CHAPTER 7

Alternating Current

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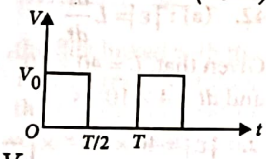
7.2 AC Voltage Applied to a Resistor

1. The peak voltage of the ac source is equal to
   (a) the value of voltage supplied to the circuit
   (b) the rms value of the source
   (c) $\sqrt{2}$ times the rms value of the ac source
   (d) $1/\sqrt{2}$ times the rms value of the ac source
   (2022)

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



   (a) $\frac{V_0}{\sqrt{3}}$ (b) V_0
   (c) $\frac{V_0}{\sqrt{2}}$ (d) $\frac{V_0}{2}$ *(Mains 2011)*

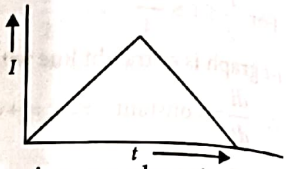
3. In an A.C. circuit, I_{rms} and I_0 are related as
   (a) $I_{rms} = \pi I_0$ (b) $I_{rms} = \sqrt{2}\, I_0$
   (c) $I_{rms} = I_0/\pi$ (d) $I_{rms} = I_0/\sqrt{2}$ *(1994)*

4. Two cables of copper are of equal lengths. One of them has a single wire of area of cross-section A, while other has 10 wires of cross-sectional area $A/10$ each. Give their suitability for transporting A.C. and D.C.
   (a) only multiple strands for A.C., either for D.C.
   (b) only multiple strands for A.C., only single strand for D.C.
   (c) only single strand for D.C., either for A.C.
   (d) only single strand for A.C., either for D.C.
   (1994)

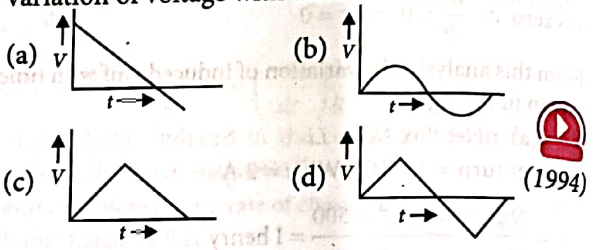
7.4 AC Voltage Applied to an Inductor

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) a capacitance of reactance $X_C = X_L$ is included in the same circuit.
(b) an iron rod is inserted in the coil.
(c) frequency of the AC source is decreased.
(d) number of turns in the coil is reduced. *(2013)*

6. The current I in an A.C. circuit with inductance coil varies with time according to the graph given below.



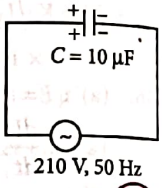
Which one of the following graphs gives the variation of voltage with time?



(1994)

7.5 AC Voltage Applied to a Capacitor

7. A 10 μF capacitor is connected to a 210 V, 50 Hz source as shown in figure. The peak current in the circuit is nearly ($\pi = 3.14$)



   (a) 0.58 A
   (b) 0.93 A
   (c) 1.20 A
   (d) 0.35 A
   (2024)

8. A 40 μF capacitor is connected to a 200 V, 50 Hz ac supply. The r.m.s value of the current in the circuit is, nearly
   (a) 1.7 A (b) 2.05 A
   (c) 2.5 A (d) 25.1 A *(2020)*

9. A small signal voltage $V(t) = V_0 \sin\omega t$ is applied across an ideal capacitor C
   (a) Current $I(t)$ is in phase with voltage $V(t)$.
   (b) Current $I(t)$ leads voltage $V(t)$ by 180°.
   (c) Current $I(t)$, lags voltage $V(t)$ by 90°.
   (d) Over a full cycle the capacitor C does not consume any energy from the voltage source. *(NEET-I 2016)*

10. In an ac circuit an alternating voltage $200\sqrt{2}\sin 100t$ 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 *(2011)*

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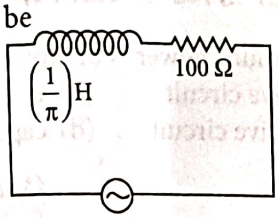
1. A capacitor of capacity C has reactance X. If capacitance and frequency become double then reactance will be
(a) $4X$ (b) $X/2$ (c) $X/4$ (d) $2X$ *(2001)*

7.6 AC Voltage Applied to a Series *LCR* Circuit

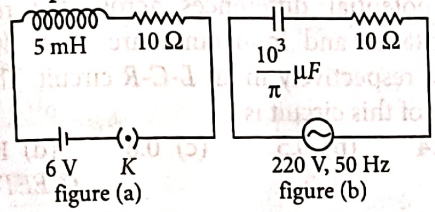
2. An ac source is connected in the given circuit. The value of ϕ will be



