

Chapter 12. Electromagnetic Induction

MCQ'S (1 Mark Each)

1) In which of the following devices, the eddy current is not used

- (a) Electromagnet (b) Induction furnace (c) Electric heater (d) Magnetic breaking in train

Ans: c) electric heater

2) An ideal transformer has 100 turns in the primary and 250 turns in the secondary. The peak value of the AC is 28 V. The rms secondary voltage is nearest to

- (a) 100 V (b) 70 V (c) 50 V (d) 40 V

Ans: c) 50 V

3) The role of inductance is equivalent to

- (a) inertia (b) force (c) energy (d) momentum

Ans: a) inertia

4) The energy stored in a 50 mH inductor carrying a current of 4 A is

- (a) 0.4 J (b) 0.1 J (c) 0.04 J (d) 0.01 J

Ans: a) 0.4 J

5) In the expression $e = -d\phi/dt$, the -ve sign signifies

- (a) The induced emf is produced only when magnetic flux decreases
(b) The induced emf opposes the change in the magnetic flux
(c) The induced emf is opposite to the direction of the flux.
(d) The induced emf is independent of change in magnetic flux.

Ans: b) The induced emf opposes the change in the magnetic flux

6) Two pure inductors each of self-inductance L are connected in series, the net inductance is

- (a) 2L (b) L (c) L/2 (d) L/4

Ans: a) 2L

7) A magnet is moved towards a coil (i) quickly (ii) slowly, then the induced e.m.f. is

- (a) larger in case (i) (b) smaller in case (i)
(c) equal to both the cases (d) larger or smaller depending upon the radius of the coil

Ans: a) larger in case (i)

Very Short Answer (VSA) (1 MARK Each)

1. State Faraday's Law of electromagnetic Induction.
2. State the mathematical relation between number of turns in primary coil to secondary coil in step up transformer.
3. State the condition at which we say the two coils kept close to each other are perfectly coupled with each other.
4. State Lenz's Law.
5. A pair of adjacent coil has a mutual inductance of 1.5 H. If the current in one coil varies from 0 to 20 A in 0.5 s, what is the change of flux linked with the other coil. (**Ans: 15 Wb**)
6. An aircraft of wing span of 50 m flies horizontally in earth's magnetic field of 6×10^{-5} T at a speed of 400 m/s. Calculate the emf generated between the tips of the wings of the aircraft. (**Ans: 1.2 V**)
7. A coil of self-inductance 3 H carries a steady current of 2 A. What is the energy stored in the magnetic field of the coil? [Ans: 6 J]

Short Answer I (SA1) (2 MARKS Each)

- 1) Why and where eddy currents are undesirable? How are they minimized?
- 2) Define Self Inductance, Mutual Inductance
- 3) Explain why the inductance of two coils connected in parallel is less than the inductance of either coil.
- 4) An emf of 96 mV is induced in the windings of a coil when a current in a nearby coil is increasing at the rate of 1.20 A/s. What is the mutual inductance of the two coils?
[Ans: 80 mH]
- 5) Calculate the induced emf between the ends of an axle of a railway carriage 1.75 m long traveling on level ground with a uniform velocity 50 kmph. The vertical component of Earth's magnetic field (B_v) is 5×10^{-5} T. **[Ans: 1.215 mV]**
- 6) The magnetic flux through a loop varies according to the relation $\Phi = 8t^2 + 6t + 2$, Φ is in milliweber and t is in second. What is the magnitude of the induced emf in the loop at t = 2 seconds? [38 mV]
- 7) Distinguish between Step up and Step-Down Transformer.

- 8) Explain back emf in a motor.
- 9) What is an ac generator? State the principle of an ac generator.

Short Answer II (SA2) (3 MARKS Each)

- 1) What is Transformer? Explain step up and step-down transformers?
- 2) Determine the motional emf induced in a straight conductor moving in a uniform magnetic field with constant velocity on the basis of Lorentz force.
- 3) Describe the construction of a simple ac generator and explain its working.
- 4) Determine the magnetic energy stored per unit length of a coaxial cable, represented by two coaxial cylindrical shells of inner radii a , Outer radii b and carrying current I .
- 5) Obtain an expression for the self-inductance of a solenoid.
- 6) The primary of a transformer has 40 turns and works on 100 V and 100 W. Find a number of turns in the secondary to step up the voltage to 400 V. Also calculate the current in the secondary and primary. [160, 0.25 A, 1 A]
- 7) The primary and secondary coil of a transformer each have an inductance of 200×10^{-6} H. The mutual inductance (M) between the windings is 4×10^{-6} H. What percentage of the flux from one coil reaches the other? [Ans: 2 %]
- 8) A plane of coil of 10 turns is tightly wound around a solenoid of diameter 2 cm having 400 turns per centimeter. The relative permeability of the core is 800. Calculate the inductance of solenoid. [Ans: 0.1264 H]

Long Answer (LA) (4 marks Each)

- 1) Find an expression for the power expended in pulling a conducting loop out of a magnetic field.
- 2) Using Ampere's law, obtain an expression for the magnetic induction near a current carrying straight infinitely long wire.
- 3) Describe the construction and working of a transformer with a neat, labelled diagram.