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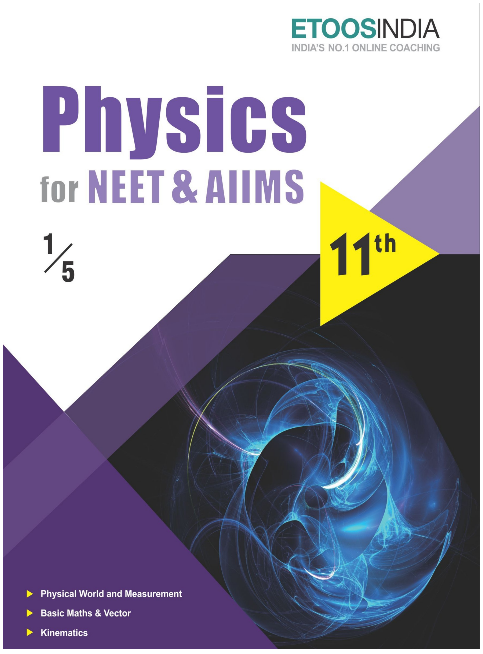

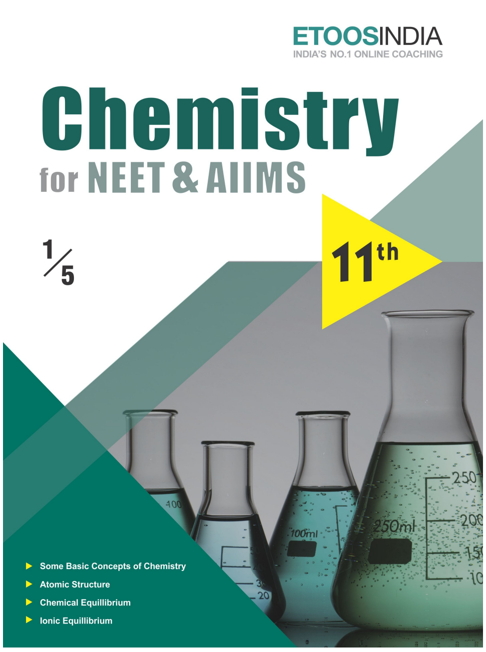

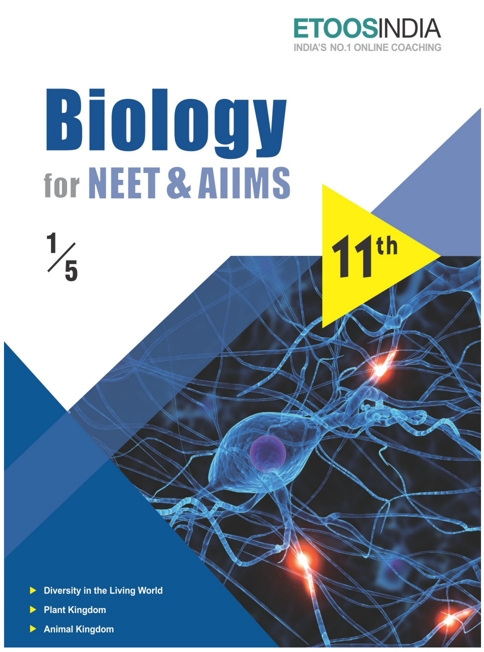

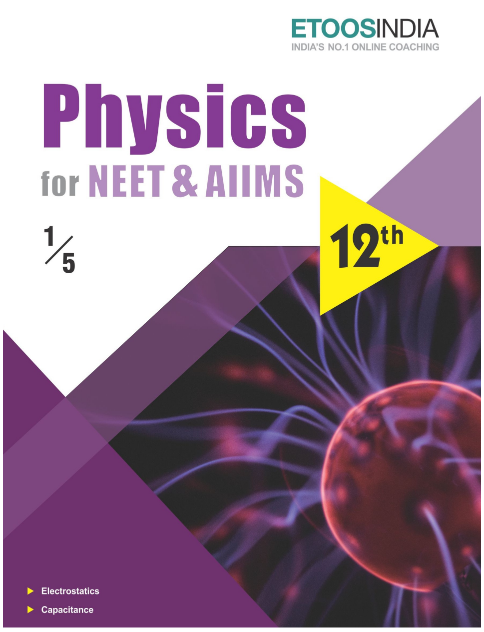

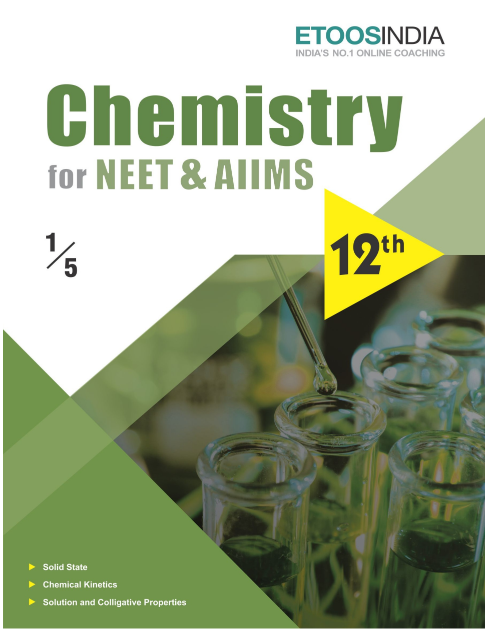

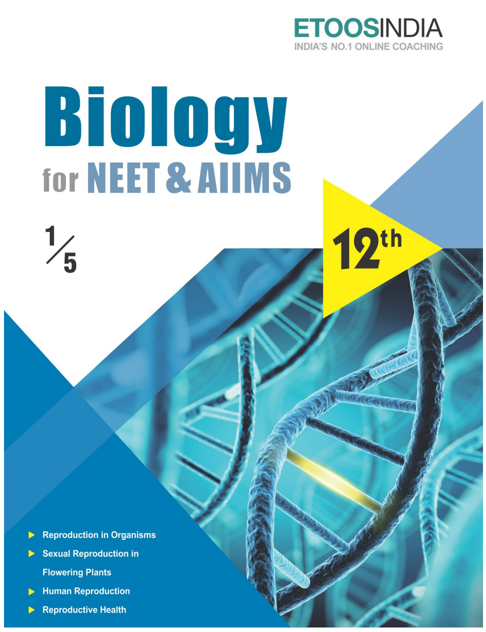

ETOOS Comprehensive Study Material
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CHAPTER 06

ALTERNATING CURRENT

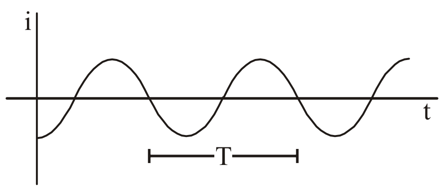
The magnetic force is animate, or imitates a soul; in many respects it surpasses the human soul while it is united to an organic body.

"WILLIAM GILBERT"

INTRODUCTION

Then a resistor is connected across the terminals of a battery, a current is established in the circuit. The current has a unique direction, it goes from the positive terminal to the negative terminal via the external resistor. The magnitude of the current also remains almost constant. If the direction of the current in a resistor or in any other element changes alternately, the current is called an alternating current (AC). In this chapter, we shall study the alternating current that varies sinusoidally with time. Such a current is given by

$$i = i_0 \sin(\omega t + \varphi).$$



ETOOS KEY POINTS

(i) Choke coil is a high inductance and negligible resistance coil.

(ii) Choke coil is used to control current in A.C. circuit at negligible power loss

(iii) Choke coil used only in A.C. and not in D.C. circuit

(iv) Choke coil is based on the principle of wattless current.

(v) Iron cored choke coil is used generally at low frequency and air cored at high frequency.

(vi) Resistance of ideal choke coil is zero

Ex. A choke coil and a resistance are connected in series in an a.c circuit and a potential of 130 volt is applied to the circuit. If the potential across the resistance is 50 V. What would be the potential difference across the choke coil.

Sol. $V = \sqrt{V_R^2 + V_L^2} \Rightarrow V_L = \sqrt{V^2 - V_R^2} = \sqrt{(130)^2 - (50)^2} = 120\,V$

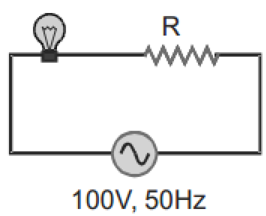
Ex. An electric lamp which runs at 80V DC consumes 10 A current. The lamp is connected to 100 V – 50 Hz ac source compute the inductance of the choke required.

