PHYSICS

BOOKS - U-LIKE PHYSICS (HINGLISH)

ALTERNATING CURRENT

Ncert Textbook Exercises

1. A 100 Ω resistor is connected to a 220 V. 50Hz as supply. (a) What is the rms value of current in the circuit? (b) What is the net power consumed over a full cycle?

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2. a) The peak voltage of an a.c. supply is 300 V. What is the rms voltage ?

(b) The rms value of current in an a.c. circuit is 10 A. What is the peak current ?

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3. A 44 mH inductor is connected to 220 V, 50 Hz a.c. supply. Determine the rms value of the current in the circuit.

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4. A 60 μF capacitor is connected to a 110 V, 60 Hz a.c. supply. Determine the rms value of the current in the circuit.

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5. In Exercises 7.3 and 7.4, what is the net power absorbed by each circuit over a complete cycle ? Explain your answer

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6. Obtain the resonant frequency ω_r of a series LCR circuit with L = 2.0 H, C = 32 μF and R = 10Ω.What is the Q-value of this circuit?

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7. A charged 30 μF capacitor is connected to a 27 mH inductor. What is the angular frequency of free oscillations of the circuit ?

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8. Suppose the initial charge on the capacitor in Exercise 7.7 is 6 mC. What is the total energy stored in the circuit initially ? What is the total energy at later time?

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9. A series LCR circuit with $R = 20\Omega$, L = 1.5 H and C = 35 μF is connected to a variable-frequency 200 V a.c. supply. When the frequency of the supply equals the natural frequency of the circuit, what is the average power transferred to the circuit in one complete cycle ?

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10. A radio can tune over the frequency range of a portion of MW broadcast band : (800 kHz to 1200 kHz). If its LC circuit has an effective inductance of 200 uH, what must be the range of its variable capacitor ? [Hint: For tuning, the natural frequency i.e., the frequency of free oscillations of the LC circuit should be equal to the frequency of the radiowave.

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11. Fig. 7.01 shows a series LCR circuit connected to a variable frequency 230 V source. L = 5.0 H, C = 80 μF, R = 40 Ω.

(a) Determine the source frequency which drives the circuit in resonance.

(b) Obtain the impedance of the circuit and the amplitude of current at the resonating frequency.

(c) Determine the rms potential drops across the three elements of the circuit. Show that the potential drop across the LC combination is zero at the resonating frequency.

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Additional Exercises

1. An LC circuit contains a 20 mH inductor and a 50 uF capacitor with an initial charge of 10 mC. The resistance of the circuit is negligible. Let the instant, the circuit is closed be t = 0.

(a) What is the total energy stored initially ? Is it conserved during LC oscillations ?

(b) What is the natural frequency of the circuit ?

(c) At what time is the energy stored

(i) completely electrical (i.e., stored in the capacitor)?

(ii) completely magnetic (i.e., stored in the inductor)?

(d) At what times is the total energy shared equally between the inductor and the capacitor ?

(e) If a resistor is inserted in the circuit, how much energy is eventually dissipated as heat ?

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2. A coil of inductance 0.50 H and resistance 100 Ω is connected to a 240 V, 50 Hz a.c. supply.

(a) What is the maximum current in the coil ?

(b) What is the time lag between the voltage maximum and the current maximum ?

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3. Obtain the answers (a) to (b) in Exercise 7.13 if the circuit is connected to a high frequency supply (240 V, 10 kHz). Hence, explain the statement that at very high frequency, an inductor in a circuit nearly amounts to an open circuit. How does an inductor behave in a d.c. circuit after the steady state ?

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4. A 100 uF capacitor in series with a 40 Ω resistance is connected to a 110 V, 60 Hz supply.

(a) What is the maximum current in the circuit ?

(b) What is the time lag between the current maximum and the voltage maximum ?

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5. Obtain the answers to (a) and (b) above in Exercise 7.15 if the circuit is connected to a 110 V, 12 kHz supply ? Hence, explain the statement that a capacitor is a conductor at very high frequencies. Compare this behaviour with that of a capacitor in a d.c. circuit after the steady state

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6. A circuit containing a 80 mH inductor and a 60 uF capacitor in series is connected to a 230 V, 50 Hz supply. The resistance of the circuit is negligible.

(a) Obtain the current amplitude and rms values.

(b) Obtain the rms values of potential drops across each element.

(c) What is the average power transferred to the inductor ?

(d) What is the average power transferred to the capacitor ? (e) What is the total average power absorbed by the circuit?

['Average implies' average over one cycle]

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7. A series LCR circuit with L = 0.12 H, C = 480 nF, R = 232 is connected to a 230 V variable frequency supply.

(a) What is the source frequency for which current amplitude is maximum ? Obtain this maximum value.

(b) What is the source frequency for which average power absorbed by the circuit is maximum ? Obtain the value of this maximum power.

(c) For which frequencies of the source is the power transferred to the circuit half the power at resonant frequency ? What is the current amplitude at these frequencies? (d) What is the Q-factor of the given circuit ?

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8. Obtain the resonant frequency and Q-factor of a series LCR circuit with L = 3.0 H, C = 27 uF and R= 7.4 Ω. It is desired to improve the sharpness of the resonance of the circuit by reducing its 'full width at half maximum' by a factor of 2. Suggest a suitable way.

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9. Answer the following questions :

(a) In any a.c. circuit, is the applied instantaneous voltage equal to the algebraic sum of the instantaneous voltages across the series elements of the circuit ? Is the same true for rins voltage ?

(b) A capacitor is used in the primary circuit of an induction coil.

(c) An applied voltage signal consists of a superposition of a d.c. voltage and an a.c. voltage of high frequency. The circuit consists of an inductor and a capacitor in series. Show that the d.c. signal will appear across C and the a.c. signal across L.

(d) A choke coil in series with a lamp is connected to a d.c. line. The lamp is seen to shine brightly. Insertion of an iron core in the choke causes no change in the lamp's brightness. Predict the corresponding observations if the connection is to an a.c. line.

(e) Why is choke coil needed in the use of fluorescent tubes with a.c. mains ? Why can we not use an ordinary resistor instead of the choke coil ?

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10. A power transmission line feeds input power at 2300 V to a step-down transformer with its primary windings having 4000 turns. What should be the number of turns in the secondary in order to get output power at 230 V ?

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11. At a hydroelectric power plant, the water pressure head is at a height of 300 m and the water flow available is 100 $m^2 s^{-1}$. If the turbine generator efficiency is 60%, estimate the electric power available from the plant (g = 9.8 m s^{-2}?).

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12. A small town with a demand of 800 kW of electric power at 220 V is situated 15 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 power from the line through a 4000 - 220 V step-down transformer at a sub-station in the town.

