance in terms of R.

Q12.A 60 W load is connected to the secondary of a transformer whose primary draws line voltage. If a current of 0.54 A flows in the load, what is the current in the primary coil? Comment on the type of transformer being used.

Q13. A radio wave of wavelength 300m can be transmitted by a transmission centre. A condenser of capacity 2.4 μF is available. Calculate the inductance of required coil for resonance.

Q14.How much current is drawn by the primary of a transformer which step down 220V to 22V to operate a device with an impedance of 220Ω?

SHORT ANSWER TYPE II (3MARKS EACH)

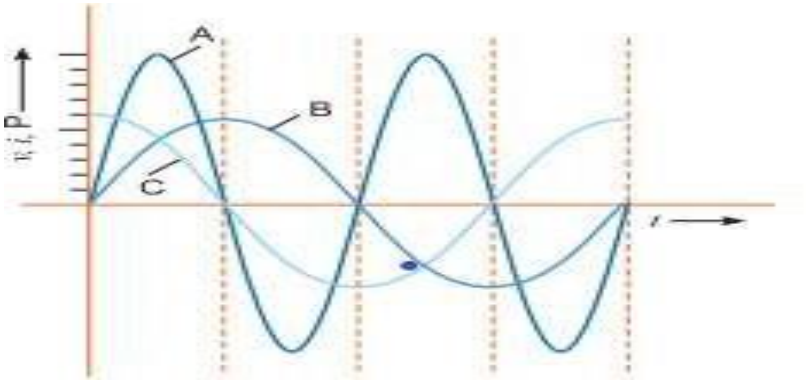
Q15.A capacitor (C) and resistor (R) are connected in series with an ac source of voltage of frequency 50 Hz. The potential difference across C and R is 120 V, 90 V respectively, and the current in the circuit is 3 A. Calculate (i) the impedance of the circuit (ii) the value of the inductance, which when connected in series with C and R will make the power factor of the circuit unity.

Q16.A device 'X' is connected to an ac source. The variation of voltage, current and power in one complete cycle is shown in the 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'.



Long Questions (Each carry 5 marks)

Q17. A voltage $V = V_0 \sin \omega t$ is applied to a series LCR circuit. Derive the expression for the average power dissipated over a cycle. Under what condition is (i) no power dissipated even though the current flows through the circuit, (ii) maximum power dissipated in the circuit?

Q18. (a) Draw the diagram of a device which is used to decrease high ac voltage into a low ac voltage and state its working principle. Write four sources of energy loss in this device.

(b) A small town with a demand of 1200 kW of electric power at 220 V is situated 20 km away from an electric plant generating power at 440 V. The resistance of the two wire line carrying power is 0.5 Ω per km. The town gets the power from the line through a 4000-220 V step-down transformer at a sub-station in the town. Estimate the line power loss in the form of heat.

Q19. A 2 μF capacitor, 100 Ω resistor and 8 H inductor are connected in series with an ac source.

(i) What should be the frequency of the source such that current drawn in the circuit is maximum? What is this frequency called?

(ii) If the peak value of emf of the source is 200 V, find the maximum current.

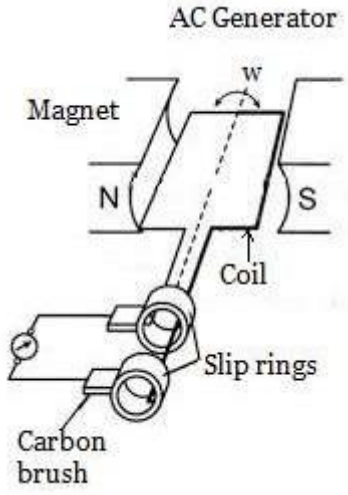
(iii)Draw a graph showing variation of amplitude of circuit current with changing frequency of applied voltage in a series LRC circuit for two different values of resistance R_1 and R_2 ($R_1 > R_2$).

Q20. (i) Draw a labelled diagram of a step-up transformer. Obtain the ratio of secondary to primaryvoltage in terms of number of turns and currents in the two coils.

(ii) A power transmission line feeds input power at 2200 V to a step-down transformer with its primary windings having 3000 turns. Find the number of turns in the secondary to get the power output at 220 V.

CASE STUDY TYPE QUESTIONS (4 MARKS EACH)

Q21. Electric generators are used to produce electrical energy. To understand how they work, let us consider the alternating current (ac) generator, a device that converts mechanical energy to electrical energy. In its simplest form, it consists of a loop of wire rotated by some external means in a magnetic field In commercial power plants, the energy required to rotate the loop can be derived from a variety of sources. For example, in a hydroelectric plant, falling water directed against the blades of a turbine produces the rotary motion; in a coal-fired plant, the energyreleased by burning coal is used to convert water to steam, and this steam is directed against the turbine blades. As a loop rotates in a magnetic field, the magnetic flux through the area enclosed by the loop changes with time; this induces an emf and a current in the loop according to Faraday's law. The ends of the loop are connected to slip rings that rotate with the loop. Connections from these slip rings, which act as output terminals of the generator, to the external circuit are made by stationary brushes in contact with the slip rings.



1. Name the principle on which ac generator based.

2. What is the condition for maximum induced emf in a Coil?

3. An ac generator consists of 8 turns of wire, each of area A = 0.090 0 m^2, and the total resistanceof the wire is 12.0 Ω. The loop rotates in a 0.500-T magnetic field at a constant frequency of 60.0Hz. Find the maximum induced emf.

4. In above case what is the maximum induced current when the output terminals are connected to a low-resistance conductor?