Sol. Resistance of lamp $R = \frac{V}{I} = \frac{80}{10} = 8\,\Omega$

Let Z be the impedance which would maintain a current of 10 A through the Lamp when it is run on 100 Volt a.c. then. $Z = \frac{V}{I} = \frac{100}{10} = 10\ \Omega$ but $Z = \sqrt{R^2 + (\omega L)^2}$

$\Rightarrow (\omega L)^2 = Z^2 - R^2 = (10)^2 - (8)^2 = 36 \Rightarrow \omega L = 6 \Rightarrow L = \frac{6}{\omega} = \frac{6}{2\pi \times 50} = 0.02H$

Ex. Calculate the resistance or inductance required to operate a lamp (60V, 10W) from a source of (100 V, 50 Hz)

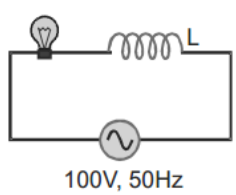


Sol. (a) Maximum voltage across lamp = 60V

$\because$ $V_{Lamp} + V_R = 100$ $\therefore$ $V_R = 40V$

Now current througth Lamp is $= \frac{\text{Wattage}}{\text{voltage}} = \frac{10}{60} = \frac{1}{6}A$

But $V_R = IR \Rightarrow 40 = \frac{1}{6}(R) \Rightarrow R = 240\ \Omega$



(b) Now in this case $(V_{Lamp})^2 + (V_L)^2 = (V)^2$

$(60)^2 + (V_L)^2 = (100)^2 \Rightarrow V_L = 80\ V$

Also $V_L = IX_L = \frac{1}{6}X_L$ so $X_L = 80 \times 6 = 480\ \Omega = L\,(2\pi f) \Rightarrow L = 1.5\ H$

A capacitor of suitable capacitance replace a choke coil in an AC circuit, the average power consumed in a capacitor is also zero. Hence, like a choke coil, a capacitor can reduce current in AC circuit without power dissipation. Cost of capacitor is much more than the cost of inductance of same reactance that's why choke coil is used.

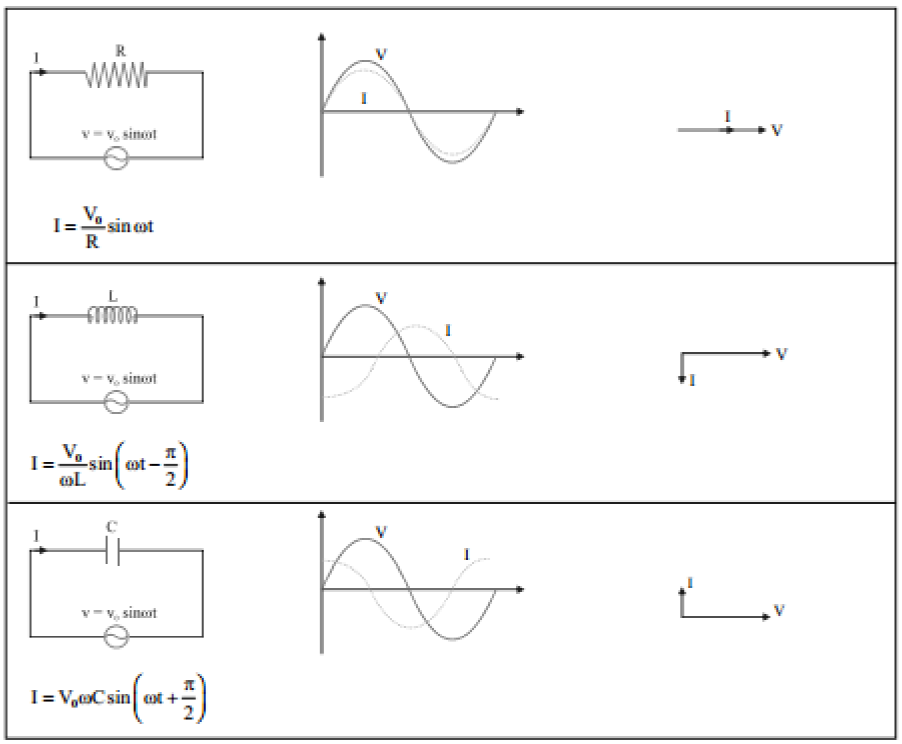
Etoos Tips & Formulas

1. Average value $I_{av} = \dfrac{\int_0^T I\,dt}{\int_0^T dt} = \dfrac{1}{T}\int_0^T I\,dt$ **RMS value** $I_{rms} = \sqrt{\dfrac{\int_0^T I^2\,dt}{\int_0^T dt}}$