$V = 220 \sin(100\pi t + \phi)$ volt

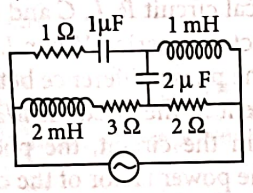
(a) 60° (b) 90°
(c) 30° (d) 45°
(Manipur NEET 2023)

3. If Z_1 and Z_2 are the impedances of the given circuits (a) and (b) as shown in figures, then choose the correct option



(a) $Z_1 < Z_2$ (b) $Z_1 + Z_2 = 20\ \Omega$
(c) $Z_1 = Z_2$ (d) $Z_1 > Z_2$
(Manipur NEET 2023)

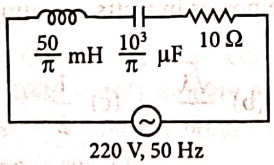
4. For very high frequencies, the effective impedance of the circuit (shown in the figure) will be



(a) 4 Ω (b) 6 Ω
(c) 1 Ω (d) 3 Ω
(Manipur NEET 2023)

15. In a series *LCR* circuit, the inductance L is 10 mH, capacitance C is 1 μF and resistance R is 100 Ω. The frequency at which resonance occurs is
(a) 1.59 rad/s (b) 1.59 kHz
(c) 15.9 rad/s (d) 15.9 kHz *(2023)*

16. The net impedance of circuit (as shown in figure) will be

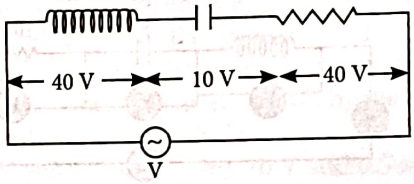


(a) $5\sqrt{5}\ \Omega$ (b) 25 Ω
(c) $10\sqrt{2}\ \Omega$ (d) 15 Ω *(2023)*

17. A series *LCR* circuit with inductance 10 H, capacitance 10 μF, resistance 50 Ω is connected to an ac source of voltage, $V = 200\sin(100t)$ volt. If the resonant frequency of the *LCR* circuit is υ_0 and the frequency of the ac source is υ, then
(a) $\upsilon_0 = \upsilon = 50$ Hz (b) $\upsilon_0 = \upsilon = \frac{50}{\pi}$ Hz
(c) $\upsilon_0 = \frac{50}{\pi}$ Hz, $\upsilon = 50$ Hz
(d) $\upsilon = 100$ Hz, $\upsilon_0 = \frac{100}{\pi}$ Hz *(2022)*

18. A series *LCR* circuit containing 5.0 H inductor 80 μF capacitor and 40 Ω resistor is connected to 230 V variable frequency ac source. The angular frequencies of the source at which power transferred to the circuit half the power at the resonant angular frequency are likely to be
(a) 42 rad/s and 58 rad/s (b) 25 rad/s and 75 rad/s
(c) 50 rad/s and 25 rad/s (d) 46 rad/s and 54 rad/s *(2021)*

19. An inductor of inductance L, a capacitor of capacitance C and a resistor of resistance 'R' are connected in series to an ac source of potential difference 'V' volts as shown in figure.
Potential difference across L, C and R is 40 V, 10 V and 40 V, respectively. The amplitude of current flowing through *LCR* series circuit is $10\sqrt{2}$ A. The impedance of the circuit is



(a) 5 Ω (b) $4\sqrt{2}\ \Omega$ (c) $5/\sqrt{2}\ \Omega$ (d) 4 Ω
(2021)

20. A series *LCR* circuit is connected to an ac voltage source. When L is removed from the circuit, the phase difference between current and voltage is $\pi/3$. If instead C is removed from the circuit, the phase difference is again $\pi/3$ between current and voltage. The power factor of the circuit is
(a) zero (b) 0.5
(c) 1.0 (d) –1.0 *(2020)*

21. A circuit when connected to an AC source of 12 V gives a current of 0.2 A. The same circuit when connected to a DC source of 12 V, gives a current of 0.4 A. The circuit is
(a) series *LR* (b) series *RC*
(c) series *LC* (d) series *LCR*
(Odisha NEET 2019)

22. Which of the following combinations should be selected for better tuning of an *L-C-R* circuit used for communication ?

