7 Alternating Current

Multiple Choice Questions (MCQs)

DIRECTIONS : *This section contains multiple choice questions. Each question has four choices (a), (b), (c) and (d) out of which only one is correct.*

1. The average value of alternating current for one complete cycle is
(a) zero (b) 1
(c) $\sqrt{2}$ (d) None of these

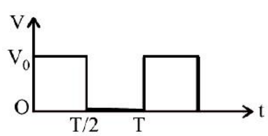
2. The ratio of mean value over half cycle to r.m.s. value of A.C. is
(a) $2 : \pi$ (b) $2\sqrt{2} : \pi$ (c) $\sqrt{2} : \pi$ (d) $\sqrt{2} : 1$

3. The instantaneous voltage through a device of impedance 20 Ω is e = 80 sin 100 πt. The effective value of the current is
(a) 3 A (b) 2.828 A
(c) 1.732 A (d) 4 A

4. If instantaneous current is given by i = 4 cos (ωt + ϕ) ampere, then the r.m.s value of current is,
(a) 4 amperes (b) $4\sqrt{2}$ amperes
(c) $2\sqrt{2}$ amperes (d) zero amperes

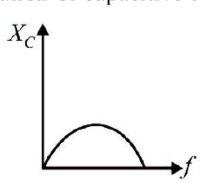
5. The average value of alternating current for one complete cycle is
(a) zero (b) 1
(c) $\sqrt{2}$ (d) None of these

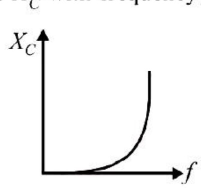
6. The r.m.s. value of potential difference V shown in the figure is

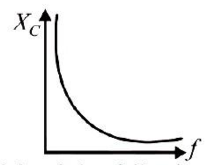


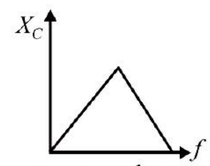
(a) V_0 (b) $V_0/\sqrt{2}$ (c) $V_0/2$ (d) $V_0/\sqrt{3}$

7. Which of the following graphs represents the correct variation of capacitive reactance X_C with frequency f ?

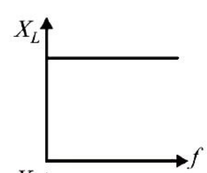
(a)


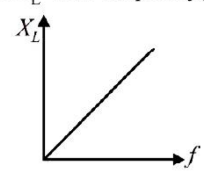
(b)


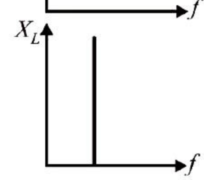
(c)


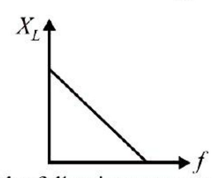
(d)


8. Which of the following graphs represents the correct variation of inductive reactance X_L with frequency f ?

(a)


(b)


(c)


(d)


9. In a series LCR circuit which of the following statements is/are true/false?
I. At resonance impedance becomes minimum and current becomes maximum.
II. At resonance current is in phase with applied voltage
III. Resonant frequency depends upon the resistance of the circuit.
(a) T,F,F (b) F,T,F (c) T,F,T (d) T,T,F

10. If the frequency of an A.C. is made 4 times of its initial value, the inductive reactance will
(a) be 4 times (b) be 2 times
(c) be half (d) remain the same

11. In an ac circuit an alternating voltage e = 200 $\sqrt{2}$ sin 100 t volts is connected to a capacitor of capacity 1 μF. The r.m.s. value of the current in the circuit is
(a) 10 mA (b) 100 mA (c) 200 mA (d) 20 mA

12. Consider the following statements and then select the true/false statements.
I. Most of the electrical device we use require AC voltage.
II. Most of the electrical energy sold by power companies is transmitted and distributed as alternating current.
III. AC voltage can be easily and efficiently converted from one to the other by means of transformers.
(a) T,F,F (b) T,F,T (c) T,T,F (d) T,T,T

13. The primary winding of a transformer has 100 turns and its secondary winding has 200 turns. The primary is connected to an A.C. supply of 120 V and the current flowing in it is 10 A. The voltage and the current in the secondary are
(a) 240 V, 5 A (b) 240 V, 10 A
(c) 60 V, 20 A (d) 120 V, 20 A

14. A charged 30 μF capacitor is connected to a 27 mH inductor. The angular frequency of free oscillations of the circuit is
(a) 1.1×10^3 rad s^{-1} (b) 2.1×10^3 rad s^{-1}
(c) 3.1×10^3 rad s^{-1} (d) 4.1×10^3 rad s^{-1}

15. If the rms current in a 50 Hz AC circuit is 5 A, the value of the current 1/300 s 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

16. An alternating current generator has an internal reactance 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 reactance 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

17. When a voltage measuring device is connected to AC mains, the meter shows the steady input voltage of 220 V. This means
(a) input voltage cannot be AC voltage, but a DC voltage
(b) maximum input voltage is 220 V
(c) the meter reads not v but $< v^2 >$ and is calibrated to read $\sqrt{< v^2 >}$
(d) The pointer of the meter is stuck by some mechanical defect

18. To reduce the resonant frequency in an L-C-R 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

19. Which of the following combinations should be selected for better tuning of an L-C-R circuit used for communication?
(a) R = 20 Ω, L = 1.5 H, C = 35 μF
(b) R = 25 Ω, L = 2.5 H, C = 45 μF
(c) R = 15 Ω, L = 3.5 H, C = 30 μF
(d) R = 25 Ω, L = 1.5 H, C = 45 μF

20. Determine the rms value of the emf given by E(in volt) = 8 sin (ωt) + 6sin (2ωt)
(a) $5\sqrt{2}$V (b) $7\sqrt{2}$V (c) 10 V (d) $10\sqrt{2}$V

21. Eddy currents in the core of transformer can't be developed by
(a) increasing the number of turns in secondary coil
(b) taking laminated transformer
(c) making step down transformer
(d) using a weak a.c. at high potential

22. A.C. power is transmitted from a power house at a high voltage as
(a) the rate of transmission is faster at high voltages
(b) it is more economical due to less power loss
(c) power cannot be transmitted at low voltages
(d) a precaution against theft of transmission lines

23. Alternating current cannot be measured by dc ammeter because
(a) average value of complete cycle is zero
(b) ac cannot pass through dc ammeter
(c) ac is virtual
(d) ac changes its direction

24. The r.m.s. value of current, I_{rms} is related to the peak current, I_0 by the relation
(a) $I_{rms} = \sqrt{2}\, I_0$ (b) $I_{rms} = \pi I_0$
(c) $I_{rms} = \frac{1}{\pi} I_0$ (d) $I_{rms} = \frac{1}{\sqrt{2}} I_0$

25. The instantaneous voltage through a device of impedance 20 Ω is e = 80 sin 100 πt. The effective value of the current is
(a) 3 A (b) 2.828 A
(c) 1.732 A (d) 4 A

26. A lamp consumes only 50% of peak power in an a.c. circuit. What is the phase difference between the applied voltage and the circuit current?
(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$ (c) $\frac{\pi}{4}$ (d) $\frac{\pi}{2}$

27. When an ac voltage of 220 V is applied to the capacitor *C*, then
(a) the maximum voltage between plates is 220 V.
(b) the current is in phase with the applied voltage.
(c) the charge on the plate is not in phase with the applied voltage.
(d) power delivered to the capacitor per cycle is zero.