(a) Estimate the line power loss in the form of heat.

(b) How much power must the plant supply, assuming there is negligible power loss due to leakage ?

(c) Characterise the step-up transformer at the plant.

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13. Do the same exercise as above with the replacement of the earlier transformer by a 40,000 - 220 V step-down transformer (Neglect, as before, leakage losses though this may not be a good assumption any longer because of the very high voltage transmission involved). Hence, explain, why high voltage transmission is preferred ?

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Case Based Source Based Integrated Questions

1. Read the passage given below and then answer questions on the basis of your under standing of the passage and the related studied concepts.

Passage:

When a resistor is connected across the terminals of a battery, a current is established in the circuit which has a unique direction going from positive terminal to the negative terminal via the external resistor. Magnitude of the current also remains practically constant. If the direction of the current in a resistor (or any other element) changes alternately, the current is called an alternating current. The alternating current being supplied in our houses varies sinusoidally with time. Such a current repeats its value after a finite time interval T, called the time period. So, the current is positive for one half period and is negative for the remaining half period. In reality it means that direction of current reverses after every half time period.

An alternating current may be expressed as $I = I_w \sin(\omega t + \phi)$ where I_m is the peak value of current or the current amplitude. The mean current for a period T is definitely zero but mean of I^2 over the same period is not zero because I^2 is always positve. The average of l^2 over a time period T or a long period of time is $l_m^2 = \frac{l_m^2}{2}$.

The square root of mean square current is called rms current or virtual current and it is given as $I_{rms} = \frac{I_m}{\sqrt{2}}$

(a) What do you mean by sinusoidal nature of an alternating current ?

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2. Read the passage given below and then answer questions on the basis of your under standing of the passage and the related studied concepts.

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(b) Two alternating currents are expressed as $I_1 = I_m \sin(\omega t + \phi)$ and $I_2 = I_m \cos(\omega t + \phi)$. What is the difference between the two currents?

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(c) In India our house hold supply is at 220 V and 50 Hz a.c. What does it mean to us?

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(d) What is the peak value of voltage supplied in our houses ?

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The square root of mean square current is called rms current or virtual current and it is given as $I_{rms} = \frac{I_m}{\sqrt{2}}$

(e) Show that mean value of an a.c. expressed as $I = I_m \sin \omega t$ for one complete cycle is zero.

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6. Read the following passage and then answer questions on the basis of your under standing of the passage and the related studied concepts. Passage: For an LCR series circuit driven with an alternating voltage of amplitude Vmand angular frequency oo, the current amplitude is given as

$$I_m = \frac{V_m}{z} = \frac{V_m}{\sqrt{R^2 + (X_L - X_C)^2}} = \frac{V_m}{\sqrt{R^2 + \left(I\omega - \frac{1}{c\omega}\right)^2}}$$

If ω is varied then for a particular frequency ω_0, $X_C = X_L$ and then Z = R and hence, $I_m = \frac{V_m}{R}$ is maximum. This frequency is called the resonant frequency. The resonant frequency $\omega_0 = \frac{1}{\sqrt{LC}}$ = Resonance of a LCR series a.c. circuit is said to be sharping current amplitude Im falls rapidly on increasing/decreasing the angular frequency from its resonant value 0. Mathematically, sharpness of resonance is measured by the quality factor of the circuit, which is given as:

$$Q = \frac{\omega L}{R} = \frac{1}{R}\sqrt{\frac{L}{C}}$$

(a) (a) Draw graphs showing variation of current amplitude of a LCR series circuit with frequency w of driving $\omega < \omega_0$, alternating voltage.

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7. Read the following passage and then answer questions on the basis of your under standing of the passage and the related studied concepts. Passage: For an LCR series circuit driven with an alternating voltage of amplitude Vmand angular frequency oo, the current amplitude is given as

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(b) How does impedance of the circuit changes with ω

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(c) What is the nature of reactance in the circuit when (i) $\omega < \omega_0$ and (ii) $\omega > \omega_0$?

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$$Q = \frac{\omega L}{R} = \frac{1}{R}\sqrt{\frac{L}{C}}$$

(d) How is a resonant circuit is utilised to tune a TV set at a particular channel ?

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$$Q = \frac{\omega L}{R} = \frac{1}{R}\sqrt{\frac{L}{C}}$$

(e) An alternating series LCR circuit consists of an inductance of 10 mH, a capacitance of 100 uF and a resistance of 5 Ω. Compute its resonance frequency w, as well as the Q-factor.

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11. Read the following passage and then answer questions on the basis of your under standing of the passage and the related studied concepts. Passage : For many purposes it is necessary to change an alternating voltage from one value to another value of greater/smaller magnitude. This is done with a device called transformer. A transformer consists of two sets of coils of enamelled copper wire, insulated from each other, wound on a laminated soft iron core. The primary coil has N_p turns and an alternating input voltage V_p is applied to the primary coil. The secondary coil has N_s turns and produced an output voltage V_s when circuit of the secondary coil is an open circuit. For an ideal transformer, in which the primary has negligible resistance and all the flux in the core links both primary and secondary windings. For such a transformer

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = k$$

(a) Distinguish between a step up transformer and a step down transformer.

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12. Read the following passage and then answer questions on the basis of your under standing of the passage and the related studied concepts. Passage : For many purposes it is necessary to change an alternating voltage from one value to another value of greater/smaller magnitude. This is done with a device called transformer. A transformer consists of two sets of coils of enamelled copper wire, insulated from each other, wound on a laminated soft iron core. The primary coil has N_p turns and an alternating input voltage V_p is applied to the primary coil. The secondary coil has N_s turns and produced an output voltage V_s when circuit of the secondary coil is an open circuit. For an ideal transformer, in which the primary has negligible resistance and all the flux in the core links both primary and secondary windings. For such a transformer

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Why do we take the transformer core of soft iron and a laminated one ?

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$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = k$$

A X-ray machine rated as 30 kV, 100 mA is to be operated on an a.c. supply of 240 volts. Specify the configuration of transformer used for successfully running the X-ray machine.

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$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = k$$

What current is drawn by X-ray machine from the a.c. supply if there is no wastage of energy at all?

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15. Read the following passage and then answer questions on the basis of your under standing of the passage and the related studied concepts. Passage : For many purposes it is necessary to change an alternating voltage from one value to another value of greater/smaller magnitude. This is done with a device called transformer. A transformer consists of two sets of coils of enamelled copper wire, insulated from each other, wound on a laminated soft iron core. The primary coil has N_p turns and an alternating input voltage V_p is applied to the primary coil. The secondary coil has N_s turns and produced an output voltage V_s when circuit of the secondary coil is an open circuit. For an ideal transformer, in which the primary has negligible resistance and all the flux in the core links both primary and secondary windings. For such a transformer

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = k$$

Does working of a transformer violate the law of conservation of energy?

