PHYSICS

BOOKS - MODERN PUBLISHERS PHYSICS (HINGLISH)

ALTERNATING CURRENT

Solved Examples

1. An AC generator is constructed coil of area 2.5 m^2 and 500 turns . Coil rotates with an angular velocity of 60 rad/s. Magnetic field applied on coil is 0.6 T and the resistance of the coil is 500 ω . What is the flux through the coil when the current is zero? What is the flux when the current is maximum ?

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2. An AC generator consists of a coil of 200 turns and area of $5m^2$ rotating at a constant angular speed of 60 rad /s in a uniform magnetic field of 0.05 T. The resistance of the coil is 400 ω . Calculate maximum current drawn from the generator .

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3. An AC generator is constructed using coil of area $2.5m^2$ and 500 turns . Coil rotates with an angular velocity of 60 rad/s . Magnetic field applied on coil is 0.6 T. Resistance of the coil is 500 ohm . Find the rms current in the coil . If we assume that coil is fixed but instead source of magnetic field is rotated around the coil will the generator work. ?

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4. Calculate the instantaneous voltage for AC supply of 220 V and 50 Hz.

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5. Find the rms value of current if the peak value of an alternating voltage applied to a 20

ω resistance is 8 V . Also write the equation for instantaneous current if the voltange frequency is 60 Hz.

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6. In india we use alternating voltage with rms value of 220 V and frequency 50 Hz. (a) Calculate corresponding peak voltage . (b) What minimum time the voltage takes to change from 0 to rms value ? (c) What maximum time will it take to become 0 starting from rms value ?

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7. Electric current in a circuit is given as a function of time as below .

$$I = I_0\left(\frac{3t}{2\tau}\right)$$

Calculate the rms value of current for the time period t=0 to 2τ .

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8. In an AC circuit of 100 Hz, the effective value of current is 6 A. Calculate (i) the peak value of current (ii) mean value of current over half cycle and (iii) value of current 1/ 500 s after it was zero .

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9. A bulb is rated as 55 W and 220 volt . It is connected across the supply of 220 V- 50 Hz. Calculate (a) rms current flowing through the bulb and (b) Peak current flowing through the bulb .

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10. An electric bulb is rated as 55 W for 110 volt DC supply . It is connected across an AC source and its brightness is found to be normal . Calculate peak voltage of AC supply .

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11. Expression for instantaneous value of an alternating voltage is given below:

$\varepsilon = 150 \sin 200\pi t$

where t is the time in seconds .

Calculate (i) the peak value of voltage (ii) rms value of voltage and (iii) frequency of supply.

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12. A 100 Ω iron is connected to an AC source of 220 V 50 Hz . Calculate the time taken by the current to change from its maximum value to rms value .

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13. The current in a discharging LR circuit is given by $I = i_0 e^{-\frac{t}{\tau}}$ where τ is the time constant of the circuit. Calculate the rms current for the period $t = 0$ to $t = \tau$.

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14. A pure inductive circuit with inductance 30 mH is connected to a source of 220 V. Calculate the inductive reactance and rms current in the circuit given the frequency of source is 100 Hz.

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15. A coil has an inductance of 1 henry. (a) At what frequency will it have a reactance of 3142 ohm? (b) What should be the capacity of a condenser which has the same reactanc at frequency ?

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16. An inductor of inductance 1 H is connected across an A C supply . The current in the circuit is a sinusoidal function of time with amplitude 0.5 A and frequency 50 Hz. Calculate the effective potential difference across the inductor .

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17. A capacitor has a capacitance of $\frac{2}{\pi}\mu F$. Calculate its reactance at a frequency of (i) 100 Hz and (ii) 10^4 Hz.

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18. An emf $\varepsilon = 220$ sin 50 π t is applied to a circuit which consistas of an inductance of $\frac{1}{2\pi}$ H. Write an equation for instantaneous current in the circuit . Calculate the reading of

an AC ammeter when it is connected in the circuit .

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19. A capacitor of capacitance 2 μF is connected to an osillator giving an output voltage e = 20 sin ω t volt . If $\omega = 10\pi$ rad/ s write an equation for instantaneous current through the circuit .

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20. When an inductor L and a resistor R are connected across 12 V, 50 Hz a.c. supply, a current of 0.5 A flows through the circuit. What is the value of R if current differs in phase from applied voltage by $\pi / 3$ radian?

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21. A coil of resistance 500 Ω and inductance 1.4 H is connected to an alternating voltage supply of frequency $100 / \pi$ Hz. What is the phase difference between the voltage and current in the circuit ?

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22. A coil when connected across a 10 V d.c. supply draws a current of 2 A. When it is connected across 10 V - 50 hz a.c. supply the same coil draws a current of 1 A. Explain why? Hence determine self inductance of the coil.

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23. A 50 V-10 W electric lamp is connected across an AC source of 100 V - 50 Hz.

(i) Find the inductance of the choke required .

(ii) If a resistoer is used in place of the choke coil to obtain the same result find its value.

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24. A 130 V 50 Hz AC supply is connected to a series combination of an inductance of $0.05/\pi$ H and a resistance of 12 Ω . Calculate the magnitude of current in the circuit and phase difference between the current and the voltage.

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25. An AC circuit is shown below consisting of series combination of an inductor and a resistor .

(i) Calculate the rms value of applied voltage.

(ii) Also calculate the total impedance of the circuit if the rms current in the circuit be 2 A.

(iii) What will be the potential difference in the circuit if the direct current is passed?

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26. A series combination of circuit elements X and Y is connected across AC mains. The current is ahead of voltage by a phase difference of π /3 radians . The element Y is a resistor of 150 Ω . Name the circuit element X. Calculate the rms value of current if rms value of voltage is 150 V.

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27. Calculate the rading in the voltmeter and the ammeter in the circuit shown below :

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28. A capacitor and an inductor coil are connected in series with one AC source of rms voltage 24 V and variable frequency . Maximum current that we get is 6A by changing the frequency of the source . Now the inductor coil is taken out from the circuit and separated connected to a DC source of 12 V and internal resistance 8 Ω . Find the current drawn from the battery by the inductor coil.

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29. A 10 V -10 W lamp is to run on 220 V -50 Hz AC mains . What will be the required value of capacitance of a capacitor to run the lamp ?

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30. For a light bulb rated at 110 W for a 200 V supply calculate its resistance and peak voltage of the source. Also calculate the runs current through the bulb.

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31. In a series LCR circuit shown below the power factor is unity . Calculate the capacitance C of the capacitor.

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32. In an AC circuit a 100 m H inductor and a 80 μF capacitor are connected in series across a 230 V 50 Hz supply. The circuit has a resistance of 20 Ω. Calculate the average power transferred to each element of the circuit and the total power absorbed .

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33. One 2 ohm resistor is connected in series with an inductor of reactance 1Ω to a 5 V (rms) A C source . Find the average power dissipated in the circuit .

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34. A coil when connected in a circuit having alternating voltage of frequency 50 Hz allows a virtual current of 5 A to flow through it. Power consumed in the coil is 250 W .

Calculate the inductance of the coil if the virtual potential difference across it is the virtual potential difference across it is 110 V.

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35. A circuit draws a power of 600 W from an AC source of 200 V 50 Hz . The power factor of the circuit is 0.6 . The current lags behing the voltage . What value of capacitance should be connected in the circuit to bring its power factor to unity?

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36. An AC source of rms voltage 220 V and variable frequency is connected across a series combination of 5 H inductance $80\mu F$ capacitance and 40Ω resistance . Calculate frequency which can drive the circuit to resonance. What will be the impedance of the circuit for this frequency and peak current ?

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37. A resistor of resistance 400 ohm and a capacitor of reactance 200 ohm are connected in series of a 200 V, 50 Hz source. If the current in the circuit is 0.49 A, find the voltage across the resistor and capacitor. What is the value of inductance required so that voltage and current are in phase ?

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38. A resistor of resistance 400 Ω and inductor of inductacne 100 mH are connected imn series along with variable capacitor . Frequency of AC source is 1000 Hz. What magnitude of capacitance is required to generate maximum current in the circuit ?

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39. A radio wave of wavelength 290 m can be transmitted through a transmission centre . If

a condenser of capacity 3.5 μF is used what is the inductance of the required coil for resonance . Take speed of light $= 3 \times 10^8$ m/s

.

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40. A series LCR circuit is shown in the figure below.

Determine the source frequency which drives the circuit in resonance . Also obtain the value of Q - factor of the circuit.

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41. A series LCR circuit resonates at a frequency of 850 Hz. If the half power points are obtained at frequencies $f_1 = 750$ Hz and f_2 = 840 Hz then calculate the Q - factor of the circuit and bandwidth.

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42. When one inductor coil is connected to a 20 V DC battery then it draws a steady - state current of 10 A . This inductor coil is connected across AC supply of rms voltage 10 V and one capacitor in series . It if found that current and vlotage are in same phase . What will be the rms current in the circuit ?

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43. An LC circuit oscillating at natural frequency conssts of an inductor of inductance 30 m H and a capacitor of capacitance $60\mu F$. The maximum value of instantaneous charge on capacitor in the circuit is 200 μC . If I is the current in the circuit then answer the following :

(i) What is the value of $\frac{dI}{dt}$ when charge is 150 μC?

(ii) Calculate the value of I when charge is 200 μC .

(iii) Find the maximum value of I.

(iv) For what value of q I is half of its maximum value ?

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44. An electromagnetic wave of wavelength 300 metere canbe transmitted by a transmission centre. A condenser of capacity 2.5 μF is available. Calculate the inductance of the required coil for a resonant circuit. Use $\pi^2 = 10.$

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45. Find the energy dissipated in a time interval of 200 s when series AC circuit of 20 mH inductance 100 μF capacitance and 50 Ω resistance is connected to an AC source 12V (rms) and 50 Hz.

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46. A capacitor of 50 μF is first charged with a 100 V supply connected across it and then after the supply is removed it is connected across an inductor . As a result a maximum current of 2 A flows through the inductance . What is the value of inductance ?

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47. An ideal step -up transformer has a primarycoil of 120 turns . The transformation ratio is 100 . If the input voltage and power are 230 V and 1000 W respectively, calculate

(i) number of turns in the secondary coil .

(ii) voltage across the secondary coil.

(iii) current in the primary coil .

(iv) current in the secondary coil.

(v) power in the secondary coil.

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48. How much current is drawn by the primary coil of a transformer which steps down 220 V to 22 V to operate device with an impedance of 220 ohm.

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49. An ideal transformer is connected to a 250 V AC mains and its output voltage is 25 V . This transformer is then used to light a bulb with ratings 60 W , 25 V. Calculate the current in the primary coil of the circuit.

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50. The primary coil of a transformer has 200 turns and its secondary coil has 22,000 turns . It is connected to a 220 V AC source at the input and a resistance of 110 `kOmega1 is connected across the output . What is the output potential difference per turn and power delivered to the load ?

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51. A transformer is used to step down mains supply of 220 V to 22 V. Its primary draws a current of 6 A and secondary draws a current of 50 A . Calculate the efficiency of the transformer .

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52. A 8 k W transformer has 15 turns in its primary windings and 120 turns in its secondary windings . When an AC voltage $\varepsilon = 500$ sin 314 t is applied across its primary windings find

(i) maximum value of flux.

(ii) maximum value of secondary voltage.

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53. A town situated 20 kW away from a power plant generating power at 440 V requires 600 KW of electric power at 200 V. The resistance of two wire lines carrying poweris 0.4Ω per km. The town gets power from the line through a 3000-220 V step down transformer at a substation in the town. Find line power losses in the form of heat. How much power must the plant supply assuming that there is negligilbe power loss due to leakage ?

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54. 11 kW of electric power can be transmitted to a distant station at (i) 220 V (ii) 22000 V. Which of the two transmission modes be preferred and why ? Support your answer with calculations.

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Practice Problems

1. Find the peak value and mean value of current over a half cycle if effective current in 40 Hz AC circuit is 7 A .

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2. Calculate the root mean square value of current if the instantaneous current in a circuit connected across an AC source is given by $I = 5 \sin 31.4\, t$.

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3. Effective value of current in a circuit connected across an AC source at 60 Hz is 8A . Find the value of current 5×10^{-3} s after it was zero .

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4. Calculate the peak value of voltage and mean value of voltage during a positive half cycle in an AC circuit with root mean square value of voltage $50\sqrt{2}$ V.

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5. A light bulb is rated at 100 W for a 220 V supply. Find

(a) the resistance of the bulb.

(b) the peak voltage of the source

(c) the rms current through the bulb.

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6. A alternating voltage given by $V = 140 \sin 314t$ is connected across a pure resistor of 50 ohm. Find the rms current through the resistor.

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7. A resistor of resistance 50 Ω is connected to a power source at 220 V. Calculate the peak voltage and average voltage over half cycle if frequency of source is 50 Hz. Also calculate the rms value of current.

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8. A resistor of resistance 100Ω is connected across an alternate power source given by V = 100 sin 3.14 t . Calculate the rms value of current and frequency of the source.

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9. A 10 Ω resistor is connected across an alternating power supply of 110 V. Calculate the time taken by the current to reach the root mean square value of current from its maximum value . The frequency of the source is 50 Hz.

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10. An inductor of 5 m H is connected in series with a resistor of resistance 4 Ω . A battery of

2 V is connected across the circuit through a switch . Calculate the rate of growth of current just after the switch is on .

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11. Calculate the reactance of 10 m H inductor connected to an AC source with frequency of 100 Hz.

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12. An inductor of negligible resistance and inductance 1 H is connected across an AC power supply of 200 V . The frequency of source is 50 Hz. Calculate the value of current passing through it.

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13. A pure inductor of 25.0 mH is connected to a source of 220 V. Find the inductive reactance and rms current in the circuit if the frequency of the source is 50 Hz.

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14. An inductor of inductance 5 H is connected across an alternating power supply of 220 volts . The frequency of source is 50 Hz. Calculate the maximum value of curent in the inductor .

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15. Calculate the value of inductance of an inductor connected across an alternating power supply of 220 V of frequency 50 Hz such that maximum current flowing through it is 1 A.

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16. Calculate the rms value of current passing through a 0.5 μF capacitor connected across an alternating power supply of 220 V. The frequency of power supply in marked 50 Hz.

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17. A $2\mu F$ capacitor is connected across an AC power supply . Calculate the frequency of the supply if the capacitive reactance of the capacitor is 10 Ω .

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18. With increase in frequency of an AC supply, the capacitive reactance:

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19. A $15.0\mu F$ capacitor is connected to a 220 V, 50 Hz source. Find the capacitive reactance and the current (rms and peak) in the circuit. If the frequency is doubled, what happens to the capacitive reactance and the current ?

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20. A capacitor is connected to an AC supply at 30 Hz. The reactance of the capacitor is 80 Ω .

At what frequency its reactance will be 120 Ω ?

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21. A capacitor of capacitance $10\mu F$ is connected to a 220 V , 30 Hz alternating current source . Calculate the peak value of voltage across the capacitor . Also calculate the rms value of current in the circuit .