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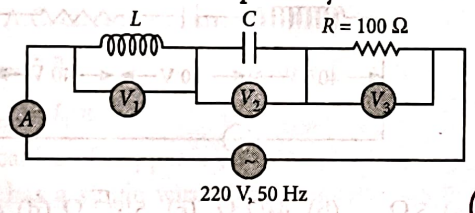
(a) $R = 20\ \Omega$, $L = 1.5$ H, $C = 35\ \mu$F
(b) $R = 25\ \Omega$, $L = 2.5$ H, $C = 45\ \mu$F
(c) $R = 15\ \Omega$, $L = 3.5$ H, $C = 30\ \mu$F
(d) $R = 25\ \Omega$, $L = 1.5$ H, $C = 45\ \mu$F *(NEET-II 2016)*

23. A series R-C circuit is connected to an alternating voltage source. Consider two situations :
(p) When capacitor is air filled.
(q) When capacitor is mica filled.
Current through resistor is i and voltage across capacitor is V then
(a) $i_p > i_q$ (b) $V_p = V_q$
(c) $V_p < V_q$ (d) $V_p > V_q$ *(2015)*

24. 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 $3\ \Omega$, the phase difference between the applied voltage and the current in the circuit is
(a) $\pi/6$ (b) $\pi/4$ (c) $\pi/2$ (d) zero *(2011)*

25. A coil has resistance 30 ohm and inductive reactance 20 ohm at 50 Hz frequency. If an ac source, of 200 volt, 100 Hz, is connected across the coil, the current in the coil will be
(a) 2.0 A (b) 4.0 A (c) 8.0 A (d) $\frac{20}{\sqrt{13}}$ A *(Mains 2011)*

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



(a) 150 V, 2.2 A (b) 220 V, 2.2 A
(c) 220 V, 2.0 A (d) 100 V, 2.0 A *(2010)*

27. What is the value of inductance L for which the current is maximum in a series LCR circuit with $C = 10\ \mu$F and $\omega = 1000\ s^{-1}$?
(a) 1 mH
(b) cannot be calculated unless R is known
(c) 10 mH (d) 100 mH *(2007)*

28. In a circuit L, C and R are connected in series with an alternating voltage source of frequency f. The current leads the voltage by 45°. The value of C is
(a) $\frac{1}{\pi f(2\pi f L - R)}$ (b) $\frac{1}{2\pi f(2\pi f L - R)}$
(c) $\frac{1}{\pi f(2\pi f L + R)}$ (d) $\frac{1}{2\pi f(2\pi f L + R)}$ *(2005)*

29. The value of quality factor is
(a) $\frac{\omega L}{R}$ (b) $\frac{1}{\omega RC}$ (c) $\sqrt{LC}$ (d) L/R *(2000)*

30. A series L-C-R circuit is connected to a source of A.C. current. At resonance, the phase difference between the applied voltage and the current in the circuit, is
(a) π (b) zero (c) $\pi/4$ (d) $\pi/2$ *(1994)*

7.7 Power in AC Circuit : The Power Factor

31. The maximum power is dissipated for an ac in a/an
(a) resistive circuit (b) LC circuit
(c) inductive circuit (d) capacitive circuit *(Manipur NEET 2023)*

32. An inductor 20 mH, a capacitor 100 μF and a resistor 50 Ω are connected in series across a source of emf, $V = 10 \sin 314t$. The power loss in the circuit is
(a) 0.79 W (b) 0.43 W
(c) 2.74 W (d) 1.13 W *(2018)*

33. The potential differences across the resistance, capacitance and inductance are 80 V, 40 V and 100 V respectively in an L-C-R circuit. The power factor of this circuit is
(a) 0.4 (b) 0.5 (c) 0.8 (d) 1.0 *(NEET-II 2016)*

34. An inductor 20 mH, a capacitor 50 μF and a resistor 40 Ω are connected in series across a source of emf $V = 10 \sin 340t$. The power loss in A.C. circuit is
(a) 0.76 W (b) 0.89 W
(c) 0.51 W (d) 0.67 W *(NEET-I 2016)*

35. In an electrical circuit R, L, C and ac voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage and the current in the circuit is $\pi/3$. If instead, C is removed from the circuit, the phase difference is again $\pi/3$. The power factor of the circuit is
(a) $\frac{1}{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) 1 (d) $\frac{\sqrt{3}}{2}$ *(2012)*

36. The instantaneous values of alternating current and voltages in a circuit are given as

$$i = \frac{1}{\sqrt{2}} \sin(100\pi t) \text{ ampere}$$

$$e = \frac{1}{\sqrt{2}} \sin\left(100\pi t + \frac{\pi}{3}\right) \text{ volt}$$