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16. Read the following passage and then answer questions on the basis of your understanding of the passage and the related studied concepts. A small township with a demand of 880 kW of electric power at 220 V is situated 20 km away from a mini hydropower generating station generating power at 440 V. The resistance of the two wire line carrying power is 0.5 ohm per km. The town gets power from the line through a 11 kV-220 V step down transformer at a substation at the township.

(a) The current flowing through the two wire supply line is

A. 160 A

B. 80 A

C. 2000 A

D. 8 A

Answer: B

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17. Read the following passage and then answer questions on the basis of your understanding of the passage and the related studied concepts. A small township with a demand of 880 kW of electric power at 220 V is situated 20 km away from a mini hydropower generating station generating power at 440 V. The resistance of the two wire line carrying power is 0.5 ohm per km. The town gets power from the line through a 11 kV-220 V step down transformer at a substation at the township.

(b) Estimated value of line power loss in the form of heat is

A. 128 kW

B. 256 kW

C. 4.84 kW

D. 512 kW

Answer: A

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18. Read the following passage and then answer questions on the basis of your understanding of the passage and the related studied concepts. A small township with a demand of 880 kW of electric power at 220 V is situated 20 km away from a mini hydropower generating station generating power at 440 V. The resistance of the two wire line carrying power is 0.5 ohm per km. The town gets power from the line through a 11 kV-220 V step down transformer at a substation at the township.

How much power must the hydropower plant supply to the township to fulfill its entire power demand ? Assume that there is no power loss due to leakage during transit.

A. 880 kW

B. 1008 kW

C. 1136 kW

D. 1200 kW

Answer: B

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19. Read the following passage and then answer questions on the basis of your understanding of the passage and the related studied concepts. A small township with a demand of 880 kW of electric power at 220 V is situated 20 km away from a mini hydropower generating station generating power at 440 V. The resistance of the two wire line carrying power is 0.5 ohm per km. The town gets power from the line through a 11 kV-220 V step down transformer at a substation at the township.

If the electric substation of township starts supplying power to the township, using a 33 kV - 220 V step down transformer then estimated value of line power loss in the form of heat will change to

A. 384 kW

B. 43 kW

C. 14.2 kW

D. 256 kW

Answer: C

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Multiple Choice Questions

1. Alternating current cannot be measured by a d.c. ammeter because

A. a.c. cannot pass through d.c. ammeter.

B. a.c. changes its direction.

C. average value of a.c. for complete cycle is zero.

D. a.c. is virtual

Answer: C

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2. In an a.c. circuit with voltage V and current I, the power dissipated is

A. VI

B. $\frac{1}{2}VI$

C. $\frac{1}{\sqrt{2}}VI$

D. depends on the phase between V and I

Answer: D

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3. If the rms current in a 50 Hz a.c. circuit is 5 A, the value of the currents $\frac{1}{300}$ s after its value becomes zero is

A. $5\sqrt{2}$ A

B. $5\sqrt{\frac{3}{2}}$ A

C. $\frac{5}{6}$ A

D. $\frac{5}{\sqrt{2}} A$

Answer: B

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4. The power factor of LCR a.c. circuit at resonance is

A. $\frac{1}{\sqrt{2}}$

B. 1

C. zero

D. $\frac{1}{2}$

Answer: B

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5. An inductor of reactance 1 Ω and a resistor of 2 Ω are connected in series to the terminals of a 6 V (rms) a.c. source. The power dissipated in the circuit is

A. 8 W

B. 12 W

C. 14.4 W

D. 18 W

Answer: C

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6. In an a.c. series circuit, the instantaneous current is maximum when the instantaneous voltage is maximum. The circuit element connected to the source will be

A. Pure inductor

B. Pure capacitor

C. Pure resistor

D. combination of capacitor and an inductor.

Answer: C

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7. An a.c. voltage source of variable angular frequency w and fixed amplitude V, is connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When a is increased.

A. the bulb glows dimmer.

B. the bulb glows brighter.

C. total impedance of the circuit is unchanged.

D. total impedance of the circuit increases.

Answer: B

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8. The output of a step down transformer is measured to be 24 V when connected to a 12 watt light bulb. The value of the peak current is

A. $\frac{1}{\sqrt{2}}$ A

B. $\sqrt{2}$ A

C. 0.08333333333333

D. $2\sqrt{2}$ A

Answer: A

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9. A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately

A. 50%

B. 90%

C. 10%

D. 30%

Answer: B

View Text Solution

10. In an a.c. circuit an alternating voltage V = $200\sqrt{2}$ sin 100t volts is connected to a capacitor of capacitance 1 uF. The rms value of the current in the circuit is

A. 20 mA

B. 10 mA

C. 100 mA

D. 200 mA

Answer: A

View Text Solution

11. In a series resonant LCR circuit, the voltage across R is 100 volts and R=1 k Ω with C = 2 uF. The resonant frequency w is 200 rad s^{-1}. At resonance the voltage across L is

A. 2.5×10^{-2} V

B. 40 V

C. 250 V

D. 4×10^{-3} V

Answer: C

View Text Solution

12. An a.c. voltage is applied to a pure inductor L and drives a current in the inductor. The currentn in the inductor would be

A. ahead of the voltage by $\frac{\pi}{2}$

B. lagging the voltage by $\frac{\pi}{2}$

C. ahead of the voltage by $\frac{\pi}{4}$

D. lagging the voltage by $\frac{3\pi}{4}$

Answer: B

View Text Solution

13. In the given circuit the reading of voltmeter V_1 and V_2 are 300 volts each. The reading of the voltmeter V_3 and T 00000 ammeter A are respectively.