28. The voltage of an ac source varies with time according to the equation *V* = 100 sin 100 πt cos 100 πt where t is in seconds and V is in volt. Then
(a) the peak voltage of the source is 100 volt
(b) the peak voltage of the source is 50 volt
(c) the peak voltage of the source is $100/\sqrt{2}$ volt
(d) the frequency of the source is 50 Hz

29. The voltage of an ac supply varies with time (t) as V = 120 sin 100 πt cos 100 πt. The maximum voltage and frequency respectively are
(a) 120 volt, 100 Hz (b) $\frac{120}{\sqrt{2}}$ volt, 100 Hz
(c) 60 volt, 200 Hz (d) 60 volt, 100 Hz

30. Determine the rms value of the emf given by E (in volt) = 8 sin (ω t) + 6sin (2 ω t)
(a) $5\sqrt{2}$V (b) $7\sqrt{2}$V (c) 10 V (d) $10\sqrt{2}$V

31. In an A.C. circuit with voltage V and current I the power dissipated is
(a) $\frac{1}{\sqrt{2}}$VI
(b) $\frac{1}{2}$VI
(c) VI
(d) dependent on the phase between V and I

32. The current I passed in any instrument in alternating current circuit is I = 2 sin ωt amp and potential difference applied is given by V =5 cos ωt volt then power loss in instrument is
(a) 2.5 watt (b) 5 watt (c) 10 watt (d) zero

33. A resistance of 20 ohm is connected to a source of an alternating potential V = 200 cos(100 πt). The time taken by the current to change from its peak value to rms value, is
(a) 2.5×10^{-3} s (b) 25×10^{-3} s
(c) 0.25 s (d) 0.20 s

34. An alternating e.m.f. of angular frequency ω is applied across an inductance. The instantaneous power developed in the circuit has an angular frequency
(a) $\frac{\omega}{4}$ (b) $\frac{\omega}{2}$ (c) ω (d) 2ω

35. A sinusoidal AC current flows through a resistor of resistance R. If the peak current is I_p, then power dissipated is
(a) $I_p^2 R \cos\theta$ (b) $\frac{1}{2} I_p^2 R$
(c) $\frac{4}{3} I_p^2 R$ (d) $\frac{1}{\pi^2} I_p^2 R$

36. A direct current of 5A is superimposed on an alternating current I = 10 sin ωt flowing through a wire. The effective value of the resulting current will be:
(a) 15/2 amp (b) $5\sqrt{3}$ amp
(c) $5\sqrt{5}$ amp (d) 15 amp

37. In an LCR circuit
(a) the impedance is equal to reactance
(b) the ratio between effective voltage to effective current is called reactance
(c) at resonance the resistance is equal to the resistance
(d) at resonance the net reactance is zero

38. The power factor in a circuit connected to an A.C.
(a) unity when the circuit contians an ideal inductance only
(b) unity when the circuit contians an ideal resistance only
(c) zero when the circuit contains an ideal resistance only
(d) unity when the circuit contains an ideal capacitance only

39. The time constant of C–R circuit is
(a) 1/CR (b) C/R (c) CR (d) R/C

40. In LCR circuit if resistance increases, quality factor
(a) increases finitely (b) decreases finitely
(c) remains constant (d) None of these

41. An inductor, a resistor and a capacitor are joined in series with an AC source. As the frequency of the source is slightly increased from a very low value, the reactance of the
(a) inductor increases (b) resistor increases
(c) capacitor increases (d) circuit increases

42. With increase in frequency of an A.C. supply, the impedance of an L-C-R series circuit
(a) remains constant
(b) increases
(c) decreases
(d) decreases at first, becomes minimum and then increases.

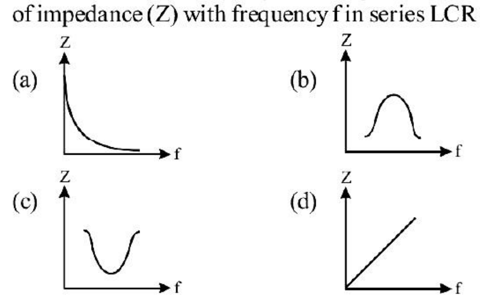
43. In an L.C.R. series a.c. circuit, the current
(a) is always in phase with the voltage
(b) always lags the generator voltage
(c) always leads the generator voltage
(d) None of these

44. A bulb and a capacitor are connected in series to a source of alternating current. If its frequency is increased, while keeping the voltage of the source constant, then bulb will
(a) give more intense light
(b) give less intense light
(c) give light of same intensity before
(d) stop radiating light

45. An LCR series circuit, connected to a source E, is at resonance. Then the voltage across
(a) R is zero (b) R equals applied voltage
(c) C is zero (d) L equals applied voltage

46. A capacitor in an ideal LC circuit is fully charged by a DC source, then it is disconnected from DC source, the current in the circuit
(a) becomes zero instantaneously
(b) grows , monotonically
(c) decays monotonically
(d) oscillate infinitely

47. Which one of the following curves represents the variation of impedance (Z) with frequency f in series LCR circuit?



48. An A.C. source is connected to a resistive circuit. Which of the following is true?
(a) Current leads ahead of voltage in phase
(b) Current lags behind voltage in phase
(c) Current and voltage are in same phase
(d) Any of the above may be true depending upon the value of resistance.