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22. An inductor of inductance L Henry is connected to an AC supply of 12 V . The frequency of source is 50 Hz and current in the inductor is 0.5 A. When the same inductor is connected across a direct current supply of 12 V it draws the current of 1.5 A . Find the value of L .

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23. A resistor and an inductor are connected in series across an AC power supply . The value of current drawn from the source is 2 A . Calculate the net impedance of circuit if voltage across inductor and resistor are 100 V and 80 V respectively.

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24. A series RL circuit is connected to an AC power supply of 120 V . The frequency of source is 50 Hz. Calculate the phase difference between the current and voltage in the circuit if values of R and L are 10 Ω and 0.01 H, respectively. Also find the current in the circuit .

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25. A 50 mH inductor is connected across a power supply of emf 130 sin (314 t) volts. Calculate the resistance of the inductor if maximum current in the circuit is 8 A.

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26. An inductor of resistance 80 Ω is connected to an AC source of frequency 50 Hz . Calculate the inductance if the impedance of circuit is 150 Ω .

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27. An RL circuit is connected to 12m V , 30 Hz AC supply . The voltage leads the current by

60° . Calculate the value of R and L if current flowing in the circuit is 0.5 A .

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28. A $10\mu F$ capacitor and a 15Ω resistor are connected in series across a 220 V 50 Hz source . Calculate the value of rms current .

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29. A resistor of $200\Omega$and a capacitor of $15.0\mu F$ are connected in series to a $220V$, $50Hz$ source.

(a) Calculate the current in the circuit .

(b) Calcutalte the voltage (rms) across the resistor and the inductor. Is the algebraic sum of these voltages more than the source voltage? If yes, resolve the paradox.

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30. In a series RC circuit connected across an AC source of 220 V 50 Hz calculate the rms voltage across resistor and capacitor if values of R and C are 100 Ω and $20 \mu F$ respectively .

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31. In an RC series circuit connected across and AC source of 150 V 70 Hz, the value of R is 820 Ω and voltage across it is 100V. Calculate the voltage drop across capacitor connected in series.

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32. धारतीय प्रतिघात (capacitive reactance) का मात्रक है

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33. A $10\mu F$ capacitor and a 15Ω resistor are connected in series and are connected across a DC supply of 100 V. Calculate the impedance of circuit.

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34. A 4 μF capacitor and a 500 Ω resistor are connected in series a power supply 20 V , 30 Hz . Calculate the phase angle between voltage and current .

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35. A series RLC circuit is connected to an AC supply 220 V, 50 Hz. The value of R is 10 Ω . The value of capacitive reactance of capacitor and incuctive reactance of inductor are 15 Ω and 20Ω respectively . Calculate the value of current in the circuit.

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36. A 50Ω resistor an inductor and a capacitor are connected to an AC source 220 V. The frequency of source is 50 Hz. Calculate the current in the circuit if voltage across resistor capacitor and inductor is 220 V, 260 V and 260 V, respectively.

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37. A 50Ω resistor is connected in series with an inductor of 0.2 H and capacitor with capacitive reactance 40Ω . The combination is further connected to an AC source 180 V , 50 Hz. What will be the phase angle between current and voltage ? Also find the value of rms current in circuit.

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38. A 50 Ω resistor is connected in series to an inductor and a capacitor to an AC source 220 V , 50 Hz . Calculate the value of inductance and capacitance if voltages across resistor inductor and capacitor are 75 V , 210 V and 420 V respectively.

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39. A generator of internal resistance 1800 Ω is connected in series with a 10 H inductor and $2\mu F$ capacitor . The emf across generator is given by relation V = 200 sin $80\pi t$. Calculate the impedance of the circuit and frequency of the generator .

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40. A bulb is connected to a 100 V DC supply . It is found that the current of 5 A flows in the circuit. The same bulb is connected to an AC supply at 120 V . The frequency of source is 50 Hz. Calculate the inductance of coil required so that the lamp glows in an AC circuit too.

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41. An inductor of negligible resistance and a 50 Ω resistor are connnected in series across an AC supply of 100 V. Calculate the voltage across the inductor if voltage across the resistor is 40 V.

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42. A pure inductor of 25.0 mH is connected to a source of 220 V. Find the inductive reactance and rms current in the circuit if the frequency of the source is 50 Hz.

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43. A 20 watt electric lamp can be operated at a 50 V DC supply . Calculate the value of capacitance of the capacitor required to run the given lamp at 220 V, 50 Hz AC supply.

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44. A 50 Ω resistor a $120\mu F$ capacitor and an inductor of inductance 0.2 H are connected in series across an AC source of 10 V, 50 Hz. Calculate the average power and energy dissipated in 500 s.

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45. An inductor is connected in series with an capacitor and a resistor to an AC supply of V volts. The readings in voltmeters connected across inductor capacitor and resistor are 120 V, 50 V and 80 V respectively . Calculate the value of V and hence also find the power factor.

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46. A square coil of side 10 cm is rotating about its vertical axis in a region of uniform magnetic field of 0.2 T. The angular speed of coil is 35 rad s^{-1}. Calculate the rms value of emf induced in the coil. Also find the power dissipated if resistance of coil is 6 ω . Number of turns in coil is 10.

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47. A series LCR circuit with an inductor a capacitor and a resistor of 80 Ω is connected to an AC source of 180 V and angular frequency of 250 rad s^{-1} . Suddenly the inductor is removed from the circuit and it is found that current leads the voltage by 45°. Similarly when only capacitor is removed from the circuit it is found that the current lags behind the voltage by 45°. Find the power dissipated in the circuit.

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48. A capacitor and resistor of 12Ω are connected in series with an AC supply 100 V, 50 Hz. Calculate the capacitance of the capacitor if power factor of the RC circuit is 0.8.

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49. A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which $R = 3 ohm$, $L = 25.48 mH$ and $C = 796 \mu F$. Find (a) the impedance of the circuit (b) phase difference between the voltage across the source and current (c) the power dissipated in the circuit and (d) the power factor.

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50. Suppose the frequency of the source in the above example can be varied (a) What is the frequency of the source at which resonance occurs ? (b) Calculate the impedeance, the current and power dissipated at the resonant condition.

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51. Calculate the capacitance of a capacitro connected across an alternating power supply with the reactance equal to the reactance of an inductor coil of 1H. The frequency of power supply is 200 Hz.

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52. A series LCR circuit is connected top an AC power source of 220 V , 50 Hz. The values of L and R are 0.41 H and 80Ω respectively. What is the value of C if current and voltage are in phase ?

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53. A 200Ω resistor is connected to a 220 V, 50 Hz AC supply. Calculate rms value of current in the circuit. Also find phase difference between voltage and the current.

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54. A series LCR circuit is connected across an AC power supply of 220 V. The frequency of source is variable . The vaues of L and C are 0.320 H and 0.32 μF respectively. Calculate the value of frequency to be applied such that voltage across R is maximum .

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55. A resistor of 80Ω in a current element X is connected across an AC supply of 150 V.

Calculate the rms value of current in the circuit if current is ahead of voltage in phase by 45° . Also identify the element X.

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56. A 80 Ω resistor a 2 H inductor and a 5.07×10^{-6} F capacitor are connected in series to an AC power supply of 220 V, 50 Hz. Calculate the potential difference across the resistor.

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57. In a series LCR circuit with value of R = 15 $\Omega, L = 5H, C = 100\mu F$ an AC power supply with variable frequency is connected . Calculate the value of angular frequency of the source at which the circuit is in resonance and current at the same frequency . The `V_("rms") value of voltage in the circuit is 220 V.

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58. A series LCR circuit with $L = 4.0H, C = 100\mu F$ and $R = 60\Omega$ is connected to a varialbe frequency 240 V source. Calcalate

(i) angular frequency of the source which drives the circuit in resonace,

(ii) current at the resonating frequency,

(iii) rms potential drop across the inductance at resonance.

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59. In a series LCR circuit with variable inductor 80 nF capacitor and 70 ohm resistance an AC source is connected . Calculate the value of inductor if current drawn into the circuit is maximum. The frequency of AC source is 1 kHz.

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60. A 5 H inductor 80Ω resistor and $3\mu F$ capacitor are connected in series with an AC source with variable frequency such that the value of current is maximum in the circuit . Calculate the value of inductive reactance capacitive reactance and total impedance . Also calculate the value of peak current if value of peak emf of source is 220 V.

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61. A $2\mu F$ capacitor, 100 ohm resistor and 8 H inductor are connected in series with an a.c. source. What should be the frequency of soure for which the current drawn in the circuit is maximum? If peak value of emf of the source is 200 V, find the maximum current, inductive reactance, capactive reactance, total impedance, peak value of current in the circuit. What is the phase relation between voltages across inductor and resistor ? Also, give the phase relation between voltages acorss inductor and capacitor.

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62. A 70 Ω resistor is connected in series to a capacitor and an inductor . The value of capacitive and inductive reactance is 7Ω . The combination is connected to a power supply of 100 V, 50 Hz in series. A voltmeter is connected in parallel across capacitor and inductor as shown in the figure. What will be the reading of the voltmeter?

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63. An inductor of 0.2 H is connected to a 5 V battery. The current flowing through the inductor is 10 A. The inductor is now removed from the battery and is connected in series to a capacitor to a 5 V AC source. Calculate the rms value of current if current and voltage in circuit is in phase.

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64. A 0.05 H inductor is connected to a fully charged 80 μF capacitor. The maximum current in the inductor is found to be 2 A. Calculate the voltage across capacitor while it was getting charged.

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65. A capacitor is connected to a 2 mH inductor in series with an AC source. Calculate the value of maximum current in the circuit if maximum energy stored in inductor is 28×10^{-6} J.

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66. A 0.2 H inductor is connected across an AC power supply . The current in the circuit increases from 0 to 3.4 A. Calculate the energy stored in magnetic field of inductor during that period.

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67. A $6 \mu F$ capacitor is connected to an AC source of frequency 100 Hz . Calculate the rms value of voltage if current in the circuit is 1.2 A.

Also calculate the average energy stored in the capacitor.

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Conceptual Questions

1. The average value of alternating current over a complete cycle is

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2. What can we say about an LR circuit with a large value of time constant ?

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3. What can we say about an RC cirucit with a small value of time constant ?

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4. An alternating power of frequency 20 cycles per second is used to supply power to an electric bulb. Can we see the fluctuation in the bulb. ?

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5. What would be the equivalent reactance of a capacitor and inductor when these are connected to a DC source ?

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6. What is wattless current ?

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7. Suppose we have a transformer which converts 220 V AC to 12 AC. In the transformer when we apply 220 V DC voltage then usually coil is burned. Why ?

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8. The reactance of a circuit is zero It is possible that the circuit contains

(i) an inductor and a capacitor

(ii) an inductor but no capacitor

(iii) a capacitor but no inductor

(iv) neither an inductor nor a capacitor .

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9. In an AC circuit , it if found that the current is zero when voltage is at its maximum. Which components may be present in the circuit ?

10. A bulb a capacitor is connected in series across an alternating power supply as shown in the adjoining figure. How will the current through bulb changes when capacitor is immersed in a dielectric liquid

11. Two identical electric bulbs X and Y are connected in two different circuits. Bulb X is connected to an AC power suply and bulb Y to a DC power supply . If potential difference across both the bulbs is same, which of the following bulb glow brighter ?

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12. At an airport, a perosn is made to walk through the door wy 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 ?

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13. Choke coil is used to control

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14. What is the use of choke coil in AC circuit? Can we use a rheostat in place of choke coil for the same purpose?

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15. what is resonance in series LCR circuit ?

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16. Can we use galvanometer to measure alternating current ?

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17. Can a hot-wire ammeter be used to measure a direct current having a constant value? Do we have to change the graduation?

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18. Why do we use a transformer in AC circuits?

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19. Two circuit elements X and Y are connected across an alternating current supply. A graph between the opposition to current offered by the elements and frequency of the power supply is plotted as shown in the figure.

Indentify the elements X and Y.

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20. A step up transformer is used to

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21. For circuits used for transporting electric power, a low power factor implies large power loss in transmission. Explain.

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22. 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?

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23. बिजली के एक बल्ब से श्रेणीक्रम में जुड़ी चोक कुंडली को दिष्टधारा (d.c.) लाइन से जोड़ा गया है जिससे लैम्प तेजी

से चमकता है। चोक में लोहे के क्रोड को प्रवेश कराने पर लैम्प की चमक (brightness) में कोई अंतर नहीं पड़ता है। यदि यही व्यवस्था a.c. लाइन से जोड़ी जाए तो लैम्प की चमक पर क्या प्रभाव पड़ेगा ?

Watch Video Solution

24. Statement 1: In a series LCR circuit at resonance condition power consumed by ciccuit is maximum.

Statement 2 : At resonance condition, the effective resistance of circuit is maximum.

Watch Video Solution

25. In a series LCR circuit, how can we achieve the maximum power by choosing appropriate value of capacitance of the capacitor in the circuit ?

Watch Video Solution

Tough Tricky Problems

1. There is an ideal inductor which when connected to 100 V - 50 Hz supply draws a current of 8A. There is an ideal resistor which when connected to 100 V - 50 Hz supply draws a current of 10 A . What current will flow in the circuit when the above described inductor and resistor are connected in series to a supply of 100 V -40 Hz ?

Watch Video Solution

2. Resistor of resistance R and capacitor of capacitance C are connected in series to an AC source of angular frequency ω . Rms current in the circuit is I. When frequency of the source is changed to one - third of initial value keeping the voltage same then current is found to be halved. Find the ratio of reactance of capacitor to that with resistance at the original frequency ω .

Watch Video Solution

3. An alternating current is given by

$I = i_1 \cos \omega t + i_2 \sin \omega t.$

The rms current is given by

Watch Video Solution

4. An AC source is reopresented as V = $200\sqrt{2} \sin 500t$. This source is connected to resistor of resistance 500Ω and capacitor of capacitance $4\mu F$ connected in series . Calculate power consumed in the circuit .

Watch Video Solution

5. There is a series LCR circuit connected to an AC source of angular frequency 3×10^5 rad/s . It is found that circuit is in resonance mode at this frequency and voltages across resistor and inductor are found to be 80 V and 60 V respectively . Calculate L and C . Resistance used in the circuit is 160 Ω.

Watch Video Solution

6. Achoke coil is connected across 18 VDC supply and current of 6 A is found to flow through it in steady state. Now the same choke coil is connected to 15 VAC source whose angular frequency is 50 rad /s and current of 3 A is found to flow through it.

(i) Calculate self - inducatance of the coil.

(ii) If a capacitor of 2500 μF is connected in series with the coil then calculate power developed in the circuit.

Watch Video Solution

7. The current in a discharging LR circuit is given by $I = i_0 e^{-\frac{t}{\tau}}$ where τ is the time constant of the circuit. Calculate the rms current for the period $t = 0$ to $t = \tau$.