A. 220 V, 2.0 A

B. 100 V, 2.0 A

C. 150V, 2.2 A

D. 220 V, 2.2 A

Answer: D

View Text Solution

14. In a series LCR circuit R = 200 Ω and the voltage and the frequency of the main supply is 220 V and 50 Hz respectively. On taking out the capacitance from the circuit the current lags behind the voltage by 30°. On taking out the inductor from the circuit the current leads the voltage by 30°. The power dissipated in the LCR circuit is

A. 305 W

B. 210 W

C. zero W

D. 242 W

Answer: D

View Text Solution

15. A generator produces a voltage that is given by V = 311 sin 314 t, where t is in seconds. The frequency and rms voltage are

A. 314 Hz, 311 V

B. 50 Hz, 220 V

C. 60 Hz, 230 V

D. 50 Hz, 240 V

Answer: B

View Text Solution

16. The peak value of 220 V of a.c. mains is

A. 155.6 V

B. 220 V

C. 311 V

D. 440 V

Answer: C

View Text Solution

17. In a sinusoidal a.c. circuit the rms value of current (I_{rms}) is related to the current amplitude (10) as per relation

A. $I_{rms} = \frac{I_0}{\pi}$

B. $I_{rms} = \frac{I_0}{\sqrt{2}}$

C. $I_{rms} = \sqrt{2} I_0$

D. $I_{rms} = \frac{\sqrt{2}}{\pi} I_0$

Answer: B

View Text Solution

18. In an a.c. circuit containing capacitance only

A. voltage is ahead of current by $\frac{\pi}{2}$

B. current is ahead of voltage by $\frac{\pi}{2}$

C. current lags behind voltage by π

D. current leads the voltage by π

Answer: C

View Text Solution

19. An alternating current by frequency v is flowing in a circuit containing a resistance R and inductance L in series. The impedance of this circuit is

A. R = $2\pi vL$

B. $\sqrt{R^2 + 4\pi^2 v^2 L^2}$

C. $\sqrt{R^2 + L^2}$

D. $\sqrt{R^2 + 2\pi vL}$

Answer: B

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View Text Solution

20. Power delivered by the source of an a.c. circuit is maximum when

A. $L\omega = C\omega$

B. $L\omega = \frac{1}{C\omega}$

C. $\omega = \frac{1}{LC}$

D. $\sqrt{\omega} = LC$

Answer: B

View Text Solution

21. If a current $I = 5\sin\left(\omega t - \frac{\pi}{2}\right)$ flows in an a.c. circuit on applying a potential V = 310 sin ωt, then the power consumption P in the circuit will be

A. $P = 310 \times 5W$

B. $P = \frac{310}{\sqrt{2}} \times \frac{5}{\sqrt{2}}$

C. $\sqrt{2} \times 310 \times 5$

D. zero

Answer: D

View Text Solution

22. The natural frequency of a LC series circuit is equal to

A. $\frac{1}{2\pi}\sqrt{LC}$

B. $\frac{1}{2\pi\sqrt{LC}}$

C. $\frac{1}{2\pi}\sqrt{\frac{L}{C}}$

D. $\frac{1}{2\pi}\sqrt{\frac{C}{L}}$

Answer: B

View Text Solution

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

A. $500 rads^{-1}$

B. $4000 rads^{-1}$

C. $5000 rads^{-1}$

D. $2 \times 10^6 rads^{-1}$

Answer: A

View Text Solution

24. The phase difference between the current and voltage of a LCR series a.c. circuit at resonance is

A. 0

B. $\frac{\pi}{2}$

C. $\frac{\pi}{4}$

D. π

Answer: A

View Text Solution

25. In a series LCR circuit, resistance R = 10 Ω and the impedance z = 20 Ω . The phase difference between the current and voltage is

A. $\frac{\pi}{6}$

B. $\frac{\pi}{4}$

C. $\frac{\pi}{3}$

D. $\frac{\pi}{2}$

Answer: C

View Text Solution

26. In an a.c. circuit the current lags behind the voltage by $\frac{\pi}{3}$. The compounds of the circuit are

A. R and L

B. L and C

C. only R

D. R and C

Answer: A

View Text Solution

27. In an LCR series a.c. circuit, the voltage across each of the components L, C and R is 50 V. The voltage across the LC combination will be

A. 50 V

B. $50\sqrt{2}$ V

C. 100 V

D. 0 V

Answer: D

View Text Solution

28. Which of the following components of a LCR circuit, with a.c. supply, dissipates energy?

A. L

B. current is ahead of voltage by $\frac{\pi}{2}$

C. R

D. all of these

Answer: C

View Text Solution

29. An inductance L, a capacitor C are connected in the circuit Fig. as shown here. The frequency of the power supply is equal to the resonance frequency of the circuit. Which ammeter reads zero ampere ?

A. A_3

B. A_2

C. A_3

D. None of these

Answer: C

View Text Solution

30. An a.c. source of variable angular frequency o is connected to an LCR series circuit. Which one of the following graphs correctly represents variation of impedance Zof a.c. circuit with angular frequency ω?

A.

B.

C.

D.

Answer: D

View Text Solution

31. We can reduce eddy currents in the core of a transformer

A. by using laminated iron core.

B. by using a core of soft iron

C. by using thick copper wire for winding.

D. by reducing the size of transformer.

Answer: A

View Text Solution

32. The ratio of secondary to primary turns of an ideal transformer is 9:4. What will be the ratio of power output to power input for the given transformer?

A. $4:9$

B. $9:4$

C. $3:2$

D. $1:1$

Answer: D

View Text Solution

33. A transformer with 80% efficiency works at 4 kW and 200 V. If the secondary voltage is 1000 V then the primary and secondary currents are respectively

A. 20 A, 3.2 A

B. 20 A, 4 A

C. 4 A, 20 A

D. 3.2 A, 20 A

Answer: A

View Text Solution

34. Quantity that remains unchanged in a transformer is

A. voltage

B. current

C. frequency

D. none of the above.

Answer: C

View Text Solution

Fill In The Blanks

1. The equation of an alternating current is given as I = 5 sin (314 t) A. The frequency of a.c. and rms value of current are respectively ....Hz and ....A.

View Text Solution

2. In a step up transformer the ratio of number of turns in primary and secondary coils is 1 : 10. If the transformer is an ideal one and its primary is connected to 220 V mains, the voltage developed across secondary coil is ....

View Text Solution

3. Variation of voltage V and current I of a circuit with time t is shown in adjoining Fig. 7.07. The current the voltage by a phase angle of........

View Text Solution

4. In a series LCR alternating current circuit under resonancecondition voltage across is exactly equal to the volt age across ....

View Text Solution

5. For a LR circuit $X_L = 40\Omega$ and $R = 40\sqrt{3}\Omega$. The power factor of the circuit is.............

View Text Solution

6. In a LCR series a.c. circuit .... power is dissipated at resonance, as value of power factor is..................

View Text Solution

7. For increasing the sharpness of resonance in a LCR series a.c. circuit, the presence in the circuit should be minimum.

View Text Solution

8. a.c. power is transmitted over long distances at voltages so that power loss during transmission is ....

View Text Solution

9. To minimise energy loss due to .... and ....we take a laminated soft iron core in a transformer.

View Text Solution

10. In an a.c. circuit instantaneous current is given as I = 10.0 sin $100\pi t$ The time required for the current to achieve its peak value will be................

View Text Solution

11. Current in an a.c. circuit is wattless if ....of the circuit is zero.

View Text Solution

True Or False

1. An alternating current is the current in which magnitude as well as direction of current changes continuously with time.

