Home Assignment – 06

UNIT – IV ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

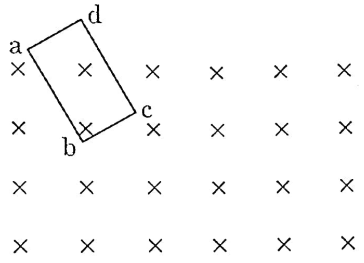
Chapter – 6 ELECTROMAGNETIC INDUCTION

CBSE 2023 (Compartment)

(SET-1)

1. A planar loop is rotated in a magnetic field about an axis perpendicular to the field. The polarity of induced emf changes once in each :
   (a) 1 revolution (b) ½ revolution (c) ¼ revolution (d) ¾ revolution

2. State Lenz's law. Determine the direction of the induced current when a rectangular conducting loop abcd in x-y plane is moved into a region of magnetic which is directed along z-axis.



OR

Two identical circular loops, one of copper and the other of aluminium are rotated about their diameters with the same angular speed in a magnetic field directed perpendicular to their axes of rotation.
Compare (i) the emf induced, and (ii) the current in the two loops. Justify your answers. (3)

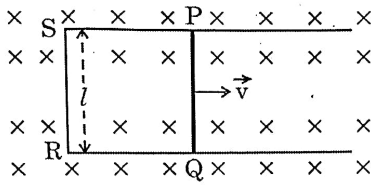
(SET-2)

1. A metal detector is based on
   (a) Self-Induction (b) Mutual Induction (c) Electrical resonance (d) Power transmission

2. A horizontal straight metallic rod of length 4 m is held at some height above the surface of earth, in east-west direction. If it is allowed to fall from rest, find the :
   (a) emf induced in the rod 2 s after it starts falling, (b) polarity of the emf induced, and
   (c) the end of the rod which is at the higher potential. (3)
   The horizontal component of the Earth's magnetic field at the place is 0.3×10^{-4} Wb/m^2 and take g = 10 m/s^2

(SET-3)

1. The figure shows a rectangular conductor PQRS with a movable arm PQ, kept in a uniform magnetic field $\vec{B}$ pointing into the page.



   (i) PQ is moved towards the right with a velocity $\vec{v}$. Obtain expression for the emf developed across PQ.
   (ii) If r is the resistance of PQRS, find the force required to move PQ with constant velocity $\vec{v}$.

2. Answer the following, giving reasons :
   (a) Induced emf does not always produces induced current.
   (b) The motion of a copper plate is damped when it is allowed to oscillate between pole pieces of a strong magnet.

CBSE 2023

1. (i) With the help of a labelled diagram, describe the principle and working of an ac generator. Hence, obtain an expression for the instantaneous value of the emf generated.
   (ii) The coil of an ac generator consists of 100 turns of wire, each of area 0.5 m^2. The resistance of the wire

is 100 Ω. The coil is rotating in a magnetic field of 0.8 T perpendicular to its axis of rotation, at a constant angular speed of 60 radian per second. Calculate the maximum emf generated and power dissipated in the coil.

OR

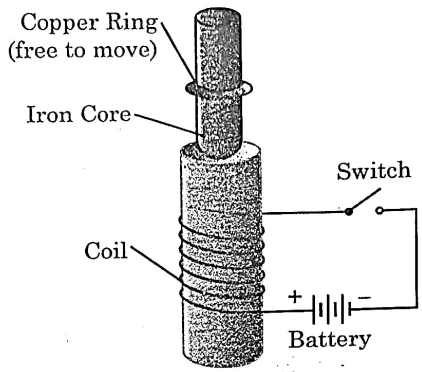
(i) Define coefficient of self-induction. Obtain an expression for self-induction of a long solenoid of length *l*, area of cross section A having N turns.