Watch Video Solution

8. A resistance of 20Ω is connected to a source of an alternating potential $V = 220\sin(100\pi t)$. The time taken by the current to change from the peak value to rms value is

Watch Video Solution

9. A circuit contains 50 μF capacitor and 20 mH inductor connected together with the help of a key which is open initially. Charge stored in the capacitor is 50 mC. Key is closed at t=0 . Calculate the minimum time interval in which energy stored in the inductor becomes equal to the energy stored in capacitor . Neglect any resistance in the circuit .

Watch Video Solution

10. A resistor of resistance 200 Ω is connected to an AC source represented as V = (20V) sin $\left(250\pi s^{-1}\right)$t. Find the amount of heat dissipated across resistor in the time interval 0 to 1 ms .

Watch Video Solution

11. There are two circuits shown in figure . Find the ratio of power factor of circuit -I to that with power factor of circuit -II .

Watch Video Solution

12. A resistor of resistance 100 Ω a capacitor of capacitance $7\mu F$ and an inductor of self - inductance 0.07H are connected in series to a source rated as 20 V-500 Hz. If thermal capacity of material of resistor is 2 J/ $^{\circ}C$.

Watch Video Solution

Ncert File Textbook Exercises

1. A 100Ω resistor is connected to a 220 V, 50 Hz ac supply.

(a) What is the rms value of current in the circuit?

(b) What is the net power consumed over a full cycle?

Watch Video Solution

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

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

Watch Video Solution

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

Watch Video Solution

4. A $60\mu F$ capacitor is connected to a 110V, 60 Hz AC supply determine the rms value of the curent in the circuit.

Watch Video Solution

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

Watch Video Solution

6. Obtain the resonant frequency ω_r of a series LCR circuit with $L = 2.0H$. $C = 32\mu F$ and $R = 10\Omega$. What is the Q-value of this circuit ?

Watch Video Solution

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

Watch Video Solution

8. Suppose the initial charge on the capactor in the above question is 6 mC. What is the total energy stored in the capactor intially ? What is the total energy at later time ?

Watch Video Solution

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

Watch Video Solution

10. A radio cn tune over the frequency range of a portion of Mw broadcast band (800 kHz to 1200 kHz) . If its circuit has an effective inductance of 200 μH, what must be the range of its veriable capacitor ?

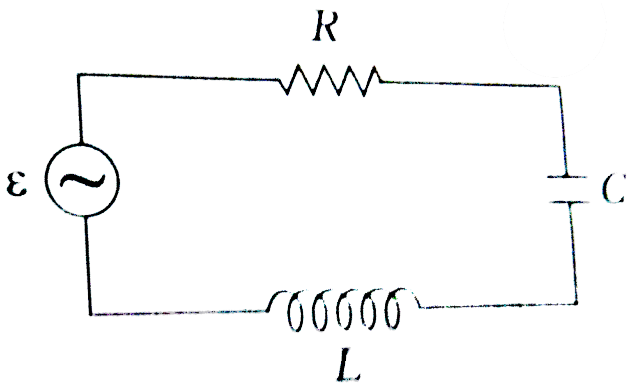
View Text Solution

11. Figure here, shows a series L-C-R circuit connected to a variable frequency 230 V source. L = 5.0H, C = $80\mu F$ and r =40Ω

(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 L-C combination is zero at the resonating frequency.



Watch Video Solution

Ncert File Additional Exercises

1. An LC circuit contains a 20 mH inductor and a $50\mu F$ 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 the oscillalions?

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

(c) At what time is the energy stored? (i) Completely electrical ? (ii) Completely magnetic ?

(d) At what time 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 ?

Watch Video Solution

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

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

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

View Text Solution

3. Obtain the answers to (a) and (b) Q.13, if the circuit is connected to a high frequency supply (240 V , 10 kHz). Hence explain statement that at very high frequency. Inductor in circuit nearly amount to open circuit. How does an indcutor behave in a d.c. circuit after the steady state ?

Watch Video Solution

4. A $100\mu F$ capacitor in series with a 40Ω resistance is connected to 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 ?

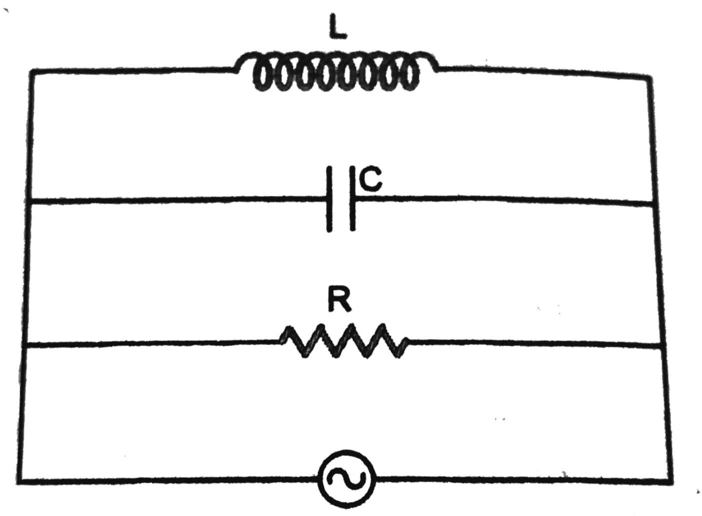
Watch Video Solution

5. Obtain the answers to (a) and (b) in Q .15, if the circuit is connected to 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 d.c. after the steady state.

Watch Video Solution

6. Keeping the source of frequency equal to the resonating frequency of the series LCR circuit, if the three elements L, C and R in are arranged in parallel , show that the total current in the parallel LCR circuit is a minimum at this frequency. Obtain the r.m.s. value of current in each brach of the circuit for the elements and source specified in for this frequency.



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7. A circuit containing a 80 mH inductor and a 60 μF capacitor in series is connected to a 230

V, 50 Hz supply. The resistance in the circuit is negaligible.

(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 b the circuit ? (Average'implies' averaged over one cycle '.)

Watch Video Solution

8. Suppose the circuit in Exercise 7.18 has a resistance of 15Ω Obtain the average power transferred to each element of the circuit, and the total power absorbed.

Watch Video Solution

9. A series LCR circuit with $L = 0.12H, C = 480nF,$ and $R = 23\Omega$ is connected to a $230V$ variable frequency supply.

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

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

(c) For which frequencies of the source is the power transferred to the circuit half the power at resonant frequency?

(d) What is the Q-factor of the circuit?

Watch Video Solution

10. Obtain the resonant frequency and Q factor of a series LCR circuit with L = 3.0 H, $C = 27 \mu F$ and R = 7.4 ohm.

Watch Video Solution

11. Answer the following questions :

(a) In any a.c. circuit, is the applied instantaneous voltage equal to the algebraic sum of the instantaneous voltages acorss the series elements of the circuit ? Is the same true for r.m.s. 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 will appear 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 observation if the connection is to an a.c. line.

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

Watch Video Solution

12. A power transmission line feeds input power at 2300 V to a step down trnasformer with it primary windings having 4000 turns. What should be the number of turns in the seconday windings in order to get output power at 230 V?

Watch Video Solution

13. At a hydroelectric power plant, the water pressure head is at a height of 300 m and the water flow available is $100 m^3 s^{-1}$. If the turbine generator efficiency is 60%, estimate the electric power available from the plant $(g = 9.8 m s^{-2})$.

Watch Video Solution

14. 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 line wires carrying power is 0.5Ω per km. The town gets power from the lines through a 4000-220 V step down transformer at a substation in the town.

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) Characterize the step up transformer at the plant.

Watch Video Solution

15. 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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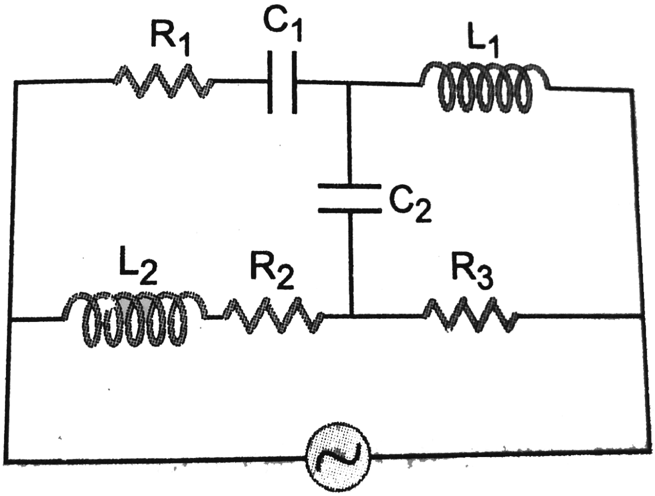
Ncert File Exemplar Problems Subjective Question Very Short Answer Type Questions

1. If a LC circuit is considered analogous to a harmonically osicallting spring block system, which energy of the LC circuit would be analogous to potential energy and which one analogous to kinetic energy ?

Watch Video Solution

2. Draw the effective equivalent circuit of the circuit show in Fig. at very high frequencies and find the effective impedance.



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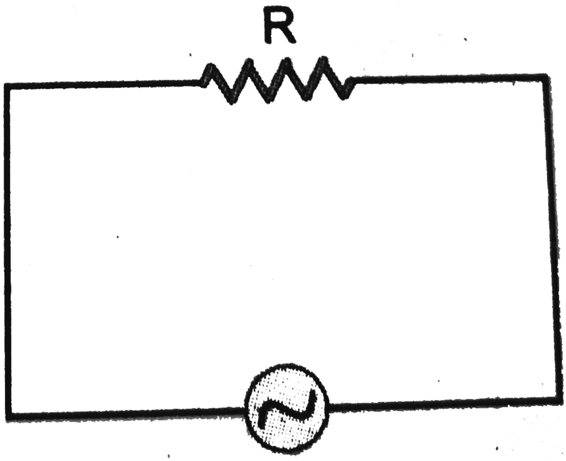
3. Study the circuit (a) and (b) shown in Fig. and answer the following questions.

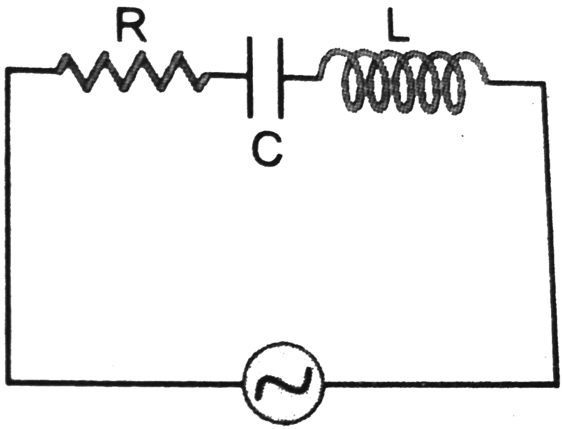
(a) Under which conditions would the rms currents in the two circuits be the same ?

Can the rms curent in circuit (b) be larger than that in (a) ?

a



b



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

Watch Video Solution

5. In series LCR circuit , the plot of I_{rms} vs ω is shown in the figure given below. Find the bandwidth and mark in the figure.

View Text Solution

6. The alteranting current in a circuit is described by the grap shown in the following figure . Show rms current in this graph.

View Text Solution

7. How does the sign of the phase angle ϕ, by which the supply voltage leads the current in

an LCR serices circuit, change as the supply frequency is gradually increased from very low to very high values ?

Watch Video Solution

8. 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 below.

(a) which curve shows powre consumption over a full cycle ?

(b) What is the average powr consumption over a cycle ?

(c) Identify the device 'X'.

View Text Solution

9. Both alternating current and direct are measured in ampers. But how is the ampere defined for an alternating current ?

Watch Video Solution

10. 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.

Watch Video Solution

11. 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 types of transformer being used.

Watch Video Solution

12. Explain why the reactance offered by an inductor increases with increasing frequency of an alternaitng voltage.

Watch Video Solution

13. Explain why the reactance offered by an inductor increases with increasing frequency of an alternaitng voltage.

Watch Video Solution

Higher Order Thinking Skills Advanced Level

1. An electric lamp having resistance 5 Ω gives correct brightness when 10 A current flows through it. We need to operate this lamp using AC source rated as 200 V-50 Hz. Calculate the self-indcutance of choke coil needed.

Watch Video Solution

2. An inductor is connected in series with a resistor of resistance 1000 Ω and a capacitor of capacitance 2 μF. Potential difference of 100 V exists across the resistor . Angular frequency of source is 200 rad/s, and the same is equal to resonant frequency of the circuit find the rms voltage across inductor .

Watch Video Solution

3. Potential difference between the two brushes of generator is found to be 200 V when current of 5 A is being delivered by it. When current delivered by the same generator is 10 A, then potentail difference between the brushes of generator becomes 180 V. What is the induced emf and resistance of armature coil ?

Watch Video Solution

4. The is one parallel plate air capacitor having plate area 40 cm^2 and separation between the plates equal to 0.1 mm. Dielectric strength of air is 3×10^6 V/m. find maximum rms voltage that can be applied across capacitor without electric breackdown.

Watch Video Solution

5. The voltage supplied to a circuit is given by $V = V_0 t^{\frac{3}{2}}$, where t is time in second. Find the rms value of voltage for the period, t=0 to t=1s.

Watch Video Solution

6. An inductor is self-indcutance 0.5 H is connected is series with a resistance 200 Ω and a variable capacitor. Now this combination is connected to an AC source of angular frequency 1000 rad/s. What capacitance should be adjusted for capacitor to get maximum current in the circuit ?

Watch Video Solution

7. An inductor coil is connected to a 10 V battery and in steady state, a current of 10 A is found to flow through it. Now this inductor coil is connected in series with a capacitor , and this combination is connected across AC supply of rms voltage 12 V. it is found that current flowing in the circuit is in the same phase with the voltage. Find the rms current flowing through the circuit.

View Text Solution

Revision Exercises Very Short Annwer Qustion

1. What is alternating current ?

Watch Video Solution

2. What do you mean by frequency of AC ?

Watch Video Solution

3. How can we represent AC mathematically ?

Watch Video Solution

4. The peak value of 220 a.c. is

Watch Video Solution

5. How does AC differ from DC? What are the advantages and disadvantages of AC over DC?

Watch Video Solution

6. What is the phase relationship between voltage and current in an AC circuit containing only resistance ?

Watch Video Solution

7. Draw a graph between voltage and current in case of an AC circuit containing only resistance .

Watch Video Solution

8. Is the behaviour of resistance is the same in both AC and DC circuits ?

Watch Video Solution

9. What is the average value of a.c. over a full cycle ?

Watch Video Solution

10. What is the relation between mean value of AC with the peak value ?

Watch Video Solution

11. Give the relation between the rms value and peak value of AC .

View Text Solution

12. What is the significance of phasors in AC circuits ?

Watch Video Solution

13. What is the phase relationship between voltage and current in case of AC circuit containing only inductor ?

Watch Video Solution

14. Draw a graph between voltage and currenrt in case of an AC circuit containing only inductor.

Watch Video Solution

15. Compare between inductive reactance and capacitive reactance.

Watch Video Solution

16. How inductive reactance depends on the frequency of AC ?

View Text Solution

17. What is the phase relationship between voltage and current in case of AC circuit containing only capacitor ?

View Text Solution

18. Draw a graph between voltage and current in case of an AC circuit containing only capacitor .

Watch Video Solution

19. Define capacitor reactance. Write its SI units.

Watch Video Solution

20. How capacitive reactance depends on the frequency of AC ?

View Text Solution

21. What is the value of capacitive reactance (X_C) in DC circuits ?

View Text Solution

22. Plot a graph showing variation of capacitive reactance with the change in the frequency of the AC source.

Watch Video Solution

23. Find the reactance of a capacitor having a capacitance $\left(\frac{1}{\pi}\right)\mu$F at 50 Hz .

Watch Video Solution

24. How the reactance of an inductor depends on frequency ?

Watch Video Solution

25. Write the mathematical form of impedance (Z) of an AC circuit .

Watch Video Solution

26. If $Z=\sqrt{R^2+(X_C-X_L)^2}$ then give the phase relationship of current and voltage.

Watch Video Solution

27. In a series LCR circuit, $V_L = V_C \neq V_R$.

What is the value of power factor ?