The average power in watts consumed in the circuit is
(a) $\frac{1}{4}$ (b) $\frac{\sqrt{3}}{4}$ (c) $\frac{1}{2}$ (d) $\frac{1}{8}$ *(Mains 2012)*

37. Power dissipated in an LCR series circuit connected to an A.C. source of emf ε is

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

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

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

(d) $\frac{\varepsilon^2 R}{\left[R^2+\left(L\omega-\frac{1}{C\omega}\right)^2\right]}$ *(2009)*

38. In an a.c. circuit the e.m.f. (ε) and the current (i) at any instant are given respectively by
$e = E_0\sin\omega t$, $i = I_0\sin(\omega t - \phi)$
The average power in the circuit over one cycle of a.c. is
(a) $\frac{E_0 I_0}{2}\cos\phi$ (b) $E_0 I_0$
(c) $\frac{E_0 I_0}{2}$ (d) $\frac{E_0 I_0}{2}\sin\phi$ *(2008)*

39. A coil of inductive reactance 31 Ω has a resistance of 8 Ω. It is placed in series with a condenser of capacitative reactance 25 Ω. The combination is connected to an a.c. source of 110 V. The power factor of the circuit is
(a) 0.33 (b) 0.56
(c) 0.64 (d) 0.80 *(2006)*

40. For a series LCR circuit, the power loss at resonance is
(a) $\frac{V^2}{\left[\omega L-\frac{1}{\omega C}\right]}$ (b) $I^2L\omega$
(c) I^2R (d) $\frac{V^2}{C\omega}$ *(2002)*

41. In an a.c. circuit with phase voltage V and current I, the power dissipated is
(a) $V.I$
(b) depends on phase angle between V and I
(c) $\frac{1}{2}\times V.I$ (d) $\frac{1}{\sqrt{2}}\times V.I$ *(1997)*

42. In an A.C. circuit, the current flowing is $I = 5\sin(100t - \pi/2)$ ampere and the potential difference is $V = 200\sin(100t)$ volts. The power consumption is equal to
(a) 20 W (b) 0 W
(c) 1000 W (d) 40 W *(1995)*

7.8 Transformers

43. In an ideal transformer, the turns ratio is $\frac{N_p}{N_s}=\frac{1}{2}$. The ratio $V_s : V_p$ is equal to (the symbols carry their usual meaning)
(a) 1 : 2 (b) 2 : 1 (c) 1 : 1 (d) 1 : 4 *(2024)*

44. A 12 V, 60 W lamp is connected to the secondary of a step down transformer, whose primary is connected to ac mains of 220 V. Assuming the transformer to be ideal, what is the current in the primary winding?
(a) 3.7 A (b) 0.37 A
(c) 0.27 A (d) 2.7 A *(2023)*

45. A step down transformer connected to an ac mains supply of 220 V is made to operate at 11 V, 44 W lamp. Ignoring power losses in the transformer, what is the current in the primary circuit?
(a) 4 A (b) 0.2 A (c) 0.4 A (d) 2 A *(2021)*

46. A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A, the voltage across the secondary coil and the current in the primary coil respectively are
(a) 300 V, 15 A (b) 450 V, 15 A
(c) 450 V, 13.5 A (d) 600 V, 15 A *(2014)*

47. The primary of a transformer when connected to a dc battery of 10 volt draws a current of 1 mA. The number of turns of the primary and secondary windings are 50 and 100 respectively. The voltage in the secondary and the current drawn by the circuit in the secondary are respectively
(a) 20 V and 2.0 mA (b) 10 V and 0.5 mA
(c) Zero volt and therefore no current
(d) 20 V and 0.5 mA *(Karnataka NEET 2013)*

48. A 220 volt input is supplied to a transformer. The output circuit draws a current of 2.0 ampere at 440 volts. If the efficiency of the transformer is 80%, the current drawn by the primary windings of the transformer is
(a) 3.6 ampere (b) 2.8 ampere
(c) 2.5 ampere (d) 5.0 ampere *(2010)*

49. The primary and secondary coils of a transformer 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 webers, t is time in seconds and ϕ_0 is a constant, the output voltage across the secondary coil is
(a) 120 volts (b) 220 volts
(c) 30 volts (d) 90 volts *(2007)*

50. 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% *(2007)*

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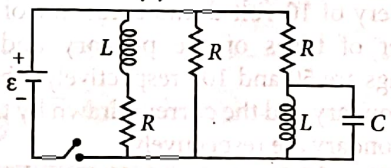
51. The core of a transformer is laminated because
(a) ratio of voltage in primary and secondary may be increased
(b) energy losses due to eddy currents may be minimised
(c) the weight of the transformer may be reduced
(d) rusting of the core may be prevented. *(2006)*