49. 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 impedance of the circuit becomes 'Z', the power drawn will be
(a) $P\sqrt{\frac{R}{Z}}$ (b) $P\left(\frac{R}{Z}\right)$ (c) P (d) $P\left(\frac{R}{Z}\right)^2$

50. With increase in frequency of an A.C. supply, the inductive reactance
(a) decreases
(b) increases directly with frequency
(c) increases as square of frequency
(d) decreases inversely with frequency

51. The transformer voltage induced in the secondary coil of a transformer is mainly due to
(a) a varying electric field
(b) a varying magnetic field
(c) the vibrations of the primary coil
(d) the iron core of the transformer

52. A transformer is employed to
(a) convert A.C. into D.C.
(b) convert D.C. into A.C.
(c) obtain a suitable A.C. voltage
(d) obtain a suitable D.C. voltage

53. The loss of energy in the form of heat in the iron core of a transformer is
(a) iron loss (b) copper loss
(c) mechanical loss (d) None of these

54. Quantity that remains unchanged in a transformer is
(a) voltage (b) current
(c) frequency (d) None of these

55. The transformation ratio in the step-up transformer is
(a) one
(b) greater than one
(c) less than one
(d) the ratio greater or less than one depends on the other factor

56. A transistor-oscillator using a resonant circuit with an inductor L (of negligible resistance) and a capacitor C in series produce oscillations of frequency f. If L is doubled and C is changed to 4C, the frequency will be
(a) 8f (b) $f/2\sqrt{2}$ (c) f/2 (d) f/4

57. A transformer has an efficiency of 80%. It works at 4 kW and 100 V. If secondary voltage is 240 V, the current in primary coil is
(a) 0.4 A (b) 4 A (c) 10 A (d) 40 A

58. In an oscillating LC circuit the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic field is
(a) $\frac{Q}{2}$ (b) $\frac{Q}{\sqrt{3}}$ (c) $\frac{Q}{\sqrt{2}}$ (d) Q

59. In a transformer, number of turns in the primary coil are 140 and that in the secondary coil are 280. If current in primary coil is 4 A, then that in the secondary coil is
(a) 4 A (b) 2 A (c) 6 A (d) 10A.

60. 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) $\pi\sqrt{LC}$

61. The primary winding of a transformer has 100 turns and its secondary winding has 200 turns. The primary is connected to an A.C. supply of 120 V and the current flowing in it is 10 A. The voltage and the current in the secondary are
(a) 240 V, 5 A (b) 240 V, 10 A
(c) 60 V, 20 A (d) 120 V, 20 A

62. An AC generator of 220 V having internal resistance r = 10Ω and external resistance R = 100Ω. What is the power developed in the external circuit?
(a) 484 W (b) 400 W (c) 441 W (d) 369 W

63. A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is 0.5 amp, the efficiency of the transformer is approximately
(a) 50% (b) 90% (c) 10% (d) 30%.

64. A treansformer is used to light a 140 watt, 24 volt lamp form 240 V AC mains. The current in the main cable is 0.4 4 amp. The efficiency of the transformer is:
(a) 48% (b) 63.8% (c) 83.3% (d) 90%

65. A transformer reduces 220 V to 11 V. The primary draws 5 A of current and secondary 90 A. The efficiency of the transformer is
(a) 20% (b) 40% (c) 70% (d) 90%

66. The current flowing in a step down transformer 220 V to 22 V having impedance 220 Ω, is
(a) 0.1 mA (b) 1 mA (c) 0.1 A (d) 1 A

Case/Passage Based Questions

DIRECTIONS : *Study the given paragraph(s) and answer the following questions.*

Case/Passage-I

Mean value of alternating current is defined as that value of steady current which would sent same amount of charge through a circuit in the time of half cycle (π /2) as is sent by the a.c. through the same circuit in the same time.

$$I_{mean} = \frac{2I_0}{\pi}, E_{mean} = \frac{2E_0}{\pi}$$

Here, I_0 *and* E_0 *are Peak current and voltage.*

R.M.S value of alternating current is the steady current which when passed through a given resistor for a certain time, shall produce the same heat as the given A.C. shall do when passed for the same time.

$$I_{rms} = \frac{I_0}{\sqrt{2}} = 0.707I_0, E_{rms} = \frac{E_0}{\sqrt{2}} = 0.707E_0$$

67. The alternating current of equivalent value of $\frac{I_0}{\sqrt{2}}$ is
(a) peak current (b) r.m.s. current
(c) D.C. current (d) all of these

68. The r.m.s value of an a.c. of 50 Hz is 10 amp. The time taken by the alternating current in reaching from zero to maximum value and the peak value of current will be
(a) 2×10^{-2} sec and 14.14 amp
(b) 1×10^{-2} sec and 7.07 amp
(c) 5×10^{-3} sec and 7.07 amp
(d) 5×10^{-3} sec and 14.14 amp

69. The instantaneous voltage through a device of impedance 20 Ω is $e = 80 \sin 100\pi t$. The effective value of the current is
(a) 3 A (b) 2.828 A (c) 1.732 A (d) 4 A

70. The voltage of an ac supply varies with time (t) as V = 120 sin 100 πt cos 100 πt. The maximum voltage and frequency respectively are
(a) 120 volt, 100 Hz (b) $\frac{120}{\sqrt{2}}$ volt, 100 Hz
(c) 60 volt, 200 Hz (d) 60 volt, 100 Hz

71. The equation of alternating current is :
$I = 50\sqrt{2} \sin 400\pi t$ amp. Then the frequency and root mean square of current are respectively
(a) 200 Hz, 50 amp (b) 400π Hz, $50\sqrt{2}$ amp
(c) 200 Hz, $50\sqrt{2}$ amp (d) 50 Hz, 200 amp

Case/Passage-II

In a series LCR circuit with an ideal ac source of peak voltage $E_0 = 50V$, frequency $v = \frac{50}{\pi}$ Hz and $R = 300\Omega$. The average electric field energy stored in the capacitor and average magnetic energy stored in the coil are 25 mJ and 5 mJ respectively. The value of RMS current in the circuit is 0.1 A. Then find :

72. Capacitance (C) of the capacitor is
(a) 10μF (b) 15μF
(c) 20μF (d) None of these

73. Inductance (L) of inductor is
(a) 0.25 henry (b) 0.5 henry
(c) 1 henry (d) 2 henry

74. The sum of rms potential difference across each of the three elements is
(a) 50 volt (b) $50\sqrt{2}$ volt
(c) $\frac{50}{\sqrt{2}}$ volt (d) None of these

75. In a LCR circuit at resonance which of these will effect the current in circuit
(a) R only (b) L and R only
(c) R and C only (d) all L, C and R

76. In a series combination of R, L and C to an A.C. source at resonance, if R = 20 ohm, then impedance Z of the combination is
(a) 20 ohm (b) Zero (c) 1 ohm (d) 400 ohm

Case/Passage-III

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. In the method using transformers, the dissipation is much smaller. In this method, a step-up transformer 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 resistive and the transformers are ideal with power factor unity. All the currents and voltages mentioned are rms values.