Watch Video Solution

28. What is inductance dominated circuit ?

View Text Solution

29. Give the expression for the phase angle in an AC circuit containing resistor inductor and capacitor .

Watch Video Solution

30. What is a series resonance circuit ?

View Text Solution

31. Give any two applications of resonance.

Watch Video Solution

32. What happens to the impedance and current amplitude at resonant frequency ?

View Text Solution

33. Can resonance phenomenon be exhibited in a circuit containing L and R ?

View Text Solution

34. What is the significance of resonant circuits ?

Watch Video Solution

35. The Q - factor of a resonant circuit is equal to

Watch Video Solution

36. If $L \text{ and } R$ denote inductance and resistance , respectively , then the dimensions of L/R are

Watch Video Solution

37. Differentiate between AC and DC by giving two points .

Watch Video Solution

38. How quality factor Q depends on the resistance of the circuit ?

Watch Video Solution

39. How the quality factor effects the bandwidth and sharpness of resonance ?

Watch Video Solution

40. How the quality factor effects the selectivity of the circuits ?

Watch Video Solution

41. What do you mean by power in an Ac circuit ?

Watch Video Solution

42. Give the expression for average power dissipated in a resistor over a complete as cycle.

Watch Video Solution

43. What is the power factor of a circuit having a pure resistance only?

Watch Video Solution

44. What is the power factor of an A circuit containing inductor or capacitor ?

Watch Video Solution

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

Watch Video Solution

46. Define the term 'wattles current'.

Watch Video Solution

47. What is the idle component or wattless component of AC ?

Watch Video Solution

48. Why inductors or capacitors are used in AC circuits for controlling currents ?

Watch Video Solution

49. What are undamped and damped oscillations ?

Watch Video Solution

50. What are undamped and damped oscillations ?

Watch Video Solution

51. What is the dimensional formula of $\sqrt{LC}$?

Watch Video Solution

52. What is the natural frequency of LC circuit ? What is the reactance of this circuit at this frequency ?

Watch Video Solution

53. What is the energy stored in a pure LC circuit ?

Watch Video Solution

54. Why connot we use a.c. for electrolysis?

Watch Video Solution

55. $\sqrt{k/m}$ has dimennsions of which physical quantity?

Watch Video Solution

56. What is a transformer ? On what principle the transformer is based ?

View Text Solution

57. What is a step up transformer?

Watch Video Solution

58. What is a step down transformer?

Watch Video Solution

59. What is transformation ratio ?

Watch Video Solution

60. What happens to the AC current in a transformer if alternating voltage is increased to n times ?

Watch Video Solution

61. What is the efficiency of a transformer ?

Watch Video Solution

62. Why the core of a transformer is made up of a high permeability material ?

Watch Video Solution

63. What is the average value of alternate voltage and current in a complete cycle ?

Watch Video Solution

64. Why cannot a transformer be used to step up d.c. voltage ?

Watch Video Solution

65. Name the main component which changes an a.c. generator into d.c. generator.

Watch Video Solution

66. What is the instantaneous value of induced emf generated in the coil of AC generator ?

Watch Video Solution

67. What should be the value of sin ωt for induced emf to be maximum ?

Watch Video Solution

68. What job do the brushes perform in an AC generator?

Watch Video Solution

69. What is a choke coil ?

Watch Video Solution

70. What is the resistance of an ideal choke coil ?

Watch Video Solution

71. How much power is consumed in a purely inductive and a purely capacitive AC circuit ?

Watch Video Solution

Revision Exercises Additional Questions

1. A transformer is based on the principle of

A. self induction

B. mutual induction

C. eddy currents

D. none of these

Answer: B

Watch Video Solution

2. Which of the following equantities remain constant in a step- down transformer ?

A. Current

B. Voltage

C. Power

D. none of these

Answer: C

Watch Video Solution

3. A circuit has a resistance of 12Ω and an impedance of 15Ω . The power factor of the circuit will be

A. 0.8

B. 0.4

C. 1.25

D. 0.125

Answer: A

Watch Video Solution

4. Phase difference between voltage and current when an ac source is connected to an inductor :

A. 0°

B. 90°

C. 45°

D. 180°

Answer: B

Watch Video Solution

5. When AC passes through capacitor the current

A. leads voltage by phase π.

B. remains in phase with voltage .

C. leads voltage by phase $\pi / 2$.

D. lags voltage by phase $\pi / 2$

Answer: C

Watch Video Solution

6. In AC circuits choke is preferred as resistors because

A. a choke is cheap .

B. there is no wastage of power .

C. a choke is compact in size.

D. a choke is good absorber of heat .

Answer: B

Watch Video Solution

7. Resonance occur in a series LCR . Circuit when :

A. $X_L = X_C$

B. $X_L > X_C$

C. $X_L < X_C$

D. none of these

Answer: A

View Text Solution

8. The power factor for a purely capacitive circuit is

A. 1

B. $\sqrt{2}$

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

D. Zero

Answer: A

View Text Solution

9. In a circuit, the current lags behind the voltage by a phase difference of $\pi/2$, the circuit will contain which of the following ?

A. only R

B. only L

C. onlyC

D. R and C.

Answer: B

Watch Video Solution

10. In an LCR circuit, the capacitance is made one-fourth, when in resonance. Then what should be the change in inductance, so that the circuit remains in resonance?

A. 8 times

B. $\frac{1}{4}$

C. 2 times

D. 4 times

Answer: D

Watch Video Solution

Revision Exercises Fill In The Blanks

1. AC generator is based on the concept of ....

Watch Video Solution

2. Average value of current for one complete cycle can be calculated by integrating current with respect to time for .... Time period and then dividing it by time period .

Watch Video Solution

3. The rms value of alternating current which when passed through a resistor produces heat energy four times that produced by directed current of 2 A through the same resistor in same time is

Watch Video Solution

4. Time constant of circuit containing pure inductor connected across the alternating voltage is ....

Watch Video Solution

5. Average power consumed by pure inductive and pure capacitive circuits is zero and such circuits are called ....

Watch Video Solution

6. A system has a tendency to oscillate at a certain fixed frequency the fixed frequency is known as .... of the system.

Watch Video Solution

7. Average value of alternating current for one positive half cycle is .... Of the peak value .

Watch Video Solution

8. The equivalent frequency of DC source is ....

.

View Text Solution

9. In a pure .... Circuit current leads the voltage by $\pi /2$.

Watch Video Solution

10. .... Instrument is used for the measurement of alternating current .

Watch Video Solution

Revision Exercises Short Answer Questions

1. Define average value of alternating current . Derive an expression for it .

Watch Video Solution

2. An alternating current from a source is represented by $I = I_0$ sin 314 t. What is the effective value of current ?

Watch Video Solution

3. Prove mathematically that the average value of alternating current over one complete cycle is zero.

Watch Video Solution

4. Define root mean square value of alternating current and derive an expression for it . How is it related to mean value of alternating current ?

Watch Video Solution

5. Derive the expression for the power dissipated by an ideal resistor in an AC circuit .

Watch Video Solution

6. Derive the relation between current and voltage in a purely resistive circuit ?

Watch Video Solution

7. A voltage, $E = E_0 \sin \omega t$ is applied across an inductor L. Obtain an expression for the current.

Watch Video Solution

8. An inductor acts as a conductor for d.c. why ?

Watch Video Solution

9. With the help of a phasor diagram find an expression for impedance (Z) in a series L-C-R circuit.

Watch Video Solution

10. A capacitor behaves like a perfect conductor for high frequency AC. Explain why.

Watch Video Solution

11. A Capacitor blocks d.c. and allows a.c. Why ?

Watch Video Solution

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

Watch Video Solution

13. Prove that an ideal capacitor in an a.c. circuit does not dissipate power.

Watch Video Solution

14. Show that the current leads the voltage in phase by $\pi/2$ in an AC circuit containing an ideal capacitor .

Watch Video Solution

15. What is a phasor ? What is the phase difference between current and voltage in a purely capacitive AC circuit ? Show the phase difference through a phasor diagram .

Watch Video Solution

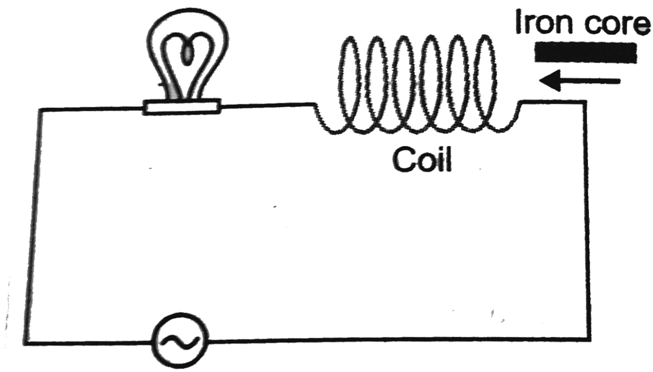
16. Can a capacitor of suitable capacitance be use dto control a.c in place of the choke coil ?

Watch Video Solution

17. Show that in the free oscillations of an LC circuit, the sum of energies stored in the capacitor and and the inductor is constant in time.

Watch Video Solution

18. A bulb connected in series with a solenoid is lit by a.c. source, Fig. If the soft in core is introduced in the solenoid, will is bulb glow brighter ?



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19. How will the inductive reactance and capacitive reactance change on doubling the frequency of AC ?

Watch Video Solution

20. Can the voltage drop across the inductor or capacitro in a series LCR circuit be greater than the applied voltage of the ac souce? Justify your answer.

Watch Video Solution

21. What do you mean by impedance of LCR series circuit ? Derive an expression for it . What is the condition for resonance ?

Watch Video Solution

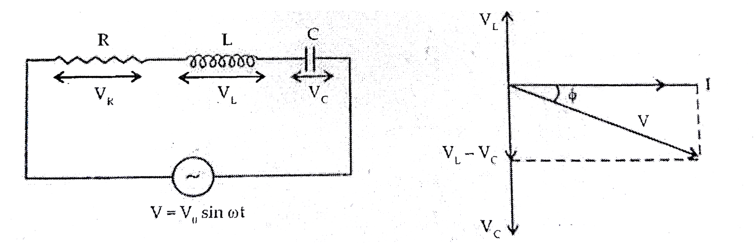
22. Why does a capacitor block DC whereas an inductor allows DC to pass through it easily ?

Watch Video Solution

23. (i) An a.c. Source of voltage $V = V_0 \sin \omega t$ is connected to a series combination of L,C and R . Use the phasor diagram to obtain expression for impedance of the circuit and phase angle between

voltage and current . Find the condition when current will be 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 which 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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24. In an LCR series combination R= 400 Ω L =100 mH and C = $1 \mu F$.

This combination is connected to a 25 sin 2000 t volt voltage source . Find (i) the impedance of the circuit .

(ii) the peak value of the ciruit current .

Watch Video Solution

25. Give three elements X, Y and Z to be connected across an ac source . With only X connected across the ac source voltage and current are found to be in the same phase . With only element Y in the circuit the voltage lage behind the current in phase by $\pi/2$ while with the element Z in the circuit the voltage leads the current in phase by $\pi/2$.

(a) Identify the elements X, Y and Z .

(b) When all these elements are connected in series across the same source (i) determine the power factor and (ii) find out the condition when the circuit is in resonant state .

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26. A capacitor C a variable resistor R and a bulb B are connected in series to the AC mains in circuit as shown. 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 keeping resistance R to be the same and (ii) the resistance R is increased keeping the same capacitance ?

View Text Solution

27. Why is the use of AC voltage preferred over DC voltage ? Give two reasons .

Watch Video Solution

28. A voltage $V = V_0 \sin \omega t$ is applied to a series LCR circuit. Derive 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?

Watch Video Solution

29. Draw the phasor diagram of a series LCR connected across an ac source V=$V_0 \sin \omega t$. Hence derive the expression for the impedance of the circuit . Obtain the conditions for the phase angle under which the current is (i) maximum and (ii) minimum.

Watch Video Solution

30. (a) For a given a.c., $i = i_m$ sin wt, show that the average power dissipated in a resistor R over a complete cycle is $\frac{1}{2}i._m^2 R$.

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

Watch Video Solution

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

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

(c) When and inductor is connected to a 200 V DC voltage, a current of 1Aflows trough it. when the same inductor is connected to a 200 V, 50 Hz AC source, only 0.5 A current flows. Explain, why ? Also, calculate the self inductance of the inductor.

Watch Video Solution

32. What is electric resonance ?

Watch Video Solution

33. Write down the condition of resonance in series L-C-R circuit and hence find an expression for the resonant frequency.

Watch Video Solution

34. An inductor L of inductance X_L is connected in series with a bulb B and an AC source . How would brightness of the bulb change when (i) number of turns in the inductor is increased (ii) an iron rod is inserted in the inductor and (iii) a capacitor of reactance $X_C = X_L$ is inserted in series .

Watch Video Solution

35. Answer the following questions :

(a) In any a.c. circuit, is the applied instantaneous voltage equal to the algebraic sum of the instantaneous voltages acorss the series elements of the circuit ? Is the same true for r.m.s. 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 will appear 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 observation if the connection is to an a.c. line.

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

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Watch Video Solution

36. What is the power dissipation in an AC circuit in which voltage and current are given by $V = 300\sin\left(\omega t + \frac{\pi}{2}\right)$ and I = 5 sinωt ?

Watch Video Solution

37. Obtain anexpression for the average power of an a.c circuit .

Watch Video Solution

38. What is wattless current ?

Watch Video Solution

39. What is power factor of an LCR circuit ? Explain on the basis of power factor that an ideal inductor is a wattless component .

Watch Video Solution

40. Given below are two electric circuits A and B.

Calculate the ratio of power factor of the circuit B to the power factor of circuit A.

View Text Solution

41. Describe the principle and theory of a transformer . Why the efficiency of a transformer is always less than unity?

Watch Video Solution

42. With the help of a labelled diagram explain the working of a transformer . Write any three source of energy loss in a transformer .

Watch Video Solution

43. Electrical energy is transmitted over large distances at high alternating voltages. Which of the following statements is (are) correct?