For sinusoidal voltage $V = V_0 \sin \omega t$: $V_{av} = \dfrac{2V_0}{\pi}$ & $V_{rms} = \dfrac{V_0}{\sqrt{2}}$

For sinusoidal current $I = I_0 \sin(\omega t + \phi)$: $I_{av} = \dfrac{2I_0}{\pi}$ & $I_{rms} = \dfrac{I_0}{\sqrt{2}}$

2. AC Circuits



3. Impendance : $Z = \sqrt{R^2 + X^2}$ where X = reactance

SOLVED EXAMPLE

Ex. 1 The peak voltage in a 220 V AC source is

(A) 220 V (B) about 160 V
(C) about 310 V (D) 440 V

Sol. $V_0 = \sqrt{2}\ V_{rms} = \sqrt{2} \times 220 \simeq 330$ V

Ans is (C)

Ex. 2 An AC source is rated 220 V, 50 Hz. The average voltage is calculated in a time interval of 0.01 s. It

(A) must be zero (B) may be zero
(C) is never zero (D) is (220/√2)V

Sol. May be zero

Ans. is (B)

Ex. 3 Find the effective value of current i = 2 + 4 cos 100 πt.

Sol. $I_{rms} = \left[\int_0^T \frac{(2+4\cos 100\pi t)^2\,dt}{T}\right]^{1/2} = 2\sqrt{3}$

Ex. 4 The peak value of an alternating current is 5 A and its frequency is 60 Hz. Find its rms value. How long will the current take to reach the peak value starting from zero?

Sol. $I_{rms} = \frac{I_0}{\sqrt{2}} = \frac{5}{\sqrt{2}}$ A, $t = \frac{T}{4} = \frac{1}{240}$ s

Ex. 5 An alternating current having peak value 14 A is used to heat a metal wire. To produce the same heating effect, a constant current i can be used where i is

(A) 14 A (B) about 20 A
(C) 7 A (D) about 10 A

Sol. $I_{RMS} = \frac{I_0}{\sqrt{2}} = \frac{14}{\sqrt{2}} \simeq 10$ Ans. is (D)

Ex. 6 Find the average power concumed in the circuit if a voltage $v_s = 200\sqrt{2}\ \sin \omega t$ is applied to an AC circuit and the current in the circuit is found to be i = 2 sin (ωt + π/4).

Sol. $P = V_{RMS} I_{RMS} \cos\phi = \frac{200\sqrt{2}}{\sqrt{2}} \times \frac{2}{\sqrt{2}} \times \cos\frac{\pi}{4} = 200$ W

Ex. 7 A capacitor acts as an infinite resistance for

(A) DC (B) AC
(C) DC as well as AC (D) neither AC nor DC

Sol. $x_C = \frac{1}{\omega c}$ for DC ω = 0. so, $x_C = \infty$

Ans. is (A)

Ex. 8 A 10 μF capacitor is connected with an ac source $E = 200\sqrt{2}\ \sin(100\,t)$ V through an ac ammeter (it reads rms value).

What will be the reading of the ammeter?

Sol. $I_0 = \frac{V_0}{x_C} = \frac{200\sqrt{2}}{1/\omega C}$; $I_{RMS} = \frac{I_0}{\sqrt{2}} = 200$ mA

Ex. 9 Find the reactance of a capacitor (C = 200 μF) when it is connected to (A) 10 Hz AC source, (B) a 50 Hz AC source and (C) a 500 Hz AC source.

Sol. (A) $x_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} \simeq 80\ \Omega$ for f = 10 Hz AC source,

(B) $x_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} \simeq 16\ \Omega$ for f = 50 Hz and

(C) $x_C = \frac{1}{\omega C} = \frac{1}{2\pi f C} \simeq 1.6\ \Omega$ for f= 500 Hz.

Ex. 10 An inductor (L = 200 mH) is connected to an AC source of peak current. What is the intantaneous voltage of the source when the current is at its peak value?

Sol. Because phase difference between volatage and current is π/2 for pure inductor.