77. 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 consumers has to be supplied at 200 V, the ratio of the 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

78. If the 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

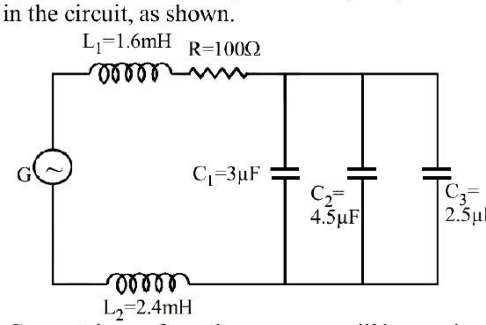
79. Transformers are used
(a) in DC circuit only
(b) in AC circuits only
(c) in both DC and AC circuits
(d) neither in DC nor in AC circuits

80. A transformer is employed to
(a) convert A.C. into D.C.
(b) convert D.C. into A.C.
(c) obtain a suitable A.C. voltage
(d) obtain a suitable D.C. voltage

81. The transformer voltage induced in the secondary coil of a transformer is mainly due to
(a) a varying electric field
(b) a varying magnetic field
(c) the vibrations of the primary coil
(d) the iron core of the transformer

Case/Passage-IV

An ac generator G with an adjustable frequency of oscillation is used in the circuit, as shown.



82. Current drawn from the ac source will be maximum if its angular frequency is
(a) 10^5 rad/s (b) 10^4 rad/s
(c) 5000 rad/s (d) 500 rad/s

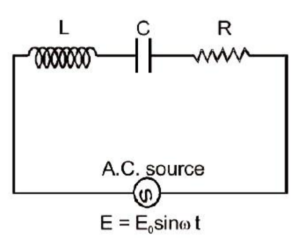
83. To increase resonant frequency of the circuit, some of the changes in the circuit are carried out. Which change(s) would certainly result in the increase in resonant frequency
(a) R is increased
(b) L_1 is increased and C_1 is decreased
(c) L_2 is decreased and C_2 is increased
(d) C_3 is decreased in the circuit

84. If the ac source G is of 100V rating at resonant frequency of the circuit, then average power supplied by the source is
(a) 50W (b) 100W (c) 500W (d) 1000W

85. A generator at a utility company produces 100 A of current at 4000 V. The voltage is stepped up to 2,40,000V by a transformer before it is sent on a high voltage transmission line. The current in transmission line is
(a) 3.67A (b) 2.67A (c) 1.67A (d) 2.40A

Case/Passage-V

A circuit containing a series combination of a resistance R, a coil of inductance L and a capacitor of capacitance C, connected with a source of alternating e.m.f. of peak value of E_0, as shown in fig.



Let in series LCR circuit applied alternating emf is $E = E_0 \sin \omega t$. As L,C and R are joined in series, therefore, current at any instant through the three elements has the same amplitude and phase. However voltage across each element bears a different phase relationship with the current.

86. If an LCR series circuit is connected to an ac source, then at resonance the voltage across
(a) R is zero
(b) R equals the applied voltage
(c) C is zero
(d) L equals the applied voltage

87. At resonant frequency the current amplitude in series *LCR* circuit is
(a) maximum (b) minimum
(c) zero (d) infinity

88. Resonance frequency of LCR series a.c. circuit is f_0. Now the capacitance is made 4 times, then the new resonance frequency will become
(a) $f_0/4$ (b) $2f_0$
(c) f_0 (d) $f_0/2$

89. If resistance of 100Ω, and inductance of 0.5 henry and capacitance of 10×10^6 farad are connected in series through 50 Hz A.C. supply, then impedance is
(a) 1.8765 Ω (b) 18.76 Ω
(c) 187.6 Ω (d) 101.3 Ω

90. In an L-C-R series circuit connected to an AC source, $V = V_0 \sin\left(100\pi t + \frac{\pi}{6}\right)$. Given $V_R = 40V$, $V_L = 40V$ and $V_C = 10V$. Resistance $R = 4\Omega$.
Peak value of current in the circuit is
(a) $10\sqrt{2}A$ (b) $15\sqrt{2}A$
(c) $20\sqrt{2}A$ (d) $25\sqrt{2}A$

Assertion & Reason

DIRECTIONS : *Each of these questions contains an assertion followed by reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.*
(a) If both **Assertion** and **Reason** are **correct** and the Reason is the **correct explanation** of the Assertion.
(b) If both **Assertion** and **Reason** are correct but Reason is **not the correct explanation** of the Assertion.
(c) If the **Assertion** is **correct** but **Reason** is **incorrect**.
(d) If the **Assertion** is **incorrect** but the **Reason** is **correct**.

91. Assertion : 200V AC is more dangerous than 200V D.C.
Reason : For 200V AC, the corresponding peak value is $200\sqrt{2}$. But for 200V DC, peak value is 200V only.

92. Assertion : The alternating current lags behind the emf by a phase angle of $\frac{\pi}{2}$, when AC flows through an inductor.
Reason : The inductive reactance increases as the frequency of AC source increases.

93. Assertion : The inductive reactance limits amplitude of the current in a purely inductive circuit.
Reason: The inductive reactance is independent of the frequency of the current.

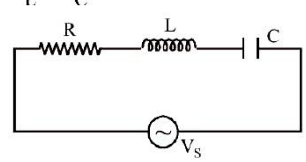
94. Assertion : A capacitor is connected to a direct current source. Its reactance is infinite.
Reason : Reactance of a capacitor is given by $X_c = \frac{1}{\omega C}$.

95. Assertion : In series LCR resonance circuit, the impedance is equal to the ohmic resistance.
Reason: At resonance, the inductive reactance exceeds the capacitive reactance.

96. Assertion : Choke coil is preferred over a resistor to control the current in an AC circuit.
Reason : Power factor of an ideal choked AC circuit is zero.

97. Assertion : The electrostatic energy stored in capacitor plus magnetic energy stored in inductor will always be zero in a series LCR circuit driven by ac voltage source under condition of resonance.
Reason : The voltage of ac source appears partially across the resistor in a series LCR circuit driven by ac voltage source under condition of resonance.

98. Assertion : In a series R, L, C circuit if V_R, V_L, and V_C denote rms voltage across R, L and C respectively and V_S is the rms voltage across the source, then $V_S = V_R + V_L + V_C$.



Reason : In AC circuits, Kirchhoff voltage law is not valid at every instant of time.

99. Assertion : Transformer can transfer power from primary to secondary coil.
Reason : In an ideal transformer *VI* = varries.

100. Assertion : A laminated core is used in transformers to increase eddy currents.
Reason : The efficiency of a transformer increases with increase in eddy currents.

101. Assertion : In the purely resistive element of a series LCR, AC circuit the maximum value of rms current increases with increase in the angular frequency of the applied emf.
Reason : $\varepsilon_{max} = \frac{I_{max}}{z}$, $z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$,
where I_{max} is the peak current in a cycle.

102. Assertion : A capacitor blocks direct current in the steady state.
Reason : The capacitive reactance of the capacitor is inversely proportional to frequency f of the source of emf.