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44. Why cannot a transformer be used to step up d.c. voltage ?

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45. The core of a transformer is made of magnetic material of high permeanbility. Why ?

Watch Video Solution

46. State the principle of an ac generator.

Watch Video Solution

47. An a.c. generator having a constant magnetic field is conneted to a resistive load. What will be the effect of doulbling the speed of rotation on: (i) frequency of a.c. (ii) generated e.m.f. (iii) mechanical power required to rotate the generator ?

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48. Can a.c. source be connected to a circuit and yet deliver no power to it ? If so, under what circumstance ?

Watch Video Solution

49. At resonance in an LCR circuit the emf and current are

(i) in phase .

(ii) out of phase .

(iii) having a phase difference of $\pi/2$.

(iv) having a phase difference of $\pi/6$.

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Revision Exercises Long Answer Questions

1. What is meant by rms value of a.c. ?Derive an expression for altenating emf ?

Watch Video Solution

2. A horizontal straight wire 10 m long extending from east to west is falling with a speed of 5.0 ms, at right angles to the horizontal component of the earth's magnetic field, $0.30 \times 10^{-4} Wbm^2$

What is the instantaneous value of the emf induced in the wire?

Watch Video Solution

3. A series LCR circuit with $L = 0.12H, C = 480nF,$ and $R = 23\Omega$ is connected to a $230V$ variable frequency supply.

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

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

(c) For which frequencies of the source is the power transferred to the circuit half the power at resonant frequency?

(d) What is the Q-factor of the circuit?

Watch Video Solution

4. A source of alternating emf of 220 V - 50 Hz is connected in series with a resistance of 200Ω an inductance of 100 mH and a capacitance of 30μ F . Does the current lead or lag the voltage and by what angle ?

Watch Video Solution

5. Calculate the frequency of series resonance circuit. Define Q factor of this circuit. Explain briefly how the phenomenon of resonance in the circuit can be used in the tuning mechanism of a radio or TV set.

Watch Video Solution

6. (a) An AC source of voltage $V = V_0 \sin \omega t$ is connected across a series combination of an inductor a capacitor and a resistor . Use the phasor diagram to obtain the expression for the impedance of the circuit and phase angle between the voltage and the current.

(b) A capacitor of unknown capacitance a resistor of 100 Ω and an inductor of self - inductance L $= (4/\pi^2)$ henry are in series connected to an AC 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 .

View Text Solution

7. (a) State the principle of an ac generator and explain its working with the help of a labelled digram. Obtain the expression for the emf induced in a coil having N turns each of cross-section area.

A, rotating with a constant angular speed ω in a magnetic filed ω, directed prependicular to the axis of rotation.

(b) An aeroplane if flying horizontally for west to east with a velocity of 900 km/hours. Calcuate the potential difference developed between the ends of its wings having a span of 20n. The horizontal component of the

Earth's magnetic field is $5 \times 10^{-4} T$ and the angle of dip is 30°.

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8. (a) Draw the diagram of a device which is used to decrease high S voltage into a 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

440V. The resistance of the two wire line carrying power is 0.5Ω per km. The town gets the power from the line thruough a 4000-220 V step-down transformer at s sub-station in the twon. Estimate the line power loss in the from of heat.

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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 acorss the series elements of the circuit ? Is the same true for r.m.s. 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 will appear 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 observation if the connection is to an a.c. line.

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

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10. A device X is connected across an ac source of voltage $V = V_0 \sin \omega t.$ The current throught X is given as $I = I_0 \sin\left(omgat + \frac{\pi}{2}\right)$

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

(b) Draw graph showing variation of voltage and current with time over one cycle of ac, for X.

How does the reactance of the device X vary with frequencey of the ac? Show this variation grachically.

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

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Revision Exercises Nuumerical Problems

1. The instantaneous current from an AC source is I = 6 sin (314 t) ampere. What are the half cycle average and rms values of the current ?

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2. The rms value of current in a 50 Hz AC source is 4 A. What will be the value of current after 1/400 seconds after its value becomes zero?

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3. What will be the instantaneous voltage for an a.c. supply of 230 V and 50 Hz?

Watch Video Solution

4. Consider an AC supply of 220 V-50 Hz. A resistance of 30Ω is connected to this source . Find the (a) rms value of current (b) the peak value of current and (c) the time taken by current to change its value from maximum to rms value .

Watch Video Solution

5. A light bulb is rated 100 W for 220 V ac supply of 50 Hz. Calculate

(i) the resistance of the bulb,

(ii) the rms current through the bulb.

Watch Video Solution

6. An alternating voltage given by $V = 140 \sin 314t$ is connected across a pure resistor of 50 ohm. Find (i) the frequency of the source. (ii) the rms current thought the resistor.

Watch Video Solution

7. A coil draws current of 1.0 amp and 100 watt power from an AC source of 110 volt and 50 Hz frequency . Find the resistance and inductance of coil.

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8. The currents flowing in the two coils of self - inductance $L_1 = 20$ m H and $L_2 = 15$ mH are increasing at the same rate. If the the power supplied to the two coils is equal find the ratio of (i) induced voltages (ii) the currents and (iii) the energies stored in the two coils at a given instant.

Watch Video Solution

9. A resistance of 600 Ω an inductor of 0.4 H and a capacitor of 0.01 μF are connected in series to an AC source of variable frequency . Find the frequency of AC source for which current in the circuit is maximum. Also calculate the bandwidth and quality factor for the circuit .

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10. A capacitor of capacitance 100 μF and a coil of resistance 50 ohm and inductance 0.5 henry are connected in series with 110 volt and 50 Hz source . Calculate the impedance of the circuit.

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11. Obtain the resonant frequency ω_r of a series LCR circuit with L = 2.0 H. $C = 32\mu F$,

and $R = 10\Omega$. What is the Q - value of this circuit?

Watch Video Solution

12. In a series LCR circuit with an AC source of effective voltage 50 V , frequency $\nu = 50 / \pi$ Hz R= 300$\Omega C = 20 \mu F$ and L = 1.0 H. Find the rms current in the circuit.

Watch Video Solution

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

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14. A series LCR circuit with R = 1 $k\Omega$, L=1.0 mH C= 0.001 μF is connected to a sinusoidal voltage of peak value $200\sqrt{2}$ V . When the frequency of the supply equals the natural frequency of the circuit what is the average power transferred to the circuit in one cycle .

Watch Video Solution

15. A coil having inductance of 5 H and resistance of 30 $Omeg$ has a peak voltage as

$9\sqrt{3}$ volts 50 Hz connected across it . Find the current through the coil and the absorbed power.

Watch Video Solution

16. A capacitor having capacitance C is put in series with a 20 Ω resistance . The power factor is equal to 0.5 . Find the value of C if AC supply is 90 V - 200 Hz.

Watch Video Solution

17. The number of the turns in the primary coil of a transformer is 10 times than the same in the secondary coil . If the voltage across the primary is 20 V then find the voltage across the secondary .

Watch Video Solution

18. The ratio of turns in the primary and secondary coils of a transformer is $1:15$. If the voltage and current in the primary coil are 12 volt and 30 ampere respectively then what will be the voltage and current in secondary coil?

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Competition File Objective Type Questions A Mutiple Choice Questions

1. An AC source is rated as 220 V-50 Hz. What will be the peak voltage of this source ?

A. Approximately 110 V

B. Approximately 310 V

C. 220 V

D. 440 V

Answer: B

Watch Video Solution

2. A sinusoidal voltage Vsin(at) is applied across a series combination of resistance R and inductor L. The amplitude of the current in the circuit is

A. $\frac{V_0}{\sqrt{R^2 + (\omega L)^2}}$

B. $\frac{V_0}{\sqrt{R^2 - (\omega L)^2}}$

C. $\frac{V_0}{R + (\omega L)}$

D. $\frac{V_0}{R}$

Answer: A

Watch Video Solution

3. A coil of resistance 300Ω and inductance 1.0 henry is connected across an voltages source of frequency $300 / 2\pi Hz$. The phase difference between the voltage and current in the circuit is

A. current lags behind voltage be $\pi/4$.

B. current leads the voltage by $\pi/4$.

C. current lags behind voltage by $\pi/2$.

D. current leads the voltage by $\pi/2$.

Answer: A

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4. One small magnet is slowly inserted inside a solenoid with constant velocity as shown in figure.

which one of the following graphs will best represent emf induced as function of time ?

A.

B.

C.

D.

Answer: D

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5. A capacitor acts as an infinite resistance for

A. DC circuits.

B. AC circuits.

C. DC as well as AC circuits.

D. neither AC nor DC circuits.

Answer: A

Watch Video Solution

6. Transformers are used

A. In DC circuits.

B. in AC circuits.

C. in both DC and AC circuits.

D. neither in DC nor in AC circuits.

Answer: B

Watch Video Solution

7. What inductance should be connected in series with a capacitor of 20 mF and resistance of 10 Ω to make power factor unity ? Frequency of supply is 50 Hz.

A. 2 H

B. 1 H

C. 0.5 H

D. 0.25 H

Answer: C

Watch Video Solution

8. Alternating current with peak value $20\sqrt{2}$ A is used to produce required amount of heat across a resistor. What constant current is needed to produce same amount of heat across the same resistance in same time ?

A. 40 A

B. 20 A

C. 10A

D. 11.14A

Answer: B

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9. Coil P is connected to a bulb and coil Q is connected to an AC source.

when coil P is moved downward, then bulb is found to glow dimmer. Brightness of the bulb is lowered because

A. magnetic flux linked with coil remains constant.

B. magnetic flux linked with coil remains increases.

C. magnetic flux linked with coil remains decreases.

D. frequency of AC source will increase.

Answer: C

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10. AC source represented as V = $V_0 \sin \omega t$ is applied to a circuit and current I = $I_0 \sin(\omega t + \pi / 2)$ is found to flow through the circuit . What will be average power consumed in the circuit ?

A. $V_0 I_0$

B. $\frac{V_0 I_0}{2}$

C. $\frac{V_0 I_0}{\sqrt{2}}$

D. 0

Answer: D

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11. A constant current of magnitude $\sqrt{2}$ A is flowing through a resistor when connected to a DC source. What is rms current flowing through the resistor ?

A. $\sqrt{2}$ A

B. $1A$

C. 0.5 A

D. None of these

Answer: A

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12. Select possible correct option for a circuit with net reactance zero.

A. Circuit contains resistor and capacitor.

B. Cricuit contains inductor , capacitor and resistor .

C. Circuit contains resistor and inductor .

D. None of these

Answer: B

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13. Series LCR circuit is connected to an AC source of angular frequency ω. Current flowing in the circuit is found to lead the voltage by $\pi/4$. Magnitude of capacitance is

A. $\dfrac{1}{\omega^2(L+R)}$

B. $\dfrac{1}{\omega(L+R)}$

C. $\dfrac{1}{\omega^2 L+\omega R}$

D. $\dfrac{1}{\omega L+\omega^2 R}$

Answer: C

View Text Solution

14. An electric bulb is rated to give correct brightness at 24 V DC. It is connected to an AC source and its brightness is found to be one fourth of rated brightness. What is peak voltage across AC source ?

A. $12\sqrt{2}$

B. $12 / \sqrt{2}$

C. $24\sqrt{2}$

D. $24 / \sqrt{2}$

Answer: A

View Text Solution

15. An inductor in connected to an AC source . Magnetic field energy stored in inductor is found to change from its minimum value to maximum value in 10 ms. Frequency of AC source is

A. 25 Hz.

B. 50 Hz.

C. 75 Hz.

D. 100 Hz.

Answer: A

Watch Video Solution

16. A resistance of 300 Ω is connected in series with inductor of self-inductance 1 H and capacitor of capacitance 20 mF. This combination is connected to an AC source whose angular frequency is 100 rad/s. Impedance of the circuit is

A. 200 Ω.

B. 400 Ω.

C. 500 Ω.

D. 750 Ω.

Answer: C

View Text Solution

17. A circuit has a self inductance of 1H and carries a current of 2A. To prevent sparking when the circuit is switched off, a capacitor which can withstand 400V is used. The least capacitance of the capacitor connected across the switch must be equal to

A. 75 μF.

B. 50 μF.

C. 25 μF.

D. 12.5 μF.

Answer: C

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18. In an LCR circuit, the voltages across the components are V_L, V_C and V_R respectively. The voltage of source will be -

A. V = $V_R + V_L + V_C$

B. $V = \sqrt{V_R^2 + (V_L - V_C)^2}$

C. $V = \sqrt{V_L^2 + (V_R - V_C)^2}$

D. $V = \sqrt{V_C^2 + (V_R - V_L)^2}$

Answer: B

Watch Video Solution

19. An AC source of variable frequency f is connected to an LCR series circuit. Which one of the graphs in figure represents the variation of current of current I in the circuit with frequecy f?

A.

B.

C.

D.

Answer: D

Watch Video Solution

20. A coil and a bulb are connected in series with a dc source, a soft iron core is then inserted in the coil. Then

A. Steady state birghtness of bulb remains same

B. Steady state brightness of bulb increases

C. Steady state brightness of bulb decreases

D. Nothing can be said about the change in brightness of bulb .

Answer: A

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21. A bulb and an air-cored coil are connected in series with a 20 V DC source. Now a soft-iron core is inserted inside the coil. During the time interval when iron core is being inserted

A. brightness of bulb remains same.

B. brightness of bulb increases.

C. brightness of bulb decreases.

D. Nothing can be said about the change in brightness of bulb .

Answer: C

Watch Video Solution

22. Frequency of AC source is continuously increased, impedance of LCR series circuit

A. increases.

B. decreases.

C. remains constant.

D. first decreases to a minimum value and then increases.

Answer: D

Watch Video Solution

23. Power factor of an ideal choke coil (i.e. R = 0) is

A. approx 0.

B. zero

C. approx 1.

D. 1

Answer: B

Watch Video Solution

24. At resonance, the value of the power factor in an LCR series circuit is

A. 0

B. 1

C. 0.5

D. ∞

Answer: B

Watch Video Solution

25. In an LCR circuit, the resonating frequency is 500 kHz. If the value of L is increased two times and value of C is decreased $\frac{1}{8}$ times, then the new resonating frequency in kHz will be -

A. 1500

B. 1000

C. 500

D. 250

Answer: B

Watch Video Solution

26. L,C and R represent the physical quantities inductance, capacitance and resistance respectively. Which of the following combinations have dimensions of frequency?