So, Ans. is zero

Ex. 11 An AC source producing emf $E = E_0[\cos(100\,\pi\,s^{-1})t + \cos(500\,\pi\,s^{-1})t]$ is connected in series with a capacitor and a resistor. The current in the circuit is found to be $i = i_1\cos[(100\,\pi\,s^{-1})t + \varphi_1] + i_2\cos[(500\,\pi\,s^{-1})t + \varphi_1]$

(A) $i_1 > i_2$ (B) $i_1 = i_2$
(C) $i_1 < i_2$
(D) the information is insufficient to find the relation between i_1 and i_2

Exercise # 1

SINGLE OBJECTIVE | NEET LEVEL

1. The power is transmitted from a power house on high voltage ac because
(A) Electric current travels faster at higher *volts*
(B) It is more economical due to less power wastage
(C) It is difficult to generate power at low voltage
(D) Chances of stealing transmission lines are minimized

2. The potential difference V and the current i flowing through an instrument in an ac circuit of frequency f are given by $V = 5\cos\omega t$ *volts* and $I = 2\sin\omega t$ *amperes* (where $\omega = 2\pi f$). The power dissipated in the instrument is
(A) Zero (B) 10 W
(C) 5 W (D) 2.5 W

3. In an ac circuit, V and I are given by
$V = 100\sin(100\,t)$ *volts*, $I = 100\sin\left(100\,t + \frac{\pi}{3}\right) mA$.
The power dissipated in circuit is
(A) 10^4 *watt* (B) 10 *watt*
(C) 2.5 *watt* (D) 5 *watt*

4. Alternating current can not be measured by dc ammeter because
(A) ac cannot pass through dc ammeter
(B) Average value of complete cycle is zero
(C) ac is virtual
(D) ac changes its direction

5. The resistance of a coil for dc is in ohms. In ac, the resistance
(A) Will remain same (B) Will increase
(C) Will decrease (D) Will be zero

6. If instantaneous current is given by $i = 4\cos(\omega t + \phi)$ *amperes*, then the *r.m.s.* value of current is
(A) 4 amperes (B) $2\sqrt{2}$ amperes
(C) $4\sqrt{2}$ amperes (D) Zero amperes

7. In an ac circuit, peak value of voltage is 423 *volts*. Its effective voltage is
(A) 400 volts (B) 323 volts
(C) 300 volts (D) 340 volts

8. In an ac circuit $I = 100\sin 200\,\pi t$. The time required for the current to achieve its peak value will be
(A) $\frac{1}{100}$ *sec* (B) $\frac{1}{200}$ *sec*
(C) $\frac{1}{300}$ *sec* (D) $\frac{1}{400}$ *sec*

9. The peak value of an Alternating current is 6 *amp*, then *r.m.s.* value of current will be
(A) 3 A (B) $3\sqrt{3}\,A$
(C) $3\sqrt{2}\,A$ (D) $2\sqrt{3}\,A$

10. A generator produces a voltage that is given by $V = 240\sin 120\,t$, where t is in seconds. The frequency and *r.m.s.* voltage are
(A) 60 *Hz* and 240 V (B) 19 *Hz* and 120 V
(C) 19 *Hz* and 170 V (D) 754 *Hz* and 70 V

11. If E_0 represents the peak value of the voltage in an ac circuit, the *r.m.s.* value of the voltage will be
(A) $\frac{E_0}{\pi}$ (B) $\frac{E_0}{2}$
(C) $\frac{E_0}{\sqrt{\pi}}$ (D) $\frac{E_0}{\sqrt{2}}$

12. The peak value of 220 *volts* of ac mains is
(A) 155.6 *volts* (B) 220.0 *volts*
(C) 311.0 *volts* (D) 440 *volts*

13. A sinusoidal ac current flows through a resistor of resistance R. If the peak current is I_p, then the power dissipated is
(A) $I_p^2 R\cos\theta$ (B) $\frac{1}{2} I_p^2 R$
(C) $\frac{4}{\pi} I_p^2 R$ (D) $\frac{1}{\pi} I_p^2 R$

14. A 40 Ω electric heater is connected to a 200 V, 50 Hz mains supply. The peak value of electric current flowing in the circuit is approximately
(A) 2.5 A (B) 5.0 A
(C) 7 A (D) 10 A

Exercise # 2

SINGLE OBJECTIVE | AIIMS LEVEL

1. The peak value of an alternating e.m.f given by $E = E_0 \cos \omega t$, is 10 volt and frequency is 50 Hz. At time t = (1/600) sec, the instantaneous value of e.m.f is :