Match the Following

DIRECTIONS : *Each question contains statements given in two columns which have to be matched. Statements (A, B, C, D) in column-I have to be matched with statements (1, 2, 3, 4) in column-II.*

103. Match Columns I and II.

Column I		Column II	
(A)	RL circuit	(1)	Leading quantity - current
(B)	RC circuit	(2)	Leading quantity - voltage
(C)	Inductive circuit	(3)	Phase difference between voltage and current 0°
(D)	Resistive circuit	(4)	Phase difference between voltage and current 90°

(a) (A) → (2) ; (B) → (3) ; (C) → (1) ; (D) → (4)
(b) (A) → (2) ; (B) → (2) ; (C) → (4) ; (D) → (3)
(c) (A) → (4) ; (B) → (3) ; (C) → (2) ; (D) → (1)
(d) (A) → (2) ; (B) → (1) ; (C) → (4) ; (D) → (3)

104. In a series LCR circuit at resonance. Match columns I and II.

Column I		Column II	
(A)	Net Impedance is Z_{min} means	(1)	Circuit behaves as a resistive circuit
(B)	$V_L = V_C \Rightarrow V$ means	(2)	Whole voltage appears across the resistance
(C)	Power consumption $P = V_{rms} i_{rms}$	(3)	0°
(D)	Phase difference	(4)	$\frac{1}{2} V_0 i_0$

(a) (A) → (2); (B) → (1); (C) → (3); (D) → (4)
(b) (A) → (1); (B) → (2); (C) → (4); (D) → (3)
(c) (A) → (1); (B) → (3); (C) → (2); (D) → (4)
(d) (A) → (2); (B) → (3); (C) → (4); (D) → (1)

Fill in the Blanks

DIRECTIONS : *Complete the following statements with an appropriate word / term to be filled in the blank space(s).*

105. Laminated iron sheets are used to minimize ________ currents in the core of a transformer. **[CBSE 2020]**

106. A step up transformer operates on a 230 V line and supplies a current of 2 ampere. The ratio of primary and secondary winding is 1:25 . The current in primary is __________.

107. The ____________ is the loss of energy in the form of heat in the iron core of a transformer.

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

109. The output of a step-down transformer is measured to be 24 V when connected to a 12 W light bulb. The value of the peak current is _______.

110. In series combination of R, L and C with an A.C. source at resonance, if R = 20 ohm, then impedence Z of the combination is _______ Ω.

True / False

DIRECTIONS : *Read the following statements and write your answer as true or false.*

111. 200V AC is more dangerous than 200V D.C.

112. For 200V AC, the corresponding peak value is $200\sqrt{2}$. But for 200V DC, peak value is 200V only.

113. The electrostatic energy stored in capacitor plus magnetic energy stored in inductor will always be zero in a series LCR circuit driven by ac voltage source under condition of resonance.

114. The complete voltage of ac source appears across the resistor in a series LCR circuit driven by ac voltage source under condition of resonance.

ANSWER KEY & SOLUTIONS

1. **(a)**
2. **(b)** We know that, $I_{rms} = I_0/\sqrt{2}$ and $I_m = 2I_0/\pi$

$\therefore \frac{I_m}{I_{rms}} = \frac{2\sqrt{2}}{\pi}$

3. **(b)** Given equation, $e = 80 \sin 100\pi t$ ...(i)
Standard equation of instantaneous voltage is given by
$e = e_m \sin\omega t$ ...(ii)
Compare (i) and (ii), we get $e_m = 80$ V
where e_m is the voltage amplitude.

Current amplitude, $I_m = \frac{e_m}{Z}$ where Z = impendence

$= 80/20 = 4$ A

$I_{r.m.s} = \frac{4}{\sqrt{2}} = \frac{4\sqrt{2}}{2} = 2\sqrt{2} = 2.828$ A

4. **(c)** $i_{rms} = \frac{i_0}{\sqrt{2}} = \frac{4}{\sqrt{2}} = 2\sqrt{2}$ ampere
5. **(a)**
6. **(b)** $V_{rms} = \sqrt{\frac{(T/2)V_0^2 + 0}{T}} = \frac{V_0}{\sqrt{2}}$.
7. **(c)** Capacitive reactance, $X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

$\Rightarrow X_L \propto \frac{1}{f}$

With increases in frequency, X_C decreases.
Hence, option (c) represents the hyperbolic graph which is correct.

8. **(b)** Inductive reactance,
$X_L = \omega L = 2\pi f L$
$\Rightarrow X_L \propto f$
Hence, inductive reactance increases linearly with frequency.
9. **(d)** Resonant frequency does not depend upon the resistance of the circuit.
10. **(a)**
11. **(d)** $V_{rms} = \frac{200\sqrt{2}}{\sqrt{2}} = 200V$

$I_{rms} = \frac{V_{rms}}{X_C} = \frac{200}{\frac{1}{100\times10^{-6}}} = 2\times10^{-2} = 20mA$

12. **(d)** Most of the electrical devices we use require AC voltage. This is mainly because most of the electrical energy sold by power companies is transmitted and distributed as alternating current. The main reason for preferring use of AC voltage over DC voltage is that AC voltage can be easily and efficiently converted from one voltage to the other by means of transformers.
13. **(a)** $\frac{E_s}{E_p} = \frac{n_s}{n_p}$ or $E_s = E_p \times \left(\frac{n_s}{n_p}\right)$

$\therefore E_s = 120 \times \left(\frac{200}{100}\right) = 240V$

$\frac{I_p}{I_s} = \frac{n_s}{n_p}$ or $I_s = I_p\left(\frac{n_p}{n_s}\right)$ $\therefore I_s = 10\left(\frac{100}{200}\right) = 5$ amp

14. **(a)** Here, $C = 30\ \mu F = 30 \times 10^{-6}$ F,
$L = 27$ mH $= 27 \times 10^{-3}$ H

$\therefore \omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{27\times10^{-3}\times30\times10^{-6}}} = \frac{1}{\sqrt{81\times10^{-8}}}$

$= \frac{10^4}{9} = 1.1 \times 10^3$ rad s^{-1}

15. **(b)** As given that, $v = 50$ Hz, $I_{rms} = 5A$

$t = \frac{1}{300}s$

As we know that $I_{rms} = \frac{I_0}{\sqrt{2}}$

I_0 = Peak value $= \sqrt{2}.I_{rms} = \sqrt{2}\times5$

$I_0 = 5\sqrt{2}A$

at, $t = \frac{1}{300}$ sec, $I = I_0 \sin\omega t = 5\sqrt{2}\sin 2\pi v t$

$= 5\sqrt{2}\sin 2\pi\times50\times\frac{1}{300}$

$I = 5\sqrt{2}\sin\frac{\pi}{3} = 5\sqrt{2}\times\frac{\sqrt{3}}{2} = 5\sqrt{3/2}$ Amp $\left(\because \sin\frac{\pi}{3} = \frac{\sqrt{3}}{2}\right)$

$I = \left(5\sqrt{\frac{3}{2}}\right)$ A

16. **(c)** To deliver maximum power from the generator to the load, total internal reactance must be equal to conjugate of total external reactance.
So, $X_{int} = X_{ext}$
$X_g = (X_L) = -X_L$
Hence, $X_L = -X_g$ (Reactance in external circuit)
17. **(c)** As we know that,
The voltmeter in AC reads rms values of voltage

$I_{rms} = \sqrt{2}I_0$ and $V_{rms} = \sqrt{2}v_0$

The voltmeter in AC circuit connected to AC mains reads mean value ($<v^2>$) and is calibrated in such a way that it gives rms value of $<v^2>$, which is multiplied by form factor $\sqrt{2}$ to give rms value V_{rms}.