A. 1/LC

B. L/R

C. 1/RC

D. RC

Answer: C

Watch Video Solution

27. A coil of metal wire is kept stationary in a non-uniform magnetic field. An e.m.f. Is induced in the coil.

A. enf and current both are induced in the coil.

B. emf is induced but no current flows through the coil.

C. Current flows in the coil but no emf is induced .

D. Neither emf nor electric current in induced in the coil.

Answer: D

Watch Video Solution

28. An L-C-R series circuit with $R = 100\Omega$ is connected to a $200V, 50Hz$ a.c. source .When only the capacitance is removed, the voltage leads the current by 60° and when only the inductance is removed, the current leads the voltage by 60°. The current in the circuit is

A. 1A

B. 2A

C. 1.732 A

D. 0.866 A

Answer: B

Watch Video Solution

29. A capacitor having capacitance 2 μF is charged to a potential difference of 50 V. it is then diconnected from battery and connected to an inductor of inductance 5 mH. Peak current that flows through the inductor is

A. 1A

B. 2A

C. 3A

D. 4A

Answer: A

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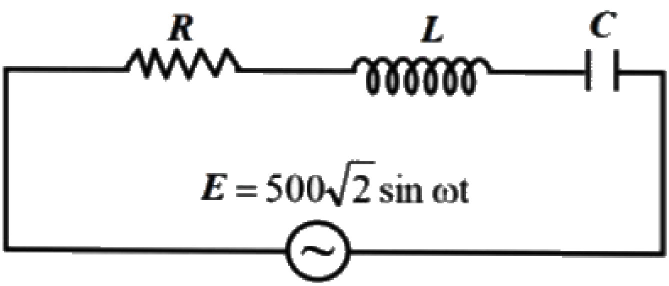
30. In the series $L - C - R$ circuit shown in the figure, the rms voltage across the resistor and inductor are 400 V and 700 V respectively. If the applied voltage is $E = 500\sqrt{2}\sin(\omega t)$, then the peak voltage across the capacitor is



A. 400 V.

B. $400\sqrt{2}$V.

C. 800 V

D. $800\sqrt{2}$ V

Answer: B

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Competition File Objective Type Questions B Multiple Choice Questions

1. The primary and secondary coils of a transmformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linked with the primary coil is given by $\phi = \phi_0 + 4t$, where ϕ is in weber, t is time in second and ϕ_0 is a constant, the output voltage across the secondary coil is

A. 120 V.

B. 220 v

C. 30 V .

D. 90 V

Answer: A

Watch Video Solution

2. What is the value of inductance L for which the current is maximum in a series LCR circuit with $C = 10\mu F$ and $\omega = 1000s^{-1}$?

A. 1 mH

B. Cannot be calculated unless R is known

C. 100 mH

D. 10 mH.

Answer: C

Watch Video Solution

3. Power dissipated in an $L-C-R$ series circuit connected to an AC source of emf ε is

A. $\dfrac{\varepsilon o n^2 \sqrt{R^2+\left(L\omega-\frac{1}{C\omega}\right)^2}}{R}$

B. $\dfrac{\varepsilon\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}{R}$

C. $\dfrac{\varepsilon^2 R}{\sqrt{R^2+\left(L\omega-\frac{1}{C\omega}\right)^2}}$

D. $\dfrac{\varepsilon^2 R}{\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}$

Answer: D

Watch Video Solution

4. In the given circuit, the readings of voltmeter V_1 and V_2 are 300 volt each. The readings of the voltmeter V_3 and ammeter A are respectively:

A. 220 V, 2.0 A

B. 100 V, 2.0 A

C. 150 V, 2.2 A

D. 220 V, 2.2 A.

Answer: D

5. A 220 V input is supplied to a transformer . The output circuit draws a current of 2.0 ampere at the current drawn by the primary winding of the transformer is

A. 2.5 ampere.

B. 5.0 ampere

C. 3.6 ampere

D. 2.8 ampere

Answer: B

View Text Solution

6. An inductor $20mH$, a capacitor $100\mu F$ and a resistor 50Ω are connected in series across a source of emf, $V = 10\sin 314t$. The power loss in the circuit is

A. 2.74 W

B. 0.43 W

C. 0. 79 W

D. 1.13 W

Answer: C

Watch Video Solution

7. A coil of self-inductance L is connected in series with a bulb B and an AC source. Brightness of the bulb decreases when

A. number of turns in the coil is reduced.

B. a capacitance of reactance $X_C = X_L$ is included in the same circuit.

C. an iron rod is inserted in the coil.

D. frequency of the AC source is decreased.

Answer: C

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8. Two cirties are 75 km apart . Electric power is sent from one city to another city through copper wires. Resistance per km is 0.5 Ω. The power loss in the wire is

A. 19.2 W.

B. 19.2 k W.

C. 19.2 J.

D. 12.2 kW.

Answer: B

View Text Solution

9. A transformer having efficiency of 80% is working on 200 V and 2 kW power supply. If the current in the secondary coil is 8A, the voltage across the secondary coil and the current in the primary coil respectively are

A. 200 V, 10 A.

B. 450 V, 15 A

C. 450 V, 13.5 V

D. 600 V, 15 A

Answer: B

Watch Video Solution

10. A resistance R draws power P when connected to an AC source. If an inductance is now placed in series with the resistance, such that the impedence of the circuit becomes Z, the power drawn will be

A. $P\sqrt{\dfrac{R}{Z}}$

B. $P\left(\dfrac{R}{Z}\right)$

C. P

D. P$\left(\dfrac{R}{Z}\right)^2$

Answer: D

Watch Video Solution

11. In an ac circuit an alternating voltage $e = 200\sqrt{2}\sin 100t$ volts is connected to a capacitor of capacity 1 μF. The rms.value of the current in the circuit is

A. 10 mA.

B. 100 mA.

C. 200 mA.

D. 20 mA.

Answer: D

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12. An AC voltage is applied to a resistance R and an inductor L in series . If R and the inductive reactance are both equal to 3 Ω, the phase difference between the applied voltage and the current in the circuit is

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

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

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

D. zero.

Answer: B

View Text Solution

13. An inductor 20 mH, a capacitor 50 μF and a resistor 40 Ω are connected in series across a source of emf, V = 10 sin 340 t. the power loss in AC circuit is

A. 0.67 W.

B. 0.46 W.

C. 0.89 W.

D. 0.51 W.

Answer: B

View Text Solution

14. A small signal voltage $V(t) = V_0 \sin \omega t$ is applied across an ideal capacitor C:

A. Over a full cycle the capacitor C does not consume any energy from the voltage source .

B. Current I(t) is in phase with voltage V(t)

C. Current I(t) leads voltage V(t) by 180°.

D. Current I(t) lags voltage V(t) by 90°.

Answer: A

Watch Video Solution

15. Figure shows a circuit that contains three indentical resistance with resistance.

R = 9.0 Ω each, two indentical inductors with inductance L = 2.0 mH each, and an ideal battery with emf ε = 18 V. The current 'I' through the battery just after the switch closed is

A. 2.0 mA

B. 0.2 A

C. 4.0 mA

D. 4.0 A

Answer: D

View Text Solution

Competition File Jee Main Other State Boards For

1. A 20 Henry inductor coil is connected to a 10 ohm resistance in series as shown in figure . The time at which rate of dissipation of energy (joul's heat) across resistance is equal to the rate at which magnetic energy is strored in the inductor , is

A. $\frac{2}{In2}$

B. In 2

C. $\frac{1}{2}$ In2

D. 2In 2

Answer: D

View Text Solution

2. An alternating voltage v(t) = 220 sin 100 pt volt is applied to a purely resistive load of 50Ω. The time taken for the current to rise from half of the peak value to the peak value is :

A. 2.2 ms

B. 3.3 ms

C. 5 ms

D. 7.2 ms

Answer: B

Watch Video Solution

3. In the circuit shown below, the key K is closed at t = 0. The current through the battery is

A. $\dfrac{V(R_1 + R_2)}{R(1)R_2}$ at t = 0 and $\dfrac{V}{R_2}$ at t = ∞

B. $\dfrac{VR_1R_2}{\sqrt{R_1^2 + R_2^2}}$ at t = 0 and $\dfrac{V}{R_2}$ at t = ∞

C. $\dfrac{V}{R_2}$ at t = 0 and $\dfrac{V(R_1 + R_2)}{R_1R_2}$ at t = ∞

D. $\dfrac{V}{R_2}$ at t = 0 and $\dfrac{VR_1R_2}{\sqrt{R_1^2 + R_2^2}}$ at t = ∞

Answer: C

View Text Solution

4. Combination of two identical capacitors, a resistor R and a dc voltage source of voltage $6V$ is used in an experiment on a $(C - R)$ circuit. It is found that for a parallel combination of the capacitor the time in which the voltage of the fully charged combination reduces to half its original voltage is 10 second. For series combination the time needed for reducing the voltage of the fully charged series combination by half is-

A. 10 second

B. 5 second.

C. 2.5 second.

D. 20 second.

Answer: C

Watch Video Solution

5. A fully charged capacitor C with initial charge q_0 is connected to a coil of self inductance L at t=0. The time at which the energy is stored equally between the electric and the magnetic fields is

A. $\frac{\pi}{4}\sqrt{LC}$

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

C. $\sqrt{LC}$

D. $\pi\sqrt{LC}$

Answer: A

Watch Video Solution

6. A resistor 'R' and $2(\mu)F$ capacitor in series is connected through a switch to 200 V direct supply. A cross the capacitor is a neon bulb that lights up at 120 V. Calculate the value of R to make the bulb light up 5 s after the switch has been closed. $(\log_{10} 2.5 = 0.4)$

A. $1.7 \times 10^5 \Omega$

B. $2.7 \times 10^6 \Omega$

C. $3.3 \times 10^7 \Omega$

D. $1.3 \times 10^4 \Omega$

Answer: B

Watch Video Solution

7. The figure shows an experimental plot for discharging of a capacitor in an R-C circuit . The time constant τ of the circuit lies between

A. 100 sec and 150 sec.

B. 150 sec and 200 sec.

C. 0 and 50 sec.

D. 50 sec and 100 sec.

Answer: D

View Text Solution

8. In an LCR circuit as shown in the both switches are open initially. Now switch S_1 is closed . S_2 kept open (q is charge on the capacitor and τ = RC is capacitive time constant). Which of the following statement is correct?

A. At t = τ, q = CV/2

B. At t = 2τ, q = CV $\left(1 - e^{-2}\right)$

C. At t = $\frac{\tau}{2}$, q = CV $\left(1 - e^{-1}\right)$

D. Work done by the battery is half of the energy dissipated in the resistor.

Answer: B

View Text Solution

9. In the circuit shown here, the point 'C' is kept connected to point 'A' till the current flowing through the circuit becomes constant. Afterward, suddenly, point 'C' is disconnected from point 'A' and connected to point ' B' at time t = 0 . Ratio of the voltage across resistance and the inductor at t = L/R will be equal to

A. $\frac{1-e}{e}$

B. $\frac{e}{1-e}$

C. 1

D. -1.

Answer: D

View Text Solution

10. A sinusoidal voltage V(t) = 100 sin $(500t)$ is applied across a pure inductance of L = 0.02 H. the current through the coil is

A. 10 cos (500t).

B. -10 cos (500t).

C. 10 sin (500t)

D. -10 sin (500t)

Answer: B

View Text Solution

11. For the LCR circuit, shown here, the current is boserved to lead the applied voltage . An additional capacitor C', When joined with the capacitor C present in the circuit makes the power factor of the circuit unity. The capacitor C' must have been connected in

A. series with C and has a magnitude $\frac{1-\omega^2 LC}{\omega^2 LC})$

B. series with C and has a magnitude $\frac{C}{(\omega^2 LC - 1)}$

C. parallel with C and has a magnitude $\frac{C}{(\omega^2 LC - 1)}$

D. parallel with c and has a magnitude

$$\frac{1-\omega^2 LC}{\omega^2} L$$

Answer: D

View Text Solution

12. An LCR circuit is equivalent to a damped pendulum. In an LCR circuit the capacitor is charged to Q_0 and then connected to the L and R as shown below:

If a student plots graphs of the square of maximum charge $(Q^2_{\max})$ on the capacitor with time (t) for two different values L_1 and $L_2 (L_1 > L_2)$ of L, then which of the following graphs represents this correctly ?

(plots are schematic and not drawn to scale)

A.

B.

C.

D.

Answer: A

View Text Solution

13. An inductor (L = 0.03 H and a resistor (R = 0.15 k Ω) are connected in series to a battery of 15 V emf in a circuit shown below. The key K_1 has been kept closed for a long time then at t = 0 , K_1 is opened and key K_2 is closed simultaneously. At t = 1 ms , the current in the circuit will be

A. 100 mA.

B. 67 mA.

C. 6.7 mA

D. 0.67 mA

Answer: D

View Text Solution

14. A series LR circuit is connected to a voltage source with V(t) = V_0 sin ω t. after very large time, current I(t) behaves as $\left(t_0 > > \frac{L}{R}\right)$

A.

B.

C.

D.

Answer: B

View Text Solution

15. An are lamp requires a direct current of 10A at 80V to function. If it is connected to a

220V(rms), 50 Hz AC supply, the series inductor needed for it to work is close to:

A. 80 H

B. 0.08 H

C. 0.044 H

D. 0.065 H

Answer: D

Watch Video Solution

16. In an a.c. circuit, the instantaneous e.m.f. and current are given by e = 100 sin 30 t $i = 20\sin\left(30t - \frac{\pi}{4}\right)$ In one cycle of a.c., the average power consumed by the circuit and the wattless current are, respectively :

A. $\frac{50}{\sqrt{2}}$, 0

B. 50 , 0

C. 50 , 10

D. $\frac{1000}{\sqrt{2}}$, 10

Answer: D

Watch Video Solution

17. In R-L-C series circuit, the potential difference across each element is 20 V. Now the value of hte resistance alone is doubled, then PD across R, L and C respectively.

A. 20 V, 10 V , 10 V

B. 20 V, 20 V, 20 V.

C. 20V, 40 V, 40 V.

D. 10 V, 20 V, 20 V.

Answer: A

Watch Video Solution

18. A series combination of resistor (R), capacitor (C) is connected to an AC source of angular frequency ω. Keeping the voltage same, If the frequency is changed to $\frac{\Omega}{3}$, the current becomes half of the original current. Then, the ratio of the capacitance reactance and resistance at the former frequency is

A. $\sqrt{0.6}$

B. $\sqrt{3}$

C. $\sqrt{2}$

D. $\sqrt{6}$

Answer: A

Watch Video Solution

19. A multimeter reads a voltage of a certain A.C. source as $100V$. What is the peak value of voltage of A.C. source?

A. 200 V.

B. 100 V.

C. 141.4 V

D. 400 V

Answer: C

Watch Video Solution

20. A power transmission line feeds input power at 2300 V a step down transformer with its primary windings having 4000 turns. The output power is delivered at 230 V by the transformer. If the current in the primary of the transformer is 5A and its efficiency is 90%, the output current would be :

A. 45 A

B. 50 A

C. 20 A

D. 25 A

Answer: A

Watch Video Solution

21. A step-down transformer has 50 turns on secondary and 1000 turns on primary winding. If a transformer is connected to 220 V, 1A C AC source, then what is output current of the transformer ?