View Text Solution

2. Effective (or rms) current of an a.c. is that steady current which consumes exactly the same power as actual a.c. consumes during one complete cycle when flowing through a given resistor

View Text Solution

3. An a.c. circuit consists of ohmic resistance only. If the frequency of a.c. source increases then current in the circuit also increases.

View Text Solution

4. If the frequency of an a.c. circuit consisting of an inductance coil is increased, the current gets increased.

View Text Solution

5. A capacitor allows alternating current to flow through itself but does not allow flow of direct current.

View Text Solution

6. An electric bulb and a capacitor are connected in series to a source of an alternating current. If the frequency of the current source is increased then the bulb gives more intense light.

View Text Solution

7. If angular frequency (c) of a.c. source joined to a LCR series circuit is gradually increased then the circuti impedance (Z) changes as per the graph shown here

View Text Solution

8. If the frequency of a.c. is doubled then the value of inductive reactance (X) as well as capacitive reactance (X) gets doubled.

View Text Solution

9. In an a.c. circuit average power consumed depends on the phase difference between current and voltage in the circuit.

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10. Current flowing through a pure inductance and a pure capacitance is called wattless current because average power consumed in the circuit is zero.

View Text Solution

Assertion Reason Type Questions

1. Assertion (A) : A capacitor blocks d.c. but offers an easy path to a.c.

Reason (R) : Capacitive reactance is inversely proportional to frequency of a.c. supply.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and renson are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: A

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2. Assertion (A) : The current lags behind the voltage by a phase angle , when an a.c. flows through an inductor.

Reason (R) : The inductive reactance increases as the frequency of a.c. source increases.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and renson are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: B

View Text Solution

3. Assertion (A) : When capacitanive reactance is smaller than the inductive reactance, the voltage leads the current

Reason (R) : The phase angle is the angle between the alternating voltage and current phasors.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and renson are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: B

View Text Solution

4. Assertion (A) : A bulb connected in series with a solenoid coil is connected to an a.c. source. The bulb glow becomes dimmer when a soft iron core is introduced in the solenoid coil.

Reason (R) : On introducing soft iron core in the solenoid coil, its inductance increases.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and renson are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: A

View Text Solution

5. Assertion (A) : In a series LCR a.c. circuit resonance can take place when inductive and capacitive reactances are equal.

Reason (R) : Sharpness of resonance increases if resistance presence in LCR resonance circuit is reduced.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and renson are true but reason is not the correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion is false but reason is true.

Answer: B

View Text Solution

Very Short Answer Questions

1. The electric mains in the house are marked 220 V, 50 Hz. Write down the equation for instantaneous voltage.

View Text Solution

2. An a.c. I = $I_m \sin \omega t$ produces certain heat H in a resistor R over a time T= $\frac{2\pi}{\omega}$. Write the valueof d.c. that would produce the same heat in the same resistor in the same time.

View Text Solution

3. When a lamp is connected to an alternating voltage supply, it lights with the same brightness as when connected to a 12 V d.c. battery. What is the peak value of alternating voltage source ?

View Text Solution

4. A reactive element, in an a.c. circuit, causes the current flowing (i) to lag in phase by $\frac{\pi}{2}$,

(ii) to lead in phase by $\frac{\pi}{2}$ with respect to the applied voltage. Identify the element in each case.

View Text Solution

5. Sketch a graph showing the variation of reactance of an inductor with frequency of the applied voltage

View Text Solution

View Text Solution

6. Sketch a graph showing the variation of capacitive reactance with the change in frequency of the a.c. source.

View Text Solution

7. Find the capacitance of the capacitor that would have a reactance of 100Ω when used with an a.c. source of frequency $\frac{5}{\pi}$ kHz.

View Text Solution

8. Define capacitive reactance. Write its SI units.

View Text Solution

9. In a series LCR circuit, the voltage across an inductor, a capacitor and a resistor are 20 V, 20 V and 40 V, respectively. What is the phase difference between the applied voltage and the current in the circuit ?

View Text Solution

10. How much average power, over a complete cycle, does an a.c. source supply to a capacitor ?

View Text Solution

11. For an ideal inductor, connected across a sinusoidal a.c. voltage source, state which one of the following quantity is zero :

(i) instantaneous power,

(ii) average power over full cycle of the a.c. voltage source.

View Text Solution

12. When an a.c. source is connected across an ideal inductor,show on a graph the nature of variation of the voltage and the current over one complete cycle.

View Text Solution

13. What is wattless current ?

View Text Solution

14. The instantaneous current and voltage of an a.c. circuit are given by 1 = 10 sin 300 t A and V = 200 sin 300 t V. What is the power dissipation in the circuit ?

View Text Solution

15. The instantaneous current and voltage of an a.c. circuit are given by I = 10 sin 314 t A and $V = 50 \sin\left(314t + \frac{\pi}{2}\right)V$. What is the power dissipation in the circuit ?

View Text Solution

16. State the conditions under which power factor is (i) maximum, and (ii) minimum.

View Text Solution

17. Can the instantaneous power output of an a.c. source ever be negative ? Can the average power output be negative?

View Text Solution

18. How does the sign of the phase angle o, by which the supply voltage leads the current in an LCR series circuit, change as the supply frequency is gradually increased from very low to very high values ?

View Text Solution

19. A bulb and a capacitor are connected in series to an a.c. source of variable frequency. How will the brightness of the bulb change on increasing the frequency of the a.c. source. Give reason.

View Text Solution

20. The power factor of an a.c. circuit is 0.5. What will be the phase difference between voltage and current in this circuit ?

View Text Solution

21. Define 'quality factor of resonance in series LCR circuit. What is its SI unit?

View Text Solution

22. Can a transformer be used in d.c. circuits ? Why?

View Text Solution

23. Why is core of a transformer laminated one ?

View Text Solution

24. What is the function of a step up transformer ?

View Text Solution

25. Which physical quantity remains unchanged in a transformer ?

View Text Solution

26. Write any two factors responsible for energy losses in actual transformers.

View Text Solution

27. Mention the two characteristic properties of the material suitable for making core of a transformer.

View Text Solution

28. Why is the use of a.c. voltage preferred over d.c. voltage ? Give two reasons.

View Text Solution

Short Answer Questions

1. Distinguish between the terms 'average value' and 'rms value of an alternating current. The instantaneous current from an a.c. source is I = 5 sin (314 t) ampere. What are the average and rms values of the current ?

View Text Solution

2. An a.c. voltage V=Vm sin ot is applied across an inductor L. Obtain an expression for current I.

View Text Solution

3. Prove that the current flowing through an ideal inductor connected across a.c. source lags behind the voltage in phase by $\frac{\pi}{2}$.