(A) 10 volt (B) $5\sqrt{3}$ volt
(C) 5 volt (D) 1 volt

2. r.m.s. value of current $i = 3 + 4 \sin (\omega t + \pi/3)$ is:

(A) 5 A (B) $\sqrt{17}$ A
(C) $\frac{5}{\sqrt{2}}$ A (D) $\frac{7}{\sqrt{2}}$ A

3. The voltage of an AC source varies with time according to the equation, $V = 100 \sin 100 \pi t \cos 100 \pi t$. Where t is in second and V is in volt. Then

(A) the peak voltage of the source is 100 volt
(B) the peak voltage of the source is $(100/\sqrt{2})$ volt
(C) the peak voltage of the source is 50 volt
(D) the frequency of the source is 50 Hz

4. An AC voltage is given by :

$$E = E_0 \sin \frac{2\pi t}{T}$$

Then the mean value of voltage calculated over time interval of T/2 seconds :

(A) is always zero (B) is never zero
(C) is $(2E_0/\pi)$ always (D) may be zero

5. An alternating voltage is given by : $e = e_1 \sin \omega t + e_2 \cos \omega t$. Then the root mean square value of voltage is given by :

(A) $\sqrt{e_1^2 + e_2^2}$ (B) $\sqrt{e_1 e_2}$
(C) $\sqrt{\frac{e_1 e_2}{2}}$ (D) $\sqrt{\frac{e_1^2 + e_2^2}{2}}$

6. Energy dissipates in LCR circuit in :

(A) L only (B) C only
(C) R only (D) all of these

7. The average power delivered to a series AC circuit is given by (symbols have their usual meaning) :

(A) $E_{rms} I_{rms}$ (B) $E_{rms} I_{rms} \cos \phi$
(C) $E_{rms} I_{rms} \sin \phi$ (D) zero

8. An AC voltage of $V = 220\sqrt{2} \sin \left(100\pi t + \frac{\pi}{2}\right)$ is applied across a DC voltmeter, its reading will be:

(A) $220\sqrt{2}$ V (B) $\sqrt{2}$ V
(C) 220 V (D) zero

9. The potential difference V across and the current I flowing through an instrument in an AC circuit are given by:

$V = 5 \cos \omega t$ volt

$I = 2 \sin \omega t$ Amp.

The power dissipated in the instrument is :

(A) zero (B) 5 watt
(C) 10 watt (D) 2.5 watt

10. What is the rms value of an alternating current which when passed through a resistor produces heat, which is thrice that produced by a D.C. current of 2 ampere in the same resistor in the same time interval?

(A) 6 ampere (B) 2 ampere
(C) $2\sqrt{3}$ ampere (D) 0.65 ampere

11. A direct current of 2 A and an alternating current having a maximum value of 2 A flow through two identical resistances. The ratio of heat produced in the two resistances in the same time interval will be:

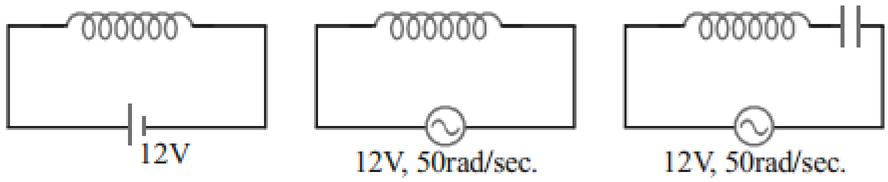
(A) 1 : 1 (B) 1 : 2
(C) 2 : 1 (D) 4 : 1

12. A sinusoidal AC current flows through a resistor of resistance R. If the peak current is I_p, then average power dissipated is :

(A) $I_p^2 R \cos \theta$ (B) $\frac{1}{2} I_p^2 R$
(C) $\frac{4}{\pi} I_p^2 R$ (D) $\frac{1}{\pi^2} I_p^2 R$

Exercise # 3 — PART - 1 — MATRIX MATCH COLUMN

1. A steady current 4 A flows in an inductor coil when connected to a 12 V dc source as shown in figure 1. If the same coil is connected to an ac source of 12 V, 50 rad/s, a current of 2.4 A flows in the circuit as shown in figure 2. Now after these observations, a capacitor of capacitance $\frac{1}{50}$F is connected in series with the coil as shown in figure 3 with the same AC source :