18. **(b)** As we know that,
The resonant frequency in an L-C-R series circuit is

$$\nu_0 = \frac{1}{2\pi\sqrt{LC}}$$

So, to reduce ν_0 either increase L or increase C.
To increase capacitance, another capacitor must be connect in parallel with the first capacitor.

19. **(c)**

20. **(a)** $E = 8 \sin \omega t + 6 \sin 2\omega t$

$$\Rightarrow E_{peak} = \sqrt{8^2 + 6^2} = 10 \text{ V}$$

$$E_{rms} = \frac{10}{\sqrt{2}} = 5\sqrt{2} \text{ V}$$

21. **(b)** 22. **(b)**

23. **(a)** Average value of complete cycle of ac is zero.

24. **(d)**

25. **(b)** Given equation, $e = 80 \sin 100\pi t$ ...(i)
Standard equation of instantaneous voltage is given by
$e = e_m \sin\omega t$ ...(ii)
Compare (i) and (ii), we get $e_m = 80$ V
where e_m is the voltage amplitude.

Current amplitude $I_m = \frac{e_m}{Z} = 80/20 = 4$ A.

$$I_{r.m.s} = \frac{4}{\sqrt{2}} = \frac{4\sqrt{2}}{2} = 2\sqrt{2} = 2.828 \text{ A}.$$

26. **(b)** $P = \frac{1}{2}V_0 i_0 \cos\phi \Rightarrow P = P_{peak}.\cos\phi$

$$\Rightarrow \frac{1}{2}(P_{peak}) = P_{peak}\cos\phi \Rightarrow \cos\phi = \frac{1}{2} \Rightarrow \phi = \frac{\pi}{3}$$

27. **(d)** When an ac voltage of 220 V is applied to a capacitor C, the charge on the plates is in phase with the applied voltage.
As the circuit is pure capacitive so, the current developed leads the applied voltage by a phase angle of 90° Hence, power delivered to the capacitor per cycle is $P = V_{rms} I_{rms} \cos 90° = 0$.

28. **(b)** $V = 50 \times 2 \sin 100\pi t \cos 100\pi t = 50 \sin 200\pi t$
$\Rightarrow V_0 = 50$ *Volts* and $\nu = 100$ *Hz*

29. **(d)** $V = 120 \sin 100\pi t \cos 100\pi t \Rightarrow V = 60 \sin 200\pi t$
$V_{max} = 60V$ and $\nu = 100Hz$

30. **(a)** $E = 8 \sin \omega t + 6 \sin 2\omega t$

$$\Rightarrow E_{peak} = \sqrt{8^2 + 6^2} = 10 \text{ V}$$

$$E_{rms} = \frac{10}{\sqrt{2}} = 5\sqrt{2} \text{ V}$$

31. **(d)** Power dissipated = E_{rms}. I_{rms} = $(E_{rms})(I_{rms})\cos\theta$
Hence, power dissipated depends upon phase difference.

32. **(d)** $I = 2 \sin\omega t$

$$V = 5\cos\omega t = 5\sin\left(\frac{\pi}{2} - \omega t\right)$$

Since, there is a phase difference of $\frac{\pi}{2}$ between the current and voltage
∴ Average power over a complete cycle is zero.

33. **(a)** The current and potential difference are in phase with the resistance. So, the time taken would be same as time for voltage to change from (t = 0) that is peak value to rms value.

Time taken by voltage to achieve its rms value of $\frac{200}{\sqrt{2}}$.

$$\frac{200}{\sqrt{2}} = 200\cos(100\pi t)$$

$$\Rightarrow \cos(100\pi t) = \frac{1}{\sqrt{2}} = \cos\left(\frac{\pi}{4}\right)$$

$$t = \frac{1}{400} \text{ second} = 2.5 \times 10^{-3} \text{ sec.}$$

34. **(d)** The instantaneous values of emf and current in inductive circuit are given by $E = E_0\sin\omega t$ and $i = i_0\sin\left(\omega t - \frac{\pi}{2}\right)$ respectively.

$$\therefore \quad P_{inst} = E.i = E_0\text{Sin}\omega t \times i_0 \sin\left(\omega t - \frac{\pi}{2}\right)$$

$$= -E_0 i_0 \sin\omega t\cos\omega t = -\frac{1}{2}E_0 i_0 \sin 2\omega t$$

Hence, angular frequency of instantaneous power is 2ω

35. **(b)** 36. **(b)**

37. **(d)** At resonance, $X_C = X_L$
Reactance of circuit becomes zero and impedance become minimum and maximum current flows through the circuit.

38. **(b)** $\cos\phi = \frac{R}{Z}$, where Z is the impedance &

$Z = \sqrt{R^2 + (X_L - X_C)^2}$, if there is only resistance then
$Z = R \Rightarrow \cos\phi = 1$

39. **(c)** The time constant for resonance circuit, = CR
Growth of charge in a circuit containing capacitance and resistance is given by the formula, $q = q_0(1 - e^{-t/CR})$
CR is known as time constant in this formula.

40. **(b)**

41. **(a)** The reactance of inductor, $X_L = \omega L$

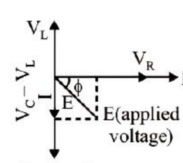
The reactance of capacitor, $X_C = \frac{1}{\omega C}$

where $\omega = 2\pi n$ & n is the frequency of A.C source.

42. **(d)**

43. **(d)** $\tan\phi = \frac{V_C - V_L}{V_R}$ (if $V_C > V_L$)

$$= \frac{V_L - V_C}{R} \text{ (if } V_L > V_C)$$



where ϕ is angle between current & applied voltage.

44. **(a)** **45. (b)**

46. **(a)** In ideal condition of LC circuit $R = 0$ and LC oscillation continue indefinitely. Energy being shunted back and forth between electric field of capacitor and magnetic field of inductor. As capacitor is fully charged current in L is zero and $\frac{1}{2}\frac{q_0^2}{C}$ energy is stored in electric field. Then capacitor begins to discharge through L causing a current to flow and build up a magnetic field, around L. Therefore, energy stored.

Now in $L = \frac{1}{2}LI_0^2$ when C is fully discharged, V across the plate reduces to zero.

$\therefore$ Electric field energy is transferred to magnetic field and vice-versa.

