PHYSICS

BOOKS - JEEVITH PUBLICATIONS PHYSICS (KANNADA ENGLISH)

ALTERNATING CURRENT

One Marks Questions With Answers

1. What is meant by alternating current?

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2. Mention any one advantage of ac over dc.

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3. What is the phase relation between voltage and current in a resistor connected to an ac voltage?

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4. Give an expression for the average value of a time function F(t) over a complete time period.

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5. What is the value of $< \cos 2\omega t >$ over a complete period?

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6. Give the average value of $\sin^2 \omega t \left(< \sin^2 \omega t > \right)$.

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

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8. What will be the instantaneous power dissipation in the resistor connected to ac?

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9. Draw voltage and current waveform in a pure resistro connected to ac

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10. Mention the average value of ac over one complete ac cycle

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11. Relate v_{rms} and v_{peak} values of ac.

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12. Relate v_{rms} and v_{ave} over one half of an ac cycle.

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13. Will there be any energy loss in the case of a pure inductor or a pure capacitor connected in ac circuits?

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14. What is a low pass filter?

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15. What is the value of inductive reactance of a pure inductor connected to DC?

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16. Why is that a pure inductor not used to control DC?

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17. What is meant by a high pass filter?

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18. What is the value of capacitive reactance connected to DC?

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19. Give the expression for wattless component of current in a pure inductor or capacitor.

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20. Mention the power factor of a pure inductor or a capacitor.

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21. What is the value of power factor of a pure resistor?

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22. How does current in a pure resistor vary in terms of phase diagram with the voltage across it?

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23. How does current in a pure capacitor vary in terms of phase angle with the voltage across it?

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24. What does an ac voltmeter or an ac ammeter in an ac circuit measure?

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25. What does a DC voltmeter measure when connected across a load resistor in an ac circuit?

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26. Can a capacitor of suitable capacitance replace a choke coil in an ac circuit?

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

(b) Power factor can often be improved by the use of a capacitor of appropriate capacitance in the circuit. Explain.

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28. A choke coil is connected in series with a lamp and the combination across a dc supply. What happens to the intensity of light if an iron core is used in the coil?

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29. If ac supply is used and an iron core is introduced in a coil connected in series with the bulb, then what happens to the intensity of the bulb?

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30. Write the expression for the electromagnetic energy of an electrical system.

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31. Give the differential equation for an LC oscillator in the absence of an ac source and resistor.

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32. What is an alternating emf?

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33. What is an AC waveform?

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34. Define the period of an AC.

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35. Define the frequency of an Ac.

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36. Define the peak value of an AC.

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37. Define the mean value of an AC.

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38. Define the rms value of an AC.

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39. Give one method of generating a sinusoidal AC.

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40. Define instantaneous value of AC.

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41. Define inductive reactance. On what factors does it depend?

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42. Define capacitive reactance. On what factors does it depend?

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43. Define impedance of an AC circuit.

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44. Write the formula for the impedance of a series LCR circuit.

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45. What is the phase relation between current and voltage in a series LCR circuit in which $X_L < X_C$?

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46. What is the power factor of a series LCR circuit in which $X_L > X_C$?

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47. Under what condition will the current through a series LCR circuit be in phase with voltage?

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48. What is a choke?

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49. What is a transformer?

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50. When is a transformer said to be ideal?

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51. What is wattless current?

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52. What is a step up transformer?

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53. What is a step down transformer?

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Two Marks Questions With Answers

1. Draw a phasor diagram for the ac circuit comprising of a pure resistor.

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2. Draw phasor diagram for the ac circuit comprising of a pure inductor.

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3. Draw phasor diagram for the ac circuit comprising of a pure capacitor.

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4. Draw phasor diagram for a RLC series circuit connected to ac voltage source.

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5. Based on what principle does a transformer work? Explain.

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6. Define 'Q' factor and sharpness of resonant curve.

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7. What is the relation between rms and average values of a sinusoidal A.C. voltage?