52. A step-up transformer operates on a 230 V line and supplies a load of 2 ampere. The ratio of the primary and secondary windings is 1 : 25. The current in the primary is
(a) 15 A (b) 50 A
(c) 25 A (d) 12.5 A *(1998)*

53. The primary winding of a transformer has 500 turns whereas its secondary has 5000 turns. The primary is connected to an A.C. supply of 20 V, 50 Hz. The secondary will have an output of
(a) 2 V, 50 Hz (b) 2 V, 5 Hz
(c) 200 V, 50 Hz (d) 200 V, 500 Hz. *(1997)*

RC/RL Circuits with DC Source*

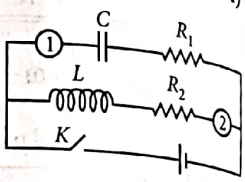
54. Figure shows a circuit that contains three identical resistors with resistance $R = 9.0\ \Omega$ each, two identical inductors with inductance $L = 2.0$ mH each, and an ideal battery with emf $\varepsilon = 18$ V. The current i through the battery just after the switch closed is



(a) 0.2 A (b) 2 A
(c) 0 ampere (d) 2 mA *(2017)*

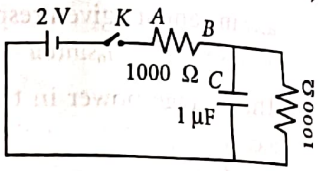
55. A coil of 40 henry inductance is connected in series with a resistance of 8 ohm and the combination is joined to the terminals of a 2 volt battery. The time constant of the circuit is
(a) 5 seconds (b) 1/5 seconds
(c) 40 seconds (d) 20 seconds *(2004)*

56. In the circuit given in figure, 1 and 2 are ammeters. Just after key K is pressed to complete the circuit, the reading will be



(a) zero in 1, maximum in 2
(b) maximum in both 1 and 2
(c) zero in both 1 and 2
(d) maximum in 1, zero in 2. *(1999)*

57. When the key K is pressed at time $t = 0$, then which of the following statement about the current I in the resistor AB of the given circuit is true?



(a) I oscillates between 1 mA and 2 mA
(b) At $t = 0$, $I = 2$ mA and with time it goes to 1 mA
(c) $I = 1$ mA at all t
(d) $I = 2$ mA at all t. *(1995)*

58. The time constant of C-R circuit is
(a) $1/CR$ (b) C/R
(c) CR (d) R/C *(1992)*

ANSWER KEY

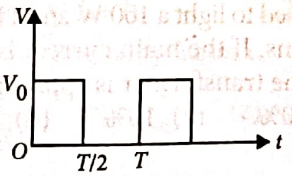
1.	(c)	2.	(c)	3.	(d)	4.	(a)	5.	(b)	6.	(a)	7.	(b)	8.	(c)	9.	(d)	10.	(d)
11.	(c)	12.	(d)	13.	(a)	14.	(d)	15.	(b)	16.	(a)	17.	(b)	18.	(d)	19.	(a)	20.	(c)
21.	(a)	22.	(c)	23.	(d)	24.	(b)	25.	(b)	26.	(b)	27.	(d)	28.	(d)	29.	(a,b)	30.	(b)
31.	(a)	32.	(a)	33.	(c)	34.	(c)	35.	(c)	36.	(d)	37.	(d)	38.	(a)	39.	(d)	40.	(c)
41.	(b)	42.	(b)	43.	(b)	44.	(c)	45.	(b)	46.	(b)	47.	(c)	48.	(d)	49.	(a)	50.	(b)
51.	(b)	52.	(b)	53.	(c)	54.	(*)	55.	(a)	56.	(d)	57.	(b)	58.	(c)				

Hints & Explanations

1. **(c)** : The relation between the peak value and the rms value is:

$$V_{rms} = \frac{V_0}{\sqrt{2}}\ ;\ \text{so, } V_0 = \sqrt{2}\, V_{rms}$$

2. **(c)** :



$$V = V_0 \text{ for } 0 \le t \le \frac{T}{2} \Rightarrow V = 0 \text{ for } \frac{T}{2} \le t \le T$$

$$V_{rms} = \left[\frac{\int_0^T V^2\,dt}{\int_0^T dt}\right]^{1/2} = \left[\frac{\int_0^{T/2} V_0^2\,dt + \int_{T/2}^{T} (0)\,dt}{\int_0^T dt}\right]^{1/2}$$

*This topic is not in the latest NCERT textbook, but it is a part of current NEET syllabus.

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