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

B. 20 A

C. 100 A

D. 2A

Answer: B

Watch Video Solution

22. In the following circuit th switch S is closed at t = 0 . The charge on the capacitor C_1 as a fouction of time will be given by $\left(C_{eq}=\frac{C_1C_2}{C_1+C_2}\right)$

A. C_2 E$[1-\exp(-eR/C_1)]$

B. $C_{\text{eq}}E\exp(-t/RC_{eq})$

C. $C_{\text{eq}}E[1 - \exp(-t/RC_{eq})]$

D. $C_2E[1 - \exp(-t/RC_2)]$

Answer: C

View Text Solution

23. For an RLC circuit driven with voltage of amplitude v_m and frequency $\omega_0 = \frac{1}{\sqrt{LC}}$ the current exibits resonance. The quality factor, Q is given by :

A. $\frac{R}{\omega_0 C})$

B. $\frac{CR}{\omega_0}$

C. $\frac{\omega_0 L}{R}$

D. $\frac{\omega_0 R}{L}$

Answer: C

Watch Video Solution

24. A capacitor of capacitance $10\mu F$ is connected to an AC source and an AC Ammeter. If the source voltage varies as

$V = 50\sqrt{2}\sin 100t,$ the reading of the ammeter is

A. 50 mA.

B. 70.7 mA

C. 5.0 mA

D. 7.07 mA.

Answer: A

Watch Video Solution

25. In the AC circuit shown, keeping 'K' pressed , if an iron rod is inserted into the coil, the bulb in the circuit

A. glows more brightly.

B. gets damaged.

C. glows with same brightness (as before the rod is inserted)

D. glows less brightly.

Answer: D

View Text Solution

26. A sinusoidal voltage of peak value 283 V and angular frequency 320/s is applied to a series LCR circuit. Given that R = 5 Ω L = 25 mH and C = 1000 μ F. The total impedance, and phse difference between the voltage across the source and the current will respectively be

A. 10 Ω and $\left(\frac{5}{3}\right)$.

B. 7Ω and 45°.

C. 10Ω and $\left(\frac{8}{3}\right)$

D. 7Ω and $\left(\frac{5}{3}\right)$.

Answer: B

Watch Video Solution

Competition File Jee Advanced For Iit Entrance

1. An AC voltage source of variable angular frequency ω and fixed amplitude V_0 is connected in series with a capacitance C and an electric bulb of resistance R (inductance Zero). When ω is increase.

A. the bulb glows dimmer

B. the bulb glows brighter.

C. total impedance of the circuit is unchanged

D. total impedance of the circuit increase.

Answer: B

Watch Video Solution

2. Find the time constant (in ms) for the given RC circuits in the given order respectively.

$R_1 = 1\Omega,\ R_2 = 2\Omega,\ C_1 = 4\mu R,\ C_2 = 2\mu\text{F},$

A. $18,\ 4,\ \frac{8}{9}$

B. $18,\ \frac{8}{9},\ 4$

C. $4,\ 18,\ \frac{8}{9}$

D. $4,\ \frac{8}{9},\ 18$

Answer: B

View Text Solution

3. A series R-C combination is connected to an AC voltage of angular frequency $\omega = 500 radian / s$. If the impendance of the R-C circuit is $R\sqrt{1.25}$, the time constant (in millisecond) of the circuit is

A. 1 ms

B. 2 ms

C. 3 ms

D. 4 ms

Answer: D

Watch Video Solution

4. When an AC source of emf E = E_0 sin (100t) is connected across a circuit, the phase difference between emf E and Current I in the circuit is observed to be $\frac{\pi}{4}$, as shown in the figure. If the

circuit consists possibly only of R - C or R - L or

L - C in series , what will be the relation between the two elements of circuit ?

A. R = 1 k Ω C = 10 μ F

B. R = 1 k Ω , C = 1 μF

C. R = 1 k Ω , L = 10 H

D. R =1 k Ω, L = 1 H

Answer: A

View Text Solution

1. There is an AC source of rms voltage 200 V and frequency 50 Hz. When the source is connected to a circuit then rms current flowing in the circuit is 15 A. Average power delivered by the source

A. is equal to 3000 W.

B. may be 3000 W

C. may be less than 3000 W.

D. may be greater than 3000 W.

Answer: B::C

Watch Video Solution

2. The reactance of a circuit is zero. It is possible that the circuit contains

A. L, C and R.

B. L and C.

C. L and R.

D. R and C.

Answer: A::B

Watch Video Solution

3. L, C and R represent the physical quantities inductance, capacitance and resistance respectively. The combinations which have the dimensions of frequency are-

A. 1/RC

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

C. R/L

D. L/R

Answer: A::B::C

Watch Video Solution

4. The SI unit of inductance the Henry can not be written as :

A. Ω-s.

B. Wb/A

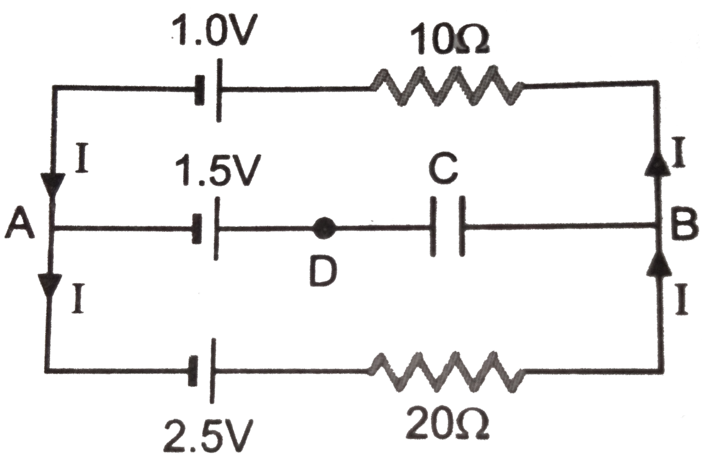
C. J/A^2

D. volt-s/A.

Answer: A::B::C::D

Watch Video Solution

5. In the circuit diagram find the potential difference across the plates of capacitor C



A. $I_1 > I_2$

B. $I_1 < I_2$

C. $V_C > V'_C$

D. $V_C < V'_C$

Answer: B::C

Watch Video Solution

6. In an AC series circuit, the instanctaneous current is zero when the instantaneous voltage is xamimum. Connected to the source may be a

A. ideal inductor

B. ideal capacitor

C. combination of ideal inductor and capacitor

D. ideal resistor .

Answer: A::B::C

Watch Video Solution

7. Name the device which converts mechanical energy into electrical energy.

A. DC generator

B. AC generator

C. Transformer

D. Motor

Answer: A::B

Watch Video Solution

8. There is one long straight conductor carrying current which is kept along the dimaeter of a circular loop without touching it.

A. emf induced in the loop is zero if AC current is flowing through the straight conductor

B. emf induced in the loop is zero if current in the straight conductor increases.

C. emf induced in the loop is zero if current in the straight conductor decreases.

D. emf induced in the loop is zero constant current flows through the straight conductor .

Answer: A::B::C::D

Watch Video Solution

9. An inductor-coil having some resistance is connected to an AC source. Which of the following quantities have zero average value over a cycle?

A. Induced emf in the inductor

B. Current

C. joules heat

D. Magnetic energy stored in inductor

Answer: A::B

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10. A constant current I is maintained in a solenoid. Which of lthe following quantities will increase if an iron rod is inserted in the solenoid along its asix?

A. Self-inductance of solenoid

B. Magnetic flux associated with the solenoid

C. Magnetic field inside the solenoid

D. Rate of heat dissipation.

Answer: A::B::C

Watch Video Solution

11. A sereis R-C circuit is connected to AC voltage source. Consider two cases, (A) when C is without a dielectric medium and (B) when C is filled with dielectric of constant 4. The current I_R through the resistor and voltage V_c across the capacitor are compared in the two cases. Which of the following is/ are true?

A. $I_R^A > I_R^B$

B. $I_R^A < I_R^B$

C. $V_C^A > V_C^B$

D. $V_C^A < V_C^B$

Answer: B::C

Watch Video Solution

12. In the given circuit, the AC source has ω = 100 rad/s. considering the inductor and capacitor to be ideal, the correct choice (s) is

(are)

A. The current through the circuit I is 0.3 A

B. The current through the circuit I is 0.3 $\sqrt{2}$ A.

C. the voltage across 100 Ω resistor = $10\sqrt{2}$ V .

D. the voltage across 50 Ω resistor = 10V .

Answer: A::C

View Text Solution

13. Two metallic rings A and B, identical in shape and size but having different resistivity ρ_A and ρ_B, are kept on top of two identical solenoids as shown in the figure. When current I is switched on in both the solenoids in identical manner, the rings A and B jump to heights h_A and h_B respectively, with $h_A > h_B$. the possible relation(s) between their resistivity and their masses m_A and m_B is (are)

A. $\rho_A > \rho_B$ and $m_A = m_B$.

B. $\rho_A < \rho_B$ and $m_A = m_B$.

C. $\rho > \rho_B$ and $m_A < m_B$

D. $\rho_A < \rho_B$ and $m_A < m_B$.

Answer: B::D

View Text Solution

14. In the circuit shown, L = 1 μ H, C = 1 μF and R = 1 kΩ they are connected in series with AC source V = V_0 sin ωt as shown . Which of the following options is/are correct ?

A. the current will be in phase with the voltage if $\omega = 10^4$ rad / s.

B. At $\omega > \; > 10^6$ rad/s, the circuit behaves like a capacitor.

C. The frequency at which the current will be in phase with the voltage is independent of R.

D. At $\omega \sim 0$ the current flowing through the circuit becomes nearly zero.

Answer: C::D

View Text Solution

15. The instantaneous voltages at three terminals marked X, Y and Z are given by [

$$V_x = V_0 \sin \omega t,$$

$$V_Y = V_0 \sin\left(\omega t + \frac{2\pi}{3}\right)$$ and

$$V_Z = V_0 \sin\left(\omega t + \frac{4\pi}{3}\right)$$

An ideal voltmeter is configured to read rms value of the potential difference between its terminals. It is connected between points X and Y and then between Y and Z. The reading(s) of the voltmeter will be

A. $V_{XY}^{rms} = V_0\sqrt{\frac{3}{2}}$.

B. $= V_{YZ}^{rms} = V_0\sqrt{\frac{1}{2}}$.

C. independent of the choice of the two terminals.

D. $V_{XY}^2 rms) = V_0$.

Answer: A::C

Watch Video Solution

16. At time t = 0. terminal A in the circuit shown in the figure is connected to B by a key and an alternating current I(t) = I_0 cos (ωt), withI_0 = 1 A and ω= 500 rass^{-1} starts flowing in it with the initial direction shown in the figure . At t = $\frac{7\pi}{6\omega}$, the key is switched from B to D. Now onwards only A and D are connected . A total charge Q flows from the battery to charge the capacitor fully. if C =

20 μ F ,

R = 10 Ω and the battery is ideal with emf of 50

V, indentify the correct statement (s).

A. Magnetic of the maximum charge on the

capacitor before t = $\frac{7\pi}{6\omega} is 1 \times 10^{-3}$ C.

B. the current in the left part of the circuit

just before t = $\frac{7\pi}{6\omega}$ is clockwise.

C. Immediately after A is connected to D,

the current in R is 10 A.

D. Q = 2×10^{-3} C.

Answer: C::D

View Text Solution

17. In the figure below, the switches S_1 and S_2 are closed simultaneously at t = 0 and a current starts to flow in the circuit. Both the batteries have the same magnitude of the electromotive force (emf) and the polarities are as indicated in the figure. Ignore mutual inductance between the inductors. the current I in the middle wire reaches its maximum magnitude $I_{\max}$ at time t = τ . Which of the following statement is (are) true?

A. $I_{\max} = \dfrac{V}{2R}$

B. $I_{\max} = \dfrac{V}{4R}$

C. $\tau = \dfrac{L}{R}$In 2

D. $\tau = \dfrac{2L}{R}$In 2

Answer: B::D

View Text Solution

Competition File D Multiple Choice Questions

1. A resistance of 40 Ω is connected in series with inductor of self-inductance 5 H and a capacitor of capacitance 80 μF. This combination is connected to an AC source of rms voltage 220 V. frequency of AC source can changed continuously.

What should be the frequency of source which drives circuit to resonance ?

A. $\frac{100}{\pi}$

B. $\frac{75}{\pi}$

C. $\frac{50}{\pi}$

D. $\frac{25}{\pi}$

Answer: D

Watch Video Solution

2. A resistance of 40 Ω is connected in series with inductor of self-inductance 5 H and a capacitor of capacitance 80 μF. This combination is connected to an AC source of rms voltage 220 V. frequency of AC source can changed continuously.

What is the impedance of circuit in a state of resonance ?

A. 40 Ω

B. 80 Ω

C. 400 Ω

D. 800 Ω

Answer: A

Watch Video Solution

3. A resistance of 40 Ω is connected in series with inductor of self-inductance 5 H and a capacitor of capacitance 80 μF. This combination is connected to an AC source of rms voltage 220 V. frequency of AC source can changed continuously.

What rms current flows in circuit in a state of resonance ?

A. 11 amp

B. 5.5 amp

C. $11\sqrt{2}$ amp

D. $5.5\sqrt{2}$ amp

Answer: B

Watch Video Solution

4. A resistance of 40 Ω is connected in series with inductor of self-inductance 5 H and a capacitor of capacitance 80 μF. This combination is connected to an AC source of rms voltage 220 V. frequency of AC source can changed continuously.

What is the average power consumed by circuit ?

A. 605 W

B. 1210 $\sqrt{2}$ W

C. 1210 W

D. 1210/$\sqrt{2}$ W

Answer: C

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5. Current flowing through an inductor as a function of time is given as follows :

I = 4 + 16 t. here I is in amperes and t is in seconds. Emf induced in the inductor is 20 mV. What is self-inductance of the inductor ?

A. 1.25×10^{-3} H

B. 2.5×10^{-4} H

C. 1.25×10^{-4} H

D. 5×10^{-3} H

Answer: A

Watch Video Solution

6. Current flowing through an inductor as a function of time is given as follows :

$I = 4 + 16\ t$. here I is in amperes and t is in seconds. Emf induced in the inductor is 20 mV. Rate of energy supplied to inductor at t = 2 s is

A. 0.36 W

B. 0.72 W

C. 1.44 W

D. 2.88 W

Answer: B

Watch Video Solution

7. A capacitor having capacitance C can be charged (with the help of a resistor having resistance R) by a battery of voltage V, by closing switch S_1 and at the same time keeping switch S_2 open. The capacitor can be connected in series with an inductor with inductance L by closing switch S_2 and opening S_1 .

Initially, the capacitor was uncharged. Now, switch S_1 is closed and S_2 is kept open. If time constant of this circuit is τ, then

A. after time interval τ, charge on the capacitor is CV/2.

B. after time interval 2π charge on the capacitor is CV $\left(1 - e^{-2}\right)$.

C. the work done by the vltage source will be half of the heat dissipated when the capacitor is fully charged .

D. after time interval 2τ, charge on the capacitor is CV $\left(1 - e^{-1}\right.$.

Answer: B

View Text Solution

8. A capacitor having capacitance C can be charged (with the help of a resistor having resistance R) by a battery of voltage V, by closing switch S_1 and at the same time keeping switch S_2 open. The capacitor can be connected in series with an inductor with inductance L by closing switch S_2 and opening S_1 .