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8. Give the differential equation for an LC oscillator.

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9. Give the expression for the instantaneous energy stored in a capacitor along with the meaning of the symbols used.

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10. Give the expression for the instantaneous energy stored in an inductor along with the meaning of the symbols used.

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11. If $V = V_m \sin \omega t$ represents instantaneous voltage connected across a resistor of resistance 'R' then write the expression for the instantaneous current in it.

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12. Write the equation for a sinusoidal AC voltage. Give meaning of the symbosl used.

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Three Marks Questions With Answers

1. Draw current v/s frequency curve for a series RLC circuit and explain the different portions of the curve.

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2. Distinguish between a pure inductor and a pure resistor.

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3. Distinguish between HF chokes and LF chokes.

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4. Define inductive reactance. On what factors does it depend?

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5. Define capacitive reactance. On what factors does it depend?

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6. Define the term power factor. What is the value of power factor for a pure resistor, pure inductor and pure capacitor?

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7. What are the uses of an induction coil?

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8. Distinguish between DC and AC.

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9. Show that the sum of electrostatic energy and magnetic energy in an LC oscillator equals $\frac{q_0^2}{2C}$.

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10. Give an expression for an ac driven series RLC circuit.

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11. S.T. average power over a complete cycle in a pure inductor connected to ac is zero.

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Five Marks Questions With Answers

1. Show that the current in a pure resistor is in phase with the ac voltage across it and hence S.T. average power dissipation in a resistor is i^2R where I is r.m.s value of ac.

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2. Show that voltage in an inductor leads the current by $\pi / 2$ rad for a pure inductor

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3. S.T. the voltage across a pure capacitor lags the current by 90° or $\frac{\pi}{2}$ rad.

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4. Obtain an expression for the impedance of a series LCR circuit. (using phasor diagram method).

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5. Give the expression for the impedance of an LCR circuit and obtain the expression for the resonant frequency. What is the power factor of the resonant circuit?

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6. Explain the advantage and disadvantages of AC over DC.

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7. Obtain an expression for the average power supplied to a series RLC circuit. Discuss the average power when the series RLC circuit behaves as a pure resistive, inductive or capacitive circuit.

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8. S.T an LC oscillator executes SHM and hence obtain an expression for the angular frequency of oscillation.

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9. Write a note a transformers.

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10. Give the qualitative explanation of the action of an LC oscillator in the absence of any external ac voltage source. Assume that the capacitor is charged initially.

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11. Obtain an expression for quality factor of series RLC circuit connected to ac source.

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12. Give analytical solution to a series RLC circuit connected to ac.

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Numericals With Solutions

1. A 220 AC voltage source is connected across a pure inductor of inductance 0.5 H. Find the current through the inductor, if the frequency of the source is

100 Hz

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2. A 220 AC voltage source is connected across a pure inductor of inductance 0.5 H. Find the current through the inductor, if the frequency of the source is

150 kHz

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3. A 220 AC voltage source is connected across a pure inductor of inductance 0.5 H. Find the current through the inductor, if the frequency of the source is 50Hz What is the power lost in the inductor?

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4. If a coil is to have a reactance of 16Ω for a frequency 2 kHz, then what must be its inductance? What will be its reactance at 10 Hz?

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5. A pair of adjacent coils have a mutual inductance of 0.25 H. If the current in the primary changes from zero to 2A in 0.05 s., then find the average induced emf in the secondary?

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6. A sinusoidal current is represented by the equation $I = 2\sin 100\pi t$. Calculate

Period

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7. A sinusoidal current is represented by the equation $I = 2\sin 100\pi t$. Calculate

RMS value

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8. A sinusoidal current is represented by the equation $I = 2\sin 100\pi t$. Calculate

Current at $t = \frac{1}{16}s$.

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9. A sinusoidal current is represented by the equation $I = I_0 \sin 100\pi t$. Calculate

Time required by the current to change its value from zero to the RMS value.