View Text Solution

4. An a.c.source is connected to a capacitor of capacitance C. Find the expression for current flowing through it.

View Text Solution

5. Explain why the reactance offered by an inductor increases with increasing frequency of an alternating voltage.

View Text Solution

6. Explain why the reactance offered by a capacitor decreases with increasing frequency of an alternating voltage

View Text Solution

7. What is a phasor ? What is its use in a.c. circuit ? Draw a phasor diagram for pure resistive a.c. circuit.

View Text Solution

8. Draw phasor diagrams showing phase relationship between voltage and current in an a.c. circuit containing

(a) a pure inductor only, and

(b) a pure capacitor only. Also show graphs of V and I versus time t

View Text Solution

9. (a) The graphs (i) and (ii) represent the variation of the opposition offered by the circuit elements to the flow of alternating current with frequency of the applied emf. Identify the circuit element corresponding to each graph.

(b) Write the expression for the impedance offered by the series combination of above two elements connected across the a.c. source. Which will be ahead in phase in this circuit, voltage or current ?

View Text Solution

10. Draw the phasor diagram for a series RC circuit connected to an a.c. source.

View Text Solution

11. (i) Draw the graphs showing variation of inductive reactance and capacitive reactance with frequency of applied a.c. source.

(ii) Can the voltage drop across the inductor or the capacitor in a series LCR circuit be greater than the applied voltage of the a.c. source ? Justify your answer.

View Text Solution

12. An inductor L of reactance Xz is connected in series with a bulb B to an a.c. source as shown in the Fig. 7.19. Briefly explain how does the brightness of the bulb change, when

(i) number of turns of the inductor is reduced ?

(ii) a capacitor of reactance Xc = X, is included in series in the same circuit?

(iii) an iron rod is inserted inside the inductor?

View Text Solution

13. An electric lamp having coil of negligible inductance connected in series with a capacitor and an a.c. source is glowing with certain brightness. How does the brightness of the lamp change on reducing the (i) capacitance, and (ii) the frequency ? Justify your answer.

View Text Solution

14. A capacitor 'C', a variable resistor 'R' and a bulb 'B' are connected in series to the a.c. mains in circuit as shown in Fig. 7.21. The bulb glows with some brightness. How will the glow of the bulb change if (i) a dielectric slab is introduced between the plates of the capacitor, Mains keeping resistance R to be the same, (ii) the resistance R is increased keeping the same capacitance ?

View Text Solution

15. An a.c. source, of voltage $V = V_m \sin \omega t$, is applied across a series LCR circuit. Draw the phasor diagram for the circuit when the

(i) capacitive reactance exceeds the inductive reactance,

(ii) inductive reactance exceeds the capacitive reactance.

View Text Solution

16. Define the quality factor in an a.c, resonant circuit. Why should the quality factor have high value in receiving circuits ? Name the factors on which it depends.

View Text Solution

17. When an a.c. source is connected to an ideal inductor, show that the average power supplied by the source over a complete cycle is zero.

View Text Solution

18. Mention the factors on which the resonant frequency of a series LCR circuit depends. Plot a graph showing variation of impedance of a series LCR circuit with the frequency of the applied a.c. source.

View Text Solution

19. When an a.c. source is connected to an ideal capacitor, show that the average power supplied by the source over a complete cycle is zero.

View Text Solution

20. (a) For a given a.c. $I = I_m \sin \omega t$ show that the average power dissipated in a resistor over a complete cycle is R$\frac{1}{2} I_m^2 R$

(b) A light bulb is rated 100 W for a 220 V a.c. supply. Calculate the resistance of the bulb.

View Text Solution

21. An alternating voltage given by V= 140 sin 314 t is connected across a pure resistor of 50 2. Find **(i) the frequency of the source.**

(ii) the rms current through the resistor.

View Text Solution

22. A 2 uF capacitor, 100 Ω resistor and 8 H inductor are connected in series with an a.c. source. Find the frequency of the a.c. source for which the current drawn in the

circuit is maximum. If the peak value of emf of the source is 200 V, calculate the

(i) maximum current, and (ii) inductive and capacitive reactance of the circuit at resonance.

View Text Solution

23. Mention various (any four) energy losses in a transformer.

View Text Solution

24. State the underlying principle of a transformer. How is the large scale transmission of electric energy over long distances done with the use of transformers ?

View Text Solution

25. An a.c. voltage V=Vm sin ωt is applied across a

(i) series RC circuit in which the capacitive impedance is 'a' times the resistance in the circuit,

(ii) series RL circuit in which the inductive impedance is 'b' times the resistance in the circuit. Calculate the value of the power factor of the circuit in each case.

View Text Solution

26. A capacitor and a resistor are connected in series with an a.c. source. If the potential difference across C, R are 120 V, 90 V, respectively and if the rms current of the

circuit is 3 A, calculate the (i) impedance, (ii) power factor of the circuit.

View Text Solution

27. An a.c. voltage of 100 V, 50 Hz is connected across a 20 Ω resistance and a 2 mH inductor in series. Calculate (1) impedance of the circuit, (ii) rms current in the circuit.

View Text Solution

28. An inductor 200 mH, a capacitor C and a resistor 10 ohm are connected in series with a 100 V, 50 s^{-1} a.c. source. If the current and voltage are in phase with each other, calculate the capacitance of the capacitor.

View Text Solution

29. The Fig. 7.24 shows a series LCR circuit connected to a variable frequency 200 V source with L = 50 mH, C = 80 uF and R = 40 Ω. Determine(i) the source frequency which drives the circuit in resonance, (ii) the quality factor Q of the circuit.

View Text Solution

30. When an alternating voltage of 220 V is applied across a device X, a current of 0.25 A flows which lags behind the voltage in phase by $\frac{\pi}{2}$ rad. If the same voltage is applied

across another device Y, the same current flows but now it is in phase with the applied voltage.

(a) Name the devices X and Y.

(b) Calculate the current flowing in the circuit when the same voltage is applied across the series combination of X and Y.

View Text Solution

31. A 200 mH (pure) inductor and a 5uF (pure) capacitor are connected, one by one, across a sinusoidal a.c. voltage source V= 70.7 sin (1000 t) volts. Obtain the expression for the current in each case.

View Text Solution

32. Calculate the current drawn by the primary of a transformer, which steps down 200 V to 20 V to operate a device of resistance 10Ω. Assume the efficiency of the transformer to be 80%.

View Text Solution

Long Answer Questions I

1. Define the term rms value of a.c. Derive the relation between rms and peak value of a.c.

View Text Solution

2. Three electrical circuits having a.c. sources of variable frequency are shown in Fig. 7.25. Initially the currents flowing in each of these is same. If the frequency of the applied a.c. source is increased, how will the current flowing in these circuits be affected ? Give reasons for your answer.