After the capacitor gets fully charged , S_1 is opened and S_2 is closed so that the inductor is connected in series with the capacitor .

then,

A. at $t = 0$, energy stored in the circuit is purely in the form of magnetic energy.

B. at any time $t > 0$, current in the circuit is in the same direction.

C. at $t > 0$, there is no exchange of energy between the inductor and capacitor .

D. at any time $t > 0$, maximum instantaneous current in the circuit may be V $\sqrt{\frac{C}{L}}$.

Answer: D

View Text Solution

9. A capacitor having capacitance C can be charged (with the help of a resistor having resistance R) by a battery of voltage V, by closing switch S_1 and at the same time keeping switch S_2 open. The capacitor can be connected in series with an inductor with inductance L by closing switch S_2 and opening S_1 .

If the total charge stored in the LC circuit is Q_0, then for t $>$ 0

A. The charge on the capacitor is Q = Q_0 cos $\left(\frac{\pi}{2}+\frac{t}{\sqrt{LC}}\right)$.

B. the charge on the capacitor is Q = Q_0 cos $\left(\frac{\pi}{2}-\frac{t}{\sqrt{LC}}\right)$.

C. the charge on the capacitor is Q = -

$$LC\frac{d^2Q}{dt^2}.$$

D. the charge on the capacitor is Q = -

$$\frac{1}{\sqrt{LC}}\frac{d^2Q}{dt^2}.$$

Answer: C

View Text Solution

10. Consider a simple RC circuit as shown in figure (a).

Process 1 : In the circuit , the switch S is closed at t = 0 and the capacitor is fully charged to voltage V_0 (i.e., charging continues for time T $>>$ RC). In the process some dissipation (E_D) occurs across the resistance R. the amount of energy finally stored in the fully charged capacitor is E_C.

In a different process, the voltage is first set to $\frac{V_0}{3}$ and maintained for a charging time T $>>$ RC then the voltage is raised to $\frac{2V_0}{3}$ without discharging the capacitor and again maintained for a time T $>>$ RC .

The process is repeated one more time by raising the voltage to V_0 and the capacitor is charged to the same final voltage V_0 as in process 1.

These two process are depicted in figure (b)

In process 1 , the energy stored in the capacitor EC and heat dissipated across resistance ED are related by

A. $E_C = \frac{1}{2} E_D$

B. $E_C = E_D$ In2.

C. $E_C = 2E_D$

D. $E_C = E_D$

Answer: D

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11. Consider a simple RC circuit as shown in figure (a).

Process 1 : In the circuit , the switch S is closed at t = 0 and the capacitor is fully charged to voltage V_0 (i.e., charging continues for time T $> >$ RC). In the process some dissipation (E_D) occurs across the resistance R. the amount of energy finally stored in the fully charged capacitor is E_C.

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The process is repeated one more time by raising the voltage to V_0 and the capacitor is charged to the same final voltage V_0 as in process 1.

These two process are depicted in figure (b)

In process 2, total energy dissipated across the resistance E_D is

A. $E_D = 3\left(\frac{1}{2}CV_0^2\right).$

B. $E_D = \frac{1}{3}\left(\frac{1}{2}CV_0^2\right)$

C. $E_D = 3CV_0^2.$

D. $E_D = \frac{1}{2}CV_0^2.$

Answer: B

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12. A thermal power plant produed electric power of 600kW at 4000V, which is to be transported to a place 20 km away form the power plant for consumer's usage. It can be transported either directly with a cable of large current carrying capacity or by sing a combination of step-up and step-down transfprmers at the two ends. THe drawback of the direct transmission is the large energy dissipation. In the method wsing transformers, the dissipatiion is much smaller. In this method a step-up transformers is used at the plant side so that the current is reduced to a smaller value. At the consumers'end, a step-down transformer is used to supply power to the consumers at the specified lower voltage. It is reasonable to assume that the power cable is purely resostive and the transformers are ideal with power factor unity. All the currents and voltagementioned are values.

If hte direct transmission method with a cable of resistance $0.4(\omega)km^{-1}$ is used, the power dissipation (in %) during transmission is

A. 20

B. 30

C. 40

D. 50

Answer: B

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13. A thermal power plant produces electric power of 600 kW at 4000 V, which is to be transported to a place 20 km away from the power plant for consumers' usage . It can be transported either directly with a cable of large current-carrying capacity or by using a combination of step-up and step-down transformers at the two ends. the drawback of the direct transmission is the large energy dissipation is much smaller. In this method, a step-up transformer is used at the plant side so that the current reduced to a smaller value. At the consumers' end. a step-down transformer is used to supply power to the consurmer at the specified lower voltage . it is reasonable to assume that the power cable is purely resistive and the transformers are ideal with a power factor unity. All the currents and voltages mentioned are rms values.

In the method using the transformers, assume that the ratio of the number of turns in the primary to that in the secondary in the step-up transformer is 1 : 10. If the power to the consumer has to be supplied at 200 v, the ratio of he number of turns in the primary to that in the secondary in the step-down transformer is

A. $200 : 1$

B. $150 : 1$

C. $100:1$

D. $50:1$

Answer: A

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Competition File Assertion Reason Type Questions

1. Assertion : Wires carrying AC current are made of multiple strands.

Reason: AC flows on the surface of the conductor and it is known as skin effect.

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

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

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: A

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2. Assertion : A transformer cannot work on dc supply.

Reason : dc changes neither in magnitude nor in direction.

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

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

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: A

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3. Assertion: when DC ammeter is used to measure current, then it measures average current flowing in the circuit .

Reason : DC ammeter is based on heating effect of current .

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

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

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: C

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4. Assertion : In a practical choke coil, power factor is very small.

Reason : In a practical choke coil, heat dissipation reduces when frequency of AC source is increased.

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

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

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: B

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5. STATEMENT-1: When a coil is connected to a cell, no current flows through it initially.

STATEMENT-2: When a coil is connected to a cell, the initial emf induced in it is equal to the emf of the cell.

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

B. If both assertion and reason are correct but reason is not the correct

explanation of assertion

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: A

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6. Assertion : Instruments used for measuring alternating voltage and current have non-uniform divisions on their scales.

Reason: Insteruments used for measuring alternating voltage and current are based on heating effect of current.

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

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

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: A

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7. Assertion : Step-down transformer can also be used as step-up transformer.

Reason: Ratio of voltage across primary and secondary coils is the same as ratio of respective number of turns.

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

B. If both assertion and reason are correct but reason is not the correct

explanation of assertion

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: A

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8. Assertion : Practical inductor cannot have zero resistance .

Reason: Wire of some material is used to make the inductor, and there is always some resistance associated with the wire.

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

B. If both assertion and reason are correct but reason is not the correct

explanation of assertion

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: A

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9. Assertion : AC circuit derives maximum power when it is in a state of resonance.

Reason: Power factor of the circuit becomes zero in case of reasonance.

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

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

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: C

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10. Assertion : in case of DC circuit , current through the branch of capacitor is zero .

Reason : Reactance of the capacitor is $1/\omega C$

and ω for the DC source can be assumed to the zero, hence reactance of capacitor for DC circuit becomes infinite .

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

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

C. If assertion is correct but reason is incorrect

D. If assertion is inncorrect but reason is correct

Answer: A

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Competition File Integer Type Questions

1. 200 V AC is applied to primary coil of a transformer and it is found that output current is 8 A and output voltage is 50 V. Assume no energy loss. Find the current in primary coil I ampere.

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2. In a series LCR circuit, rms voltage across inductor and capacitor are found ot be 8 V and 5 V respectively. If applied voltage is 5 volts, then what is rms voltage across resistance in volts ?

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3. Magnitude of power factor of an LCR circuit is found to lie between 0 and n. what is value of n.

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4. What is the power factor of an LCR circuit connected to an AC source of angular frequency $\frac{1}{\sqrt{LC}}$?

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5. A transformer has 50 turns in the primary and 100 in the secondary. If the primary is connected to a $220VDC$ supply, what will be the voltage across the secondary?

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6. A resistor of resistance 100 Ω is connected in series with an inductor of self-inductance $\sqrt{3}$. H. this combination is connected to an AC source rated as 220 V-50 $/\pi$ Hz. Power factor of the circuit is found to be 1/n. What is the value of n ?

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7. A charged capacitor is connected to an inductor . At a particular instant, energy stored in inductor is 8/9 times of initial energy stored In capacitor . What is the ratio of initial charge on capacitor to that with instantaneous charge on capacitor ?

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8. Two inductors L_1(inductors 1 mH, internal resistance 3 Ω) and L_2 (inductance 2mH, internal resistance 4Ω),and a resistor R(resistance12ω) are all connected in parallelacross a 5 V battery. The circuit is switched on at time t=0. The ratio of the maximum to the minimum current $(I_{\max} / I_{\min})$ drawn from the battery is

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9. A series R-C combination is connected to an AC voltage of angular frequency $\omega = 500$ rad/s. If the impedance of the R-C circuit is $R\sqrt{1.25}$, the time constant (in millisecnd) of the circuit is

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10. A log circular tube of length 10 m and radius 0.3 m carries a current I along its curved surface as shown . A wire -loop of resistance 0.005 Ω and of radius 0.1 m is placed inside the tube with its axis coinciding with the axis of the tube. The current the axis of the tube . the current varies as I = I_0 cos 300 t where I_0 is constant. if the magnetic moment of the loop is $N\mu_0 I_0 \sin(300t)$, then N is

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11. Two inductors L_1(inductors 1 mH, internal resistance 3 Ω) and L_2 (inductance 2mH, internal resistance 4Ω),and a resistor R(resistance12ω) are all connected in parallelacross a 5 V battery. The circuit is switched on at time t=0. The ratio of the maximum to the minimum current $(I_{\max} / I_{\min})$ drawn from the battery is

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Competition File Exemplar Problems Objective Questions Multiple Choice Question Type

1. If the rms current in a 50 Hz ac circuit is 5 A, the value of the current $1/300$ second after its value becomes zero is

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

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

C. 5/6 A

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

Answer: b

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2. 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 a rectance 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

Answer: c

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3. When a voltage measuring device is connected to a.c. mains the meter shows the steady input voltage of $220V$. This means

A. input voltage cannot be AC voltage , but a DC voltage .

B. maximum input voltage is 220 V.

C. the metre reads not V but $< V^2 >$ and is calibrated to read $\sqrt{< V^2 >}$

D. the pointer of the metre is stuck by some mechanical defect.

Answer: c

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4. 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.

Answer: b

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5. Which of the following combinations should be selected for better turning of an LCR circuit used for communication ?

A. $R = 20\ \Omega$, $L = 1.5\ H$, $C = 35\ \mu F$

B. $R = 25\ \Omega$, $L = 2.5\ H$, $C = 45\ \mu F$

C. $R = 15\ \Omega$, $L = 3.5\ H$, $C = 30\ \mu F$

D. $R = 25\ \Omega$, $L = 1.5\ H$, $C = 45\ \mu F$

Answer: c

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6. An inductor of reactance 2Ω and a resistor of 4Ω are connected in series to the terminals of a 12 V (rms) AC source. The power dissipated in the circuit is

A. 8 W

B. 12 W

C. 14.4 W

D. 28.8 W

Answer: d

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7. The output of a step-down transformer in measured to be12 V when connected to a 6 watt light bulb. The value of the peak current is

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

B. $\sqrt{2}$ A

C. $2A$

D. $2\sqrt{2}$ A

Answer: a

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8. As the frequency of an ac circuit increases, the current first increases and then decreases. What combination of circuit elements is most likely to comprise the circuit ?

A. Inductor and capacitor

B. Resistor and inductor

C. Resistor and capacitor

D. Resistor , inductor and capacitor

Answer: a,d

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9. In an alternating current circuit consisting of elements in series, the current increases on increasing the frequency of supply. Which of the following elements are likely to consitute the circuit ?

A. Only resistor

B. resistor and an inductor

C. Resistor and a capacitor

D. Only a capacitor

Answer: c,d

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10. Electrical energy is transmitted over large distances at high alternating voltages. Which of the following statements is (are) correct?

A. For a given power level, there is a lower current

B. Lower current implies less power loss

C. transmission lines can be made thinner.

D. It is easy to reduce the voltage at the reciving end using step-down transformers.

Answer: a,b,d

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11. For an LCR circuit, the power transferred from the driving source to the driven oscillator is $P = I^2 Z \cos \phi$.

A. here, the power factor cos $\phi \geq 0, P \geq 0$.

B. The driving force can give no energy to the oscillator (P = 0) in some cases.

C. The driving force cannot syphon $(p < 0)$ the energy out of oscillator.

D. The driving force can take away energy out of the oscillator.

Answer: a,b,c

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12. When an AC voltage of 220 V is applied to the capacitor C

A. the maximum voltage between plates is 220 V.

B. the current is in phase with the applied voltage.

C. The charge on the plates is in phase with the applied voltage .

D. power delivered to the capacitor is zero

Answer: c,d

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13. The line the draws power supply to your house from street has

A. zero average current .

B. 220 V average voltage .

C. Voltage and current outf phase by 90°.

D. voltage and current possibly differing in phase ϕ such that $|\phi| < \frac{\pi}{2}$.

Answer: a,d

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Chapter Practice Test

1. Write the relation between the rms value and peak value of AC.

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2. Discuss the phase relationship between current and emf in an circuit containing a capacitance only.

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3. In a series LCR circuit, $V_L = V_C \neq V_R$. What is the value of power factor ?

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4. Why cannot a transformer be used to step up d.c. voltage ?

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5. Why do we prefer a choke coil to a rhestat in controlling a.c.?

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6. Why is electrical energy transmitted at high voltage from a distant power generating station ?

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7. A step down transformer converts transmission line voltage from 2200 V to 220 V. Primary coil is having 5000 turns. Efficiency of transformer is 90% and output power is 8 kW. Evaluate number of turns in secondary coil and input power.

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8. The rms value of current in a 50 Hz AC source is 4 A. What will be the value of current after 1/400 seconds after its value becomes zero ?

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9. An electric heater is connected to DC and AC sources of equal voltage turn by turn. In which case (AC or DC) the rate of heat production will be more ?

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10. Under which condition the current will lag behind the voltage? Explain.

(i) f = f_r (ii) f $< f_r$ (iii) f $> f_r$

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

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12. Show that in the free oscillations of an LC circuit, the sum of energies stored in the capacitor and and the inductor is constant in time.

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13. Can the voltage drop across the inductor or capacitro in a series LCR circuit be greater

than the applied voltage of the ac souce?

Justify your answer.

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14. An alternating voltage given by $V = 240 \sin 314\, t$ is connected across a pure resistor of 100 ohm. Find

(a) the frequency of the source.

(b) the rms current through the resistor.

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15. What is power factor of an LCR circuit ? Explain on the basis of power factor that an ideal inductor is a wattless component.

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

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

(c) When and inductor is connected to a 200 V DC voltage, a current of 1Aflows trough it. when the same inductor is connected to a 200 V, 50 Hz AC source, only 0.5 A current flows. Explain, why ? Also, calculate the self inductance of the inductor.

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