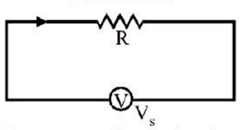
47. **(c)** Impedance at resonant frequency is minimum in series LCR circuit.

So, $Z = \sqrt{R^2 + \left(2\pi fL - \frac{1}{2\pi fC}\right)^2}$

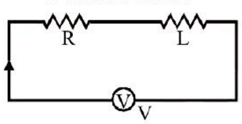
48. **(c)** When resistance is connected to A.C source, then current & voltage are in same phase.

49. **(d)**

Pure resistor



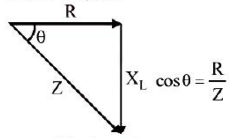
L-R series circuit



For pure resistor circuit, power

$P = \frac{V^2}{R} \Rightarrow V^2 = PR$

Phasor diagram



Z = impedance

For L-R series circuit, power

$P^1 = \frac{V^2}{Z}\cos\theta = \frac{V^2}{Z}.\frac{R}{Z} = \frac{PR}{Z^2}.R = P\left(\frac{R}{Z}\right)^2$

50. **(b)** $X_L = \omega L \Rightarrow X_L \propto \omega$

51. **(b)** **52. (c)**

53. **(a)** Iron loss is the energy loss in the form of heat due to the formation of eddy currents in the iron core of the transformer.

54. **(c)** A transformer does not change the frequency of ac.

55. **(b)**

56. **(b)** We know that frequency of electrical oscillation in L.C. circuit is

$f = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$; Now, L = 2L & C = 4C

$f' = \frac{1}{2\pi}\sqrt{\frac{1}{2L.4C}} = \frac{1}{2\pi}\sqrt{\frac{1}{LC}} \times \frac{1}{2\sqrt{2}} \Rightarrow f' = \frac{1}{2\sqrt{2}} \times f$

57. **(d)** As $E_p \mathbf{I}_p = P_i$ $\therefore$ $\mathbf{I}_p = \frac{P_i}{E_p} = \frac{4000}{100} = 40$ A.

58. **(c)** When the capacitor is completely charged, the total energy in the L.C circuit is with the capacitor and that energy is $E = \frac{1}{2}\frac{Q^2}{C}$

When half energy is with the capacitor in the form of electric field between the plates of the capacitor we get $\frac{E}{2} = \frac{1}{2}\frac{Q'^2}{C}$ where Q' is the charge on one plate of the capacitor

$\therefore$ $\frac{1}{2} \times \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}\frac{Q'^2}{C} \Rightarrow Q' = \frac{Q}{\sqrt{2}}$

59. **(b)** $N_p = 140, N_s = 280, I_p = 4A, I_s = ?$

For a transformer $\frac{I_s}{I_p} = \frac{N_p}{N_s}$

$\Rightarrow \frac{I_s}{4} = \frac{140}{280} \Rightarrow I_s = 2\,A$

60. **(a)** Energy stored in magnetic field = $\frac{1}{2}Li^2$

Energy stored in electric field = $\frac{1}{2}\frac{q^2}{C}$

$\therefore$ $\frac{1}{2}Li^2 = \frac{1}{2}\frac{q^2}{C}$

Also $q = q_0 \cos\omega t$ and $\omega = \frac{1}{\sqrt{LC}}$

On solving $t = \frac{\pi}{4}\sqrt{LC}$

61. **(a)** $\frac{E_s}{E_p} = \frac{n_s}{n_p}$ or $E_s = E_p \times \left(\frac{n_s}{n_p}\right)$

$\therefore$ $E_s = 120 \times \left(\frac{200}{100}\right) = 240$ V

$\frac{\mathbf{I}_p}{\mathbf{I}_s} = \frac{n_s}{n_p}$ or $\mathbf{I}_s = \mathbf{I}_p\left(\frac{n_p}{n_s}\right)$ $\therefore$ $\mathbf{I}_s = 10\left(\frac{100}{200}\right) = 5$ amp

62. **(b)** $V = 200$V; $r = 10\Omega$

$R' = 10 + 100\Omega = 110\Omega$

$I = \frac{V}{R'} = \frac{220}{100} = 2A$

$P = I^2R = 4 \times 100 = 400\ W$

63. **(b)** Efficiency of the transformer

$\eta = \frac{P_{output}}{P_{input}} \times 100 = \frac{100}{220 \times 0.5} \times 100 = 90.9\%$

64. **(c)**

65. **(d)** $\eta = \frac{E_sI_s}{E_pI_p} = \frac{11 \times 90}{220 \times 5} = 0.9 \times 100\% = 90\%$

66. **(c)** In a step down transformed voltage is 22 V. By ohm's law, $I = \frac{22V}{220\,ohm} = 0.1\,Amp$

67. **(b)** $\frac{I_0}{\sqrt{2}}$ = RMS current

68. **(d)**

69. **(b)** Given equation, $e = 80 \sin 100\pi t$ ...(i)
Standard equation of instantaneous voltage is given by
$e = e_m \sin\omega t$ ...(ii)
Compare (i) and (ii), we get $e_m = 80$ V
where e_m is the voltage amplitude.

Current amplitude $I_m = \frac{e_m}{Z}$ where Z = impendence
$= 80/20 = 4$ A.

$I_{r.m.s} = \frac{4}{\sqrt{2}} = \frac{4\sqrt{2}}{2} = 2\sqrt{2} = 2.828$ A.

70. **(d)** $V = 120 \sin 100\pi t \cos 100\pi t \Rightarrow V = 60 \sin 200\pi t$
$V_{max} = 60V$ and $\nu = 100$ Hz

71. **(a)** $2\pi nt = 400\pi t$ $\therefore n = 200$

$I_0 = 50\sqrt{2}$ amp.

r.m.s. current = $I_0 / \sqrt{2} = 50$ amp.

72. **(c)** Av. electric field energy $= \left(\frac{1}{2}CV_{rms}^2\right) = 25 \times 10^{-3}$ J

$\therefore \quad \frac{1}{2}C \times (I_{rms} X_C)$

$\therefore \quad \frac{1}{2} \times C.I^2_{rms} \times \frac{1}{4\pi^2 v^2 c^2} = 25 \times 10^{-3}$ J

$\therefore$ C = 20μF

73. **(c)** Av. magnetic energy $\left(\frac{1}{2}LI_{rms}^2\right)$

$\therefore \quad L = \frac{2 \times 5 \times 10^{-3}}{(.10)^2} \Rightarrow L = 1$ henry

74. **(d)** The sum for rms voltage across C, rms voltage across R and rms voltage across L is not equal to rms voltage across ideal ac source.