View Text Solution

3. Derive an expression for the impedance of an a.c. circuit consisting of an inductor and a resistor.

View Text Solution

4. A source of a.c. voltage $V = V_m \sin \omega t$ is connected to a series combination of a capacitor C and a resistor R. Draw the phasor diagram and use it to obtain the expression for (i) impedance of the circuit, and (ii) phase angle.

View Text Solution

5. (a) The graphs (i) and (ii) shown in the Fig. 7.30 represent variation of opposition offered by the circuit elements, X and Y, respectively to the flow of alternating current versus the frequency of the applied emf. Identify the elements X and Y.

(b) Write the expression for the impedance offered by the series combination of these two elements connected to an a.c. source of voltage V=$V_m \sin \omega t$. Show on a graph the variation of the voltage and the current with 'wt' in the circuit.

View Text Solution

6. For a given a.c. circuit, distinguish between resistance, reactance and impedance.

View Text Solution

7. Discuss the phenomenon of resonance in a LCR series a.c. circuit.

View Text Solution

8. The graphs, shown in Fig. 7.32 depict the variation of current amplitude I_m vs angular frequency ω for two different series LCR circuits. Observe the graphs carefully.

(i) State the relation between the L and C values of the two circuits, when the current in the two circuits is maximum.

(ii) Indicate the circuit for which

(a) power factor is higher,

(b) quality factor Q is larger. Give reasons for each case.

View Text Solution

9. In a series LCR circuit connected to an a.c. source of variable frequency and voltage $V = V_m \sin \omega t$ draw a plot showing the variation of current (I) with angular frequency (w) for two different values of resistance R_1 and $R_2 (R_1 > R_2)$. Write the condition under which the phenomenon of resonance occurs. For which value of the resistance out of the two curves, a sharper resonance is produced ? Define Q-factor of the circuit and give its significance.

View Text Solution

10. What do you understand by "sharpness of resonance" in a series LCR circuit ? Find expression for Q-factor of the circuit.

View Text Solution

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

View Text Solution

12. Show diagrammatically two different arrangements used for winding the primary and secondary coils in a transformer. Assuming the transformer to be an ideal one, write expressions for the ratio of its

(i) output voltage to input voltage.

(ii) output current to input current in terms of the number of turns in the primary and secondary coils. Mention two reasons for energy losses in an actual transformer.

View Text Solution

13. 11 kW of electric power can be transmitted to a distant station at (i) 220 V or (ii) 22,000 V. Which of the two modes of transmission should be preferred and why ? Support your answer with possible calculations.

View Text Solution

14. When an inductor L and a resistor R in series are connected across a 12 V, 50 Hz supply, a current of 0.5 A flows in the circuit. The current differs in phase from applied voltage by $\frac{\pi}{3}$. radian. Calculate the value of R.

View Text Solution

15. (a) Determine the value of phase difference between the current and the voltage in the given series LCR circuit.

Fig. 7.36

(b) Calculate the value of the additional capacitor which may be joined suitably to the capacitor C that would make the power factor of the circuit unity.

View Text Solution

16. A circuit, containing an 80 mH inductor and a 250 uF capacitor in series, is connected to a 240 V, 100 rad s^{-1} supply. The resistance of the circuit is negligible.

(i) Obtain rms value of current.

(ii) What is the total average power consumed by the circuit ?

View Text Solution

17. An inductor of unknown value, a capacitor of 100 uF and a resistor of 10 Ω are connected in series to a 200 V, 50 Hz a.c. source. It is found that the power factor of the

circuit is unity. Calculate the inductance of the inductor and the current amplitude.

View Text Solution

18. The figure 7.37 shows a series LCR circuit L = 5.0 H, C = 80 uF, R= 40 Ω connected to a variable frequency 240 V source. Calculate

(i) The angular frequency of the source which drives the circuit at resonance.

(ii) The current at the resonating frequency.

(iii) The rms potential drop across the capacitor at resonance.

View Text Solution

19. Given below [Fig. 7.38) are two electric circuits A and B. Calculate the ratio of power factor of the circuit B to the power factor of circuit A.

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20. An inductor 200 mH, capacitor 500 uF, resistor 10 Ω are connected in series with a 100 V variable frequency a.c. source. Calculate :

(i) frequency at which power factor in the circuit is unity,

(ii) current amplitude at this frequency,

(iii) Q-factor.

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21. Obtain the resonant frequency 0, of a series LCR circuit with L = 2.0 H, C = 32 uF and R = 10 Ω . What is the Q-value of this circuit?

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22. (a) An a.c. circuit as shown in the Fig. 7.39 has an inductor of inductance L and a resistor of resistance R connected in series. Using the phasor diagram, explain why the voltage in the circuit will lead the current in phase.

(b) The potential difference across the resistor is 160 V and that across the inductor is 120 V. Find the effective value of the applied voltage. If the effective current in the circuit by 1.0 A, calculate the total impedance of the circuit.

(c) What will be the potential difference in the circuit when direct current is passed through the circuit ?

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23. An inductor of 200 mH, capacitor of 400 uF and a resistor of 10 Ω are connected in series of a.c. source of 50 V of variable frequency. Calculate the

(a) angular frequency at which maximum power dissipation occurs in the circuit and the corresponding value of the effective current.

(b) value of Q-factor of the circuit.

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24. In the circuit shown in Fig. 7.41, calculate

(a) the capacitance of the capacitor if the power factor of the circuit is unity, and

(b) the Q-factor of the circuit. Given that the angular frequency of the a.c. source is $100s^{-1}$.

(C) Also calculate the average power dissipated in the circuit.

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25. The primary coil of a transformer has 200 turns and the secondary has 1000 turns. If the power output from the secondary at 1000 V is 9 kW, calculate

(i) the primary voltage, and

(ii) the heat loss in the primary coil if the resistance of primary is 0.2 Ω and the efficiency of the transformer is 90%.

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26. A town, situated 20 km away from a power plant generating power at 440 V, requires 600 kW of electric power at 220 V. The resistance of the two-wire line carrying power is 0.4 Ω per km. The town gets power from

the line through a 3000 - 220 V step down transformer at a substation in the town.

(i) Find the line power losses in the form of heat.

(ii) How much power must the plant supply, assuming there is negligible power loss due to leakage ?

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Long Answer Questions Ii

1. A series LCR circuit is connected to an a.c. source having voltage $V = V_m \sin \omega t$

Derive the expression for the instantaneous current I and its phase relationship to the applied voltage. Obtain the condition for resonance to occur. Define 'power factor'.

State the conditions under which it is (i) maximum, (ii) minimum.

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2. Derive an expression for the impedance of a series LCR circuit connected to an a.c. supply of variable frequency. Plot a graph showing variation of current with the frequency of the applied voltage. Explain briefly how the phenomenon of resonance in the circuit can be used in the tuning mechanism of a radio or TV set.