(Figure 1) (Figure 2) (Figure 3)

Column-I	Column-II (in S.I units)
(A) The inductance of the coil (nearly)	(P) 24
(B) The resistance of the coil	(Q) 3
(C) Average power (nearly)	(R) 0.08
(D) Total reactance	

2. Match the Physical quantities given in column-I with the parameters they depend on as given in column-II.

Column I	Column II
(A) Inductance of a coil	(P) Depends on resistivity
(B) Capacitance	(Q) Depends on shape
(C) Impedance of a coil	(R) Depends on medium inserted
(D) Reactance of a capacitor	(S) Depends on external AC voltage source

Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. A wire of resistance R is connected in series with an inductor of reactance ωL. Then quality factor of RL circuit is [CBSE AIPMT 2000]

(A) $\frac{R}{\omega L}$ (B) $\frac{\omega L}{R}$

(C) $\frac{R}{\sqrt{R^2+\omega^2L^2}}$ (D) $\frac{\omega L}{\sqrt{R^2+\omega^2L^2}}$

2. The reactance of a capacitor of capacitance C is X. If both the frequency and capacitance be doubled, then new reactance will be [CBSE AIPMT 2001]

(A) X (B) 2X

(C) 4 X (D) $\frac{X}{4}$

3. What is the cause of "Green house effect"? [CBSE AIPMT 2002]

(A) Infrared rays (B) Ultraviolet rays

(C) X-rays (D) Radio-waves

4. For a series L C R circuit, the power loss at resonance is [CBSE AIPMT 2002]

(A) $\frac{V^2}{\omega L-\frac{1}{\omega C}}$ (B) $i^2 C\omega$

(C) $i^2 R$ (D) $\frac{V^2}{\omega C}$

5. 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 [CBSE AIPMT 2005]

(A) $\frac{1}{2\pi f(2\pi fL+R)}$ (B) $\frac{1}{\pi f(2\pi fL+R)}$

(C) $\frac{1}{2\pi f(2\pi fL-R)}$ (D) $\frac{1}{\pi f(2\pi fL-R)}$

6. The core of a transformer is laminated because [CBSE AIPMT 2006]

(A) energy losses due to eddy currents may be minimised

(B) the weight of the transformer may be reduced

(C) rusting of the core may be prevented

(D) ratio of voltage in primary and secondary may be increased

7. A coil of inductive reactance 31 Ω has a resistance of 8Ω. It is placed in series with a condenser of capacitative reactance 25 Ω.The combination is connected to an AC source of 110 V. The power factor of the circuit is [CBSE AIPMT 2006]

(A) 0.56 (B) 0.64

(C) 0.80 (D) 0.33

8. What is the value of inductance L for which the current is maximum in a series LCR circuit with $C = 10\ \mu F$ and $\omega = 1000\ s^{-1}$? [CBSE AIPMT 2006]

(A) 100 mH

(B) 1 mH

(C) Cannot be calculated unless R is known

(D) 10 mH

9. The primary and secondary coils of a transformer have 50 and 1500 turns respectively. If the magnetic flux ϕ linkedwith 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 outpur voltage across the secondary coil is [CBSE AIPMT 2007]

(A) 90 V (B) 120 V

(C) 220 V (D) 30 V

10. A transformer is used to light a 100 W and 110 V lamp from a 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately [CBSE AIPMT 2007]

(A) 30% (B) 50%

(C) 90% (D) 10%

11. The velocity of electromagnetic radiation in a medium of permittivity ε_0 and permeability μ_0 is given by [CBSE AIPMT 2008]

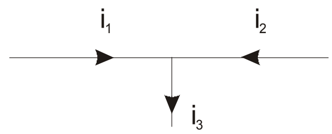
(A) $\sqrt{\frac{\varepsilon_0}{\mu_0}}$ (B) $\sqrt{\mu_0\varepsilon_0}$

(C) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$ (D) $\sqrt{\frac{\mu_0}{\varepsilon_0}}$