75. **(a)** At resonance, $\omega L = \frac{1}{\omega C}$

Hence the impedance of the circuit would be just equal to R (minimum). In other words, the LCR-series circuit will behave as a purely resistive circuit. Due to this the current is maximum. This condition is known as resonance

$\therefore$ Z = R, Current $= \frac{V}{R}$

76. **(a)** At resonance inpedence Z = R

77. **(a)** Step up transformer

$$\frac{N_s}{N_p} = \frac{V_s}{V_p} \Rightarrow \frac{10}{1} = \frac{V_s}{4000}$$

$\therefore V_s = 40{,}000$ V
Step down transformer

$$\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{40{,}000}{200} = \frac{200}{1}$$

78. **(b)** Power P = V × I

$\Rightarrow \quad I = \frac{P}{V} = \frac{600 \times 1000}{4000} = 150$ A

Total resistance = 0.4 × 20 = 8 Ω
$\therefore$ Power dissipated as heat = $I^2R = (150)^2 \times 8$
= 180,000W = 180 kW

$\therefore \quad \%\text{ loss} = \frac{180}{600} \times 100 = 30\%$

79. **(b)** Transformers are used in AC circuits only

80. **(c)** A transformer is employed to obtain a suitable AC voltage.

81. **(b)** Voltage induced in the secondary coil of a transformer is mainly due to a varying magnetic field.

82. **(c)**

83. **(d)**

84. **(b)** Current drawn is maximum at resonant angular frequency.

$L_{eq} = 4$mH, $C_{eq} = 10\mu$F

$\omega = \frac{1}{\sqrt{LC}} = 5000$ rad / s

C_{eq} decreases thereby increasing resonant frequency.

At resonance $i_{rms} = \frac{100}{100} = 1$A

Power supplied $= V_{rms} i_{rms} \cos\phi$ ($\phi = 0$ at resonance)
P = 100 W

85. **(c)** For a transformer,

$V_pI_p = V_sI_s \Rightarrow I_s = \frac{V_pI_p}{V_s} = \frac{4000 \times 100}{240000}$ A $= 1.67$ A

86. **(b)** In series RLC circuit,

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

And, at resonance, $V_L = V_C$
Hence, $V = V_R$

87. **(a)**

88. **(d)** In LCR series circuit, resonance frequency f_0 is given by

$L\omega = \frac{1}{C\omega} \Rightarrow \omega^2 = \frac{1}{LC} \quad \therefore \omega = \sqrt{\frac{1}{LC}} = 2\pi f_0$

$\therefore \quad f_0 = \frac{1}{2\pi\sqrt{LC}}$ or $f_0 \alpha \frac{1}{\sqrt{C}}$

When the capacitance of the circuit is made 4 times, its resonant frequency become f_0'

$\therefore \quad \frac{f_0'}{f_0} = \frac{\sqrt{C}}{\sqrt{4C}}$ or $f_0' = \frac{f_0}{2}$

89. **(c)** $Z=\sqrt{R^2+\left(\omega L-\frac{1}{\omega C}\right)^2}$

Here R = 100 W, L = 0.5 henry, C = 10 × 10^6 farad

$\omega = 2\,p\,\pi = 100\,\pi$.

90. **(a)**

91. **(a)** DC is a constant current but AC varies sinusoidally.

92. **(b)** In case of inductive circuit emf leads current by $\pi/2$ rad

93. **(c)** The inductive reactance limits the amplitude of current in a purely inductive circuit in the same way as the resistance limits the current in a purely resistive circuit.

i.e. $I_0=\frac{\varepsilon_0}{X_L}$

94. **(a)** As $X_C=\frac{1}{\omega C}$, so for $\omega = 0$, $X_C \to \infty$.

95. **(c)** In series resonance circuit, inductive reactance is equal to capacitive reactance.

i.e. $\omega L=\frac{1}{\omega C}$

$\therefore\ Z=\sqrt{R^2+\left(\omega L=\frac{1}{\omega C}\right)^2}=R$

96. **(a)**

97. **(d)** In resonance condition when energy across capacitor is maximum, energy stored in inductor is zero, vice versa is also true.

98. **(d)** Assertion is false because the given relation is true if all voltages are instantaneous.

99. **(c)** Transformer cannot produce power, but it transfer from primary to secondary.

100. **(d)** Large eddy currents are produced in non-laminated iron core of the transformer by the induced emf, as the resistance of bulk iron core is very small. By using thin iron sheets as core the resistance is increased. Laminating the core substantially reduces the eddy currents. Eddy current heats up the core of the transformer. More the eddy currents greater is the loss of energy and the efficiency goes down.

101. **(c)** **102.** **(a)**

103. **(d)** (A)→(2); (B)→(1); (C)→(4); (D)→(3)

104. **(b)** (A)→(1); (B)→(2); (C)→(4); (D)→(3)

105. (Eddy currents)

106. (50 A) $\frac{n_p}{n_s}=\frac{E_p}{E_s}=\frac{1}{25}$

$\therefore\ E_s = 25\,E_p$

But $E_sI_s=E_pI_p \Rightarrow I_p=\frac{E_s\times I_s}{E_p} \Rightarrow I_p = 50A$

107. (Iron loss) Iron loss is the energy loss in the form of heat due to the formation of eddy currents in the iron core of the transformer.

108. (14.4 W) As given that,

$X_L = 1\Omega, R = 2\Omega, E_{rms} = 6V, P_{av} = ?$

The average power dissipated in the L, R, series circuit with AC source

Then $P_{av} = E_{rms}I_{rms}\cos\phi$ ... (i)

$I_{rms}=\frac{I_0}{\sqrt{2}}=\frac{E_{rms}}{Z}$

$Z=\sqrt{R^2+X_L^2}=\sqrt{4+1}=\sqrt{5}$

$I_{rms}=\frac{6}{\sqrt{5}}A$

$\cos\phi=\frac{R}{Z}=\frac{2}{\sqrt{5}}$

By putting the value of I_{rms}, E_{rms}, $\cos\phi$ in equation (i), then,

$P_{av}=6\times\frac{6}{\sqrt{5}}\times\frac{2}{\sqrt{5}}=\frac{72}{\sqrt{5}\sqrt{5}}$

$=\frac{72}{5}=14.4$ watt

109. $\left(\frac{1}{\sqrt{2}}A\right)$ As given that,

Secondary voltage (V_S) is :

$V_S =$ 24 Volt

Power associated with secondary is :

$P_S =$ 12 Watt

As we know that $P_S = V_SI_S$

$I_S=\frac{P_S}{V_S}=\frac{12}{24}=\frac{1}{2}A = 0.5$ Amp

Peak value of the current in the secondary

$I_0 = I_S\sqrt{2} = 0.5\sqrt{2}$

$=\frac{5}{10}\sqrt{2}\left[I_0=\frac{1}{\sqrt{2}}\text{ Amp}\right]$

110. (20 Ω)

111. (True)

112. (True) DC is a constant current but AC varies sinusoidally.

113. (False) In resonance condition when energy across capacitor is maximum, energy stored in inductor is zero, vice versa is also true.

114. (False)