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3. A device 'X' is connected to an a.c. source $V = V_m \sin \omega t$. The variation of voltage, current and power in one cycle is shown in the given graph:

(a) Identify the device 'X'.

(b) Which of the curves A, B and C represent the voltage, current and the power consumed in the circuit ? Justify your answer.

(c) How does its impedance vary with frequency of the a.c. source ? Show graphically.

(d) Obtain an expression for the current in the circuit and its phase relation with a.c. voltage.

4. (i) An a.c. source of voltage $V = V_m \sin \omega t$ is connected to a series combination of L, C and R. Use the phasor diagram to obtain expressions for impedance of the circuit and phase angle between voltage and current. Find the condition when current will be in phase with the voltage. What is the circuit in this condition called ?

(ii) In a series LR circuit $X_L = R$ and power factor of the circuit is P_1 . When capacitor with capacitance C such that $X_L = X_C$ is put in series, the power factor becomes P_2 . Calculate P_1 / P_2

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5. (a) An a.c. source of voltage $V = V_m \sin \omega t$ is connected across a series combination of an inductor, a capacitor

and a resistor. Use the phasor diagram to obtain the expression for

(i) impedance of the circuit, and

(ii) phase angle between the voltage and the current

(b) A capacitor of unknown capacitor, a resistor of 100Ω and an inductor of self-inductance $L = \frac{4}{\pi^2}H$ are connected in series to an a.c. source of 200 V and 50 Hz. Calculate the value of the capacitance and the current that flows in the circuit when the current is in phase with the voltage.

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6. A device X is connected across an a.c. source of voltage $V = V_m \sin \omega t$. The current through X is given as

$$I = I_{\circ} \sin\left(\omega t + \frac{\pi}{2}\right)$$

(a) Identify the device X and write the expression for its reactance.

(b) Draw graphs showing variation of voltage and current with time over one cycle of a.c. for X.

(C) How does the reactance of the device X vary with frequency of the a.c. ? Show this variation graphically.

(d) Draw the phasor diagram for the device X.

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7. (a) Explain with the help of a labelled diagram, the principle and working of a transformer. Deduce the expression for its working principle.

(b) Name any four causes of energy loss in an actual transformer.

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8. (i) Draw a labelled diagram of a step down transformer. State the principle of its working.

(ii) Express the turn ratio in terms of voltages.

(iii) Find the ratio of primary and secondary currents in terms of turn ratio in an ideal transformer.

(iv) How much current is drawn by the primary of a transformer connected to 220 V supply when it delivers power to 100 V - 550 W refrigerator ?

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9. (a) Draw a labelled diagram of a stepup transformer. Obtain the ratio of secondary to primary voltage in terms of number of turns and currents in the two coils.

(b) 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.

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10. Draw a schematic diagram of a step up transformer. Explain its working principle. Deduce the expression for the secondary to the primary voltage in terms of the number of turns in the two coils. In an ideal transformer,

how is this ratio related to the currents in the two coils ?

How is the transformer used in large scale transmission and distribution of electrical energy over long distances ?

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11. (i) With the help of a labelled diagram, describe briefly the underlying principle and working of a step up transformer.

(ii) A step up transformer converts a low input voltage into a high output voltage. Does it violate law of conservation of energy? Explain.

(iii) Write any two sources of energy loss in a transformer.

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12. The primary coil of an ideal step up transformer has 100 turns and the transformation ratio is also 100. The input voltage and the power are 220 V and 1100 W respectively. Calculate

(i) number of turns in the secondary

(ii) the current in the primary

(iii) voltage across the secondary

(iv) the current in the secondary

(v) power in the secondary.

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Self Assessment Test Section A Multiple Choice Questions

1. A generator produces a voltage that is given by V=240 sin 120t, where t is in seconds. The frequency and rms voltage are (1)

A. 60 Hz and 240 V

B. 19 Hz and 120 V

C. 9 Hz and 170 V

D. 754 Hz and 70 V

Answer: C

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2. The potential difference V and current I flowing through an a.c. circuit are given as $V = 50 \cos \omega t$ and $I = 2 \sin \omega t$, where ω is the angular frequency of a.c. The power dissipated in the circuit is.

A. 100 W

B. zero

C. 25 W

D. 50 W

Answer: D

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3. A 10 Ω resistor, 5 mH inductor coil and a 10 uF capacitor are joined in series, when a suitable frequency alternating current source is joined to this combination, the circuit resonates. If the value of resistance is halved to 5 Ω, the resonance frequency

A. is halved

B. is doubled.

C. remains unchanged.

D. is quadrupled

Answer: C

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4. A variable frequency alternating voltage of constant magnitude is applied across a capacitor. Which of the following graph shows the variation of current set up in the circuit with frequency v?

A.

B.

C.

D.

Answer: A

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Self Assessment Test Section A Fill In The Blanks

1. In a LCR series circuit capacitance is changed from C to 2C. To maintain the resonant frequency unchanged the inductance L be changed to.................

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2. In an a.c. circuit the voltage across an inductance and resistance, joined in series, are 120 V and 160 V respectively. The total voltage applied across the combined circuit is ....

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3. The primary winding of a transformer has 100 turns and its secondary winding has 400 turns. The primary is connected to an a.c. supply of 120 V and the current flowing in it is 10 A. The voltage and the current in the secondary coil, assuming transformer to be an ideal one, are .... respectively.

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Self Assessment Test Section B

1. A 2 uF capacitor, 100 Ω resistor and 8 Hinductor are connected in series with an a.c. source. Find the frequency of the a.c. source for which the current drawn in the

circuit is maximum. If the peak value of emf of the source is 200 V, calculate the (i) maximum current, and (ii) inductive and capacitive reactance of the circuit at resonance.

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2. A bulb of resistance 10 Ω , connected to an inductor of inductance L, is in series with an a.c. source marked 100 V, 50 Hz. If the phase angle between the voltage and current is $\frac{\pi}{4}$. calculate the value of inductance.

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Self Assessment Test Section C

1. A capacitor (C) and resistor (R) are connected in series with an a.c. source of voltage of frequency 50 Hz. The potential difference across C and R are respectively 120 V, 90 V, 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.

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2. (a) In a series LCR circuit connected across an a.c. source of variable frequency, obtain the expression for its impedance and draw a plot showing its variation with frequency of the a.c. source.

(b) What is the phase difference between the voltages across inductor and the capacitor at resonance in the LCR circuit ?

(c) When an inductor is connected to a 200 V d.c. voltage, a current of 1 A flows through it. When the same inductor is connected to a 200 V, 50 Hz a.c. source, only 0.5 A current flows. Explain, why ? Also, calculate the self inductance of the inductor.

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