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10. An A.C. Source of 250 V, 50 Hz is connected to a circuit consisting of an electric lamp rated 100 W, 50 V and a capacitor in series. What should be value of the capacitance of the capacitor to make the lamp work at the rated value?

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11. A coil of resistance 100Ω, an inductor of 0.5 H and a capacitor of $15\mu F$ are connected in series with a $200V - 50Hz$ AC source. Calculate the current in the circuit.

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12. In the circuit as show in fgure, find the impedance of the circuit. What is the phase angle between voltage and current? (given $V_{rms} = 220V, f = 50Hz$)

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

What is the rms value of the current in the circuit?

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

What is the net power consumed over a full cycle?

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15. A 44 mH inductor is connected to a 220 V, 50Hz ac supply. Determine the r.m.s value and peak value of the current in the circuit.

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16. A $60\mu F$ capacitor is connected to a 110V, 60Hz, ac supply. Determine the r.m.s value of a current in the circuit.

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17. 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?

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18. A charged $30\mu F$ capacitor is connected in series to a 27mH inductor. What is the angular frequency of free oscillations of the circuit?

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

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

What is the maximum current in the coil?

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

What is the time lag between the voltage maximum and the current maximum?

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22. A 100×10^{-6} capacitor is series with a 40Ω resistance is connected to a 110 V, 60 Hz supply.

What is the maximum current in the circuit?

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23. A 100×10^{-6} capacitor is series with a 40Ω resistance is connected to a 110 V, 60 Hz supply.

What is the time lag between current maximum and the voltage maximum?

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24. A circuit containing an inductor of 80mH inductance and a capacitor of $60\mu F$ capacitance in series, is connected to a 230V, 50Hz supply. The resistance of the circuit is negligible.

Obtain the current amplitude and r.m.s value.

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25. A circuit containing an inductor of 80mH inductance and a capacitor of $60 \mu F$ capacitance in series, is connected to a 230V, 50Hz supply. The resistance of the circuit is negligible.

Obtain the r.m.s values of potential drop across each element.

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26. A circuit containing an inductor of 80mH inductance and a capacitor of $60\mu F$ capacitance in series, is connected to a 230V, 50Hz supply. The resistance of the circuit is negligible.

What is the average power transferred to the inductor?

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27. A circuit containing an inductor of 80mH inductance and a capacitor of $60\mu F$ capacitance in series, is connected to a 230V, 50Hz supply. The resistance of the circuit is negligible.

What is the average power transferred to the capacitor?

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28. A circuit containing an inductor of 80mH inductance and a capacitor of $60\mu F$ capacitance in series, is connected to a 230V, 50Hz supply. The resistance of the circuit is negligible.

What is the total average power absorbed by the circuit (averaged over one complete cycle)?

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29. A power transmission line feeds input power at 2300V to a step down transformer with its primary windings having 4000 turns. What should be the number of turns in the secondary in order to get the output power at 230V? For an efficiency of 0.70, calculate the rms value of the primary current when rms value of the secondary current is 5A.

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

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31. A series LRC circuit comprising of an inductor of inductance 3H, a resistor of resistance 7.4Ω and a capacitor of capacitance $27\mu F$. When connected to an a.c source, the circuit resonates at a particular frequency. Calculate angular resonant frequency and quality factor of the resonant circuit.

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32. A sinusoidal voltage of peak vale 283V and frequency 50Hz is applied to a series LCR circuit in which

$R = 3\Omega, L = 25.48mH$ and $C = 786\mu F$.

Find: Impedance of the circuit.

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33. A sinusoidal voltage of peak vale 283V and frequency 50Hz is applied to a series LCR circuit in which $R = 3\Omega, L = 25.48mH$ and $C = 786\mu F$. The phase difference between the voltage across the source and the current.

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34. A sinusoidal voltage of peak vale 283V and frequency 50Hz is applied to a series LCR circuit in which $R = 3\Omega$, $L = 25.48mH$ and $C = 786\mu F$. The power factor.

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