(ii) Calculate the self-inductance of a coil using the following data obtained when an AC source of frequency $\frac{200}{\pi}$ Hz and a DC source is applied across the coil. (5)

AC Source		
SN	V (Volts)	I (A)
1	3.0	0.5
2	6.0	1.0
3	9.0	1.5

DC Source		
SN	V (Volts)	I (A)
1	4.0	1.0
2	6.0	1.5
3	8.0	2.0

2. Case Study : Consider the experimental setup shown in the figure. This jumping ring experiment is an outstanding demonstration of some simple laws of Physics. A conducting non-magnetic ring is placed over the vertical core of a solenoid. When current is passed through the solenoid, the ring is thrown off.



Answer the following questions :

(i) Explain the reason of jumping of the ring when the switch is closed in the circuit.

(ii) What will happen if the terminals of the battery are reversed and the switch is closed ? Explain.

(iii) Expalin the two laws that help us understand this phenomenon.

OR

Briefly explain various ways to increase the strength of magnetic field produced by a given solenoid. (4)

CBSE 2022

1. The self-inductance of a solenoid of 600 turns is 108 mH. The self-inductance of a coil having 500 turns with the same length, same radius and the same medium will be

(a) 95 mH (b) 90 mH (c) 80 mH (d) 75 mH

2. The current in the primary coil of a pair of coils changes from 7 A to 3 A in 0.04 s. The mutual inductance between the two coils is 0.5 H. The induced emf in the secondary coil is

(a) 50 V (b) 75 V (c) 100 V (d) 220 V

3. A constant current is flowing through a solenoid. An iron rod is inserted in the solenoid along the axis. Which of the following quantities will not increase?

(a) The magnetic field at the centre (b) The magnetic flux linked with the solenoid

(c) The rate of heating (d) The self-inductance of the solenoid

4. A coil of area 100 cm^2 is kept at an angle of 300 with a magnetic field of 10^{-1} T. The magnetic field is reduced to zero in 10^{-4} s. the induced emf in the coil is

(a) $5\sqrt{3}\,V$ (b) $50\sqrt{3}\,V$ (c) $5\,V$ (d) $50\,V$

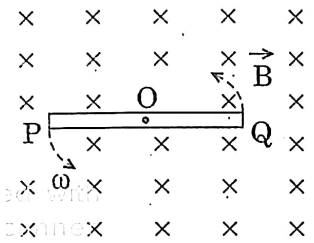
CBSE 2020

(SET – 1)

1. A conducting rod of length l is kept parallel to a uniform magnetic field $\vec{B}$. It is moved along the magnetic field with a velocity $\vec{v}$. What is the value of emf induced in the conductor? (1)
2. Draw the graph showing variation of the value of the induced emf as a function of rate of change of current flowing through an ideal inductor.

(SET – 2)

1. A metallic rod PQ of length l is rotated with angular velocity ω about the axis passing through its mid-point (O) and perpendicular to the plane of the paper, in uniform magnetic field $\vec{B}$, as shown in figure. What is the potential difference developed between the two end of the rod, P and Q?



CBSE 2019

1. (a) Derive the expression for the induced emf developed when a coil of N turns, and area of cross section A, is rotated at a constant angular speed ω in a uniform magnetic field.
   (b) A wheel with 100 metallic spokes each 0.5 m long is rotated with speed of 120 rev/min in a plane normal to the horizontal component of the Earth's magnetic field. If the resultant magnetic field at that place is 4×10^{-4} T and the angle of dip at that place is 30^0, find the emf induced between the axle and the rim of the wheel. (5)

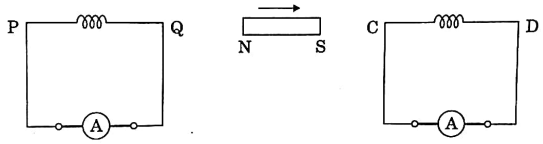
2. Derive the expression for the magnetic energy stored in an inductor when a current I develops in it. Hence, obtain the expression for the magnetic energy density. (3)