MOCK TEST

STRAIGHT OBJECTIVE TYPE

1. If $i_1 = 3 \sin \omega t$ and $i_2 = 4 \cos \omega t$, then i_3 is

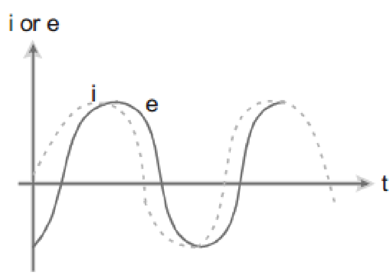


(A) $5 \sin(\omega t + 53^\circ)$ (B) $5 \sin(\omega t + 37^\circ)$ (C) $5 \sin(\omega t + 45^\circ)$ (D) $5 \cos(\omega t + 53^\circ)$

2. An alternating EMF of angular frequency $\omega \left(= \frac{1}{\sqrt{LC}}\right)$ is applied to a series LCR circuit. For this frequency of the applied EMF,
(A) The circuit is at 'resonance' and its impedance is made up only of a reactive part
(B) The current in the circuit is in phase with the applied EMF and the voltage across R equals this applied EMF
(C) The sum of the potential differences across the inductance and capacitance equals the applied EMF which is 180° ahead of phase of the current in the circuit
(D) Impedance of the circuit is less than R

3. An LCR series circuit with 100 Ω resistance is connected to an AC source of 200 V and angular frequency 300 radians per second. When only the capacitance is removed, the current lags the voltage by 60°. When only the inductance is removed, the current leads the voltage by 60º. Then the current and power dissipated in LCR circuit are respectively
(A) 1A, 200 watt. (B) 1A, 400 watt. (C) 2A, 200 watt. (D) 2A, 400 watt.

4. When an AC source of emf $E = E_0 \sin(100\, t)$ is connected across a circuit, the phase difference between the emf E and the current i in the circuit is observed to be $\frac{\pi}{4}$, as shown in the diagram. If the circuit consists possibly only of R-C or R-L or L-C series, find the relationship between the two elements.



(A) R = 1kΩ, C = 10 μF (B) R = 1kΩ, C = 1 μF
(C) R = 1kΩ, L = 10 H (D) R = 1kΩ, L = 1H

11^{th} Class Modules Chapter Details

Physics
5
Modules

Chemistry
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Mathematics
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Modules

PHYSICS	CHEMISTRY	BIOLOGY
Module-1 1. Physical World & Measurements 2. Basic Maths & Vector 3. Kinematics **Module-2** 1. Law of Motion & Friction 2. Work, Energy & Power **Module-3** 1. Motion of system of particles & Rigid Body 2. Gravitation **Module-4** 1. Mechanical Properties of Matter 2. Thermal Properties of Matter **Module-5** 1. Oscillations 2. Waves	**Module-1(PC)** 1. Some Basic Conceps of Chemistry 2. Atomic Structure 3. Chemical Equilibrium 4. Ionic Equilibrium **Module-2(PC)** 1. Thermodynamics & Thermochemistry 2. Redox Reaction 3. States Of Matter (Gaseous & Liquid) **Module-3(IC)** 1. Periodic Table 2. Chemical Bonding 3. Hydrogen & Its Compounds 4. S-Block **Module-4(OC)** 1. Nomenclature of Organic Compounds 2. Isomerism 3. General Organic Chemistry **Module-5(OC)** 1. Reaction Mechanism 2. Hydrocarbon 3. Aromatic Hydrocarbon 4. Environmental Chemistry & Analysis Of Organic Compounds	**Module-1** 1. Diversity in the Living World 2. Plant Kingdom 3. Animal Kingdom **Module-2** 1. Morphology in Flowering Plants 2. Anatomy of Flowering Plants 3. Structural Organization in Animals **Module-3** 1. Cell: The Unit of Life 2. Biomolecules 3. Cell Cycle & Cell Division 4. Transport in Plants 5. Mineral Nutrition **Module-4** 1. Photosynthesis in Higher Plants 2. Respiration in Plants 3. Plant Growth and Development 4. Digestion & Absorption 5. Breathing & Exchange of Gases **Module-5** 1. Body Fluids & Its Circulation 2. Excretory Products & Their Elimination 3. Locomotion & Its Movement 4. Neural Control & Coordination 5. Chemical Coordination and Integration

12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1
1. Electrostatics
2. Capacitance

Module-2
1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3
1. Electromagnetic Induction
2. Alternating Current

Module-4
1. Geometrical Optics
2. Wave Optics

Module-5
1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)
1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)
1. Electrochemistry
2. Surface Chemistry

Module-3(IC)
1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)
1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)
1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1
1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2
1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3
1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4
1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5
1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues