PHYSICS CLASS XII
CHAPTER – 6 ELECTROMAGNETIC INDUCTION

Q.1. When an current in a coil changes with time, how is the emf induced in the coil related to it?

Ans. Emf induced in the coil,

$$e = -L\frac{dI}{dt}$$

where L is the coefficient of self-inductance of the coil and dI/dt is the rate of change of current through the coil.

Q.2. Can a straight wire act as an inductor?

Ans. A wire cannot act as an inductor because magnetic flux linked with the wire of negligible area of cross-section is zero. The wire has to be in the form of a coil to serve as inductor.

Q.3. If the number of turns in the solenoid is doubled, keeping other factors constant, how does the self inductance of the coil change.

Ans. Self-inductance of solenoid is $\propto N^2$, so by doubling the number of turns, the self-inductance becomes four times.

Q.4. Write an expressions for the energy stored in an inductor of inductance L, when a steady current is passed through it. Is the energy electric or magnetic?

Ans. Energy stored in inductor,

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$$U = \frac{1}{2}LI^2$$

It is stored as magnetic energy.

Q.5. On what factors does the self-inductance of the solenoid depends?

Ans. The self-inductance of the solenoid depends on the

(i) number of turns (ii) length of conductor

(iii) cross-sectional area (iv) permeability of core material

Q.6. Show that the SI unit of inductance, henry is equal to volt second per ampere?

Ans. As $L = \frac{e}{dI/dt}$

SI unit of $L = \frac{1V}{1As^{-1}}$

1 henry = 1 $VA^{-1}s$

Q.7. From where does the electric energy come in a generator?

Ans. The mechanical energy used to rotate a coil inside the magnetic field is converted into electrical energy.

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Q.9. Why are the oscillations of a copper sheet in a magnetic field highly damped?

Ans. This is because of eddy currents which are induced in the copper sheet.

Q.10. Self-induction is called the inertia of electricity. Why?

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Ans. Self-induction of coil is the property by virtue of which it tends to maintain the magnetic flux linked with it and opposes any change in the flux by inducing current in it. This property of a coil is analogous to mechanical inertia that is why self induction is called the inertia of electricity.

Q.11. Can one have an inductance without a resistance? How does about a resistance with an inductance?

Ans. No, as every material has some resistance. Yes, we can coil a wire to have resistance with inductance.

Q.12. An AC generator consist of coil of 100 turns and cross-sectional area of 3m^2 , rotating at a constant angular speed of 60 rad s^{-1} in a uniform magnetic field 0.04 T. The resistance of the coil is 500 Ω. Calculate (i) maximum current drawn from the generator and (ii) minimum power dissipation of the coil.

Ans. Here, n = 100, A = 3m^2 , ω = 60 rad s^{-1} , B = 0.04 T

(i) Maximum emf produced in the coil,

$$e_0 = nBA\omega = 100 \times 0.04 \times 3 \times 60$$

$$e_0 = 720 \text{ V}$$

Since resistance of the coil is 50 Ω, the maximum current drawn from the generator,

$$I_0 = \frac{e_0}{R} = \frac{720}{500} = 1.44 \text{ A}$$

(ii) Maximum power dissipation in the coil,

p = $e_0 I_0$ = 720 × 1.44

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P = $e_0 I_0$ = 1036.8 W

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Q.13. A 100 turn coil of area 0.1 m^2 rotates at half a revolution per second . It is placed in a uniform magnetic field of 0.01 T perpendicular to the axis of rotation of the coil. Calculate the maximum voltage generated in the coil?

Ans. Here, B = 0.01 T

N = 100, A = 0.1 m^2

Frequency of rotation of the coil,

V = 0.5 s^{-1}

The maximum voltage generated in the coil,

e_0 = nBAω

e_0 = nBA × (2πv)

e_0 = 100 × 0.01 × 0.1 × 2π × 0.5

e_0 = 0.314 V

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