CBSE 2018

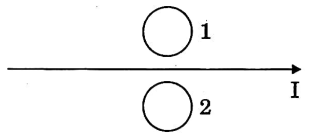
1. (a) State the principle of an ac generator and explain its working with the help of labelled diagram. Obtain the expression for the emf induced in the coil having N turns each of cross-sectional area A, rotating with constant angular speed 'ω' in a magnetic field B, directed perpendicular to the axis of rotation.
   (b) An aeroplane is flying horizontally from west to east with a velocity of 90 km/hour. Calculate the potential difference developed between the ends of its wings having a span of 20 m. The horizontal component of the Earth's magnetic field is 5×10^{-4} T and the angle of dip is 30^0. (5)

CBSE 2017

1. A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the direction of induced current in each coil. (1)



2. What is the direction of induced currents in metal rings 1 and 2 when current I in the wire is increasing steadily? (1)



3. Define mutual inductance between a pair of coils. Derive an expression for the mutual inductance of two long coaxial solenoids of the same length wound one over the other. (3)

4. Define self-inductance of a coil. Obtain the expression for the energy stored in an inductor L connected across a source of emf. (3)

5. (a) Draw a labelled diagram of an ac generator. Obtain the expression for the emf induced in the rotating coil of N turns each of cross sectional area A, in the presence of a magnetic field **B.**

(b) A horizontal conducting rod 10 cm long extending from east to west is falling with a speed 5.0 ms^{-1} at right angle to the horizontal component of the Earth's magnetic field, 0.3 x 10^{-4} Wb m^{-2}. Find the instantaneous value of emf induced in the rod. (5)

CBSE 2016

1. (a) Explain the meaning of the term mutual inductance. Consider two concentric circular coils, one of radius r_1 and the other of radius r_2 ($r_1 < r_2$) placed coaxially with centres coinciding with each other. Obtain the expression for the mutual inductance of the arrangement.

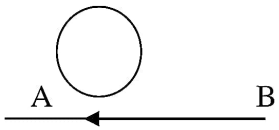
(b) A rectangular coil of area A, having number of turns N is rotated at 'f' revolution per second in a uniform magnetic field B, the field being perpendicular to the coil. Prove that the maximum emf induced in the coil is $2\pi f$ NBA. (5)

CBSE 2015

1. Define the term 'self-inductance' of a coil. Write its S. I. unit. (1)

CBSE 2014

1. The electric current flowing in a wire in the direction from B to A is decreasing. Find out the direction of induced current in the metallic loop kept above the wire as shown (1)



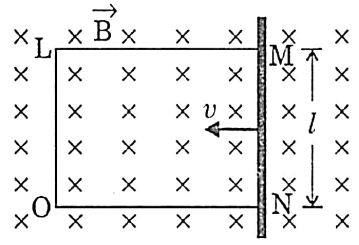
2. Define the term mutual inductance between the two coils. Obtain the expression for mutual inductance of a pair of long coaxial solenoid each of length l and radii r_1 and r_2 ($r_2 >> r_1$). Total numbers of turns in the solenoids are N_1 and N_2 respectively. (3)

CBSE 2013

1. How does the mutual inductance of a pair of a coils change when (i) distance between the coils is increased and (ii) number of turns in the coils is increased? (1)

2. The motion of a copper plate is damped when it is allowed to oscillate between the two poles of a magnet. What is the cause of this damping? (1)

3. A rectangular conductor LMNO is placed in a uniform magnetic field of 0.5 T. the field is directed perpendicular to the plane of the conductor. When the arm MN of length 20cm is moved towards left with a velocity of 10 ms^{-1}, calculate the emf induced in the arm. Given the resistance of the arm to be 5 Ω (assuming that other arms are of negligible resistance) find the value if the current in the arm. (3)



OR

A wheel of 8 metallic spokes each 50cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the earth's magnetic field. The Earth's magnetic field at the place is 0.4 G and the angle of dip is 60^0. Calculate the emf induced between the axle and the rim of the wheel.
How will the value of the emf be affected if the number if the spokes were increased? (3)