

# DUMKAL COLLEGE

## Department of Physics

Sample question papers for Electricity and Magnetism (PHS-M-T-3)

Semester-III      Total Marks: 40      Time: 2 Hours

### Question Paper - Set 1

**Instructions: Answer all questions. Marks are indicated against each question. Assume missing data if necessary and justify your assumptions.**

Section A: Short Answer Questions ( $2 \times 5 = 10$  Marks)

(Answer any five questions. Each question carries 2 marks.)

1. Define an electric field and give its unit.
2. What is Gauss's law in electrostatics?
3. Write Laplace's equation for electrostatic potential.
4. Define electric flux and state its unit.
5. What is displacement vector (D) in dielectrics?
6. State Biot-Savart's law.
7. Define magnetic permeability and its significance.

Section B: Medium Answer Questions ( $5 \times 4 = 20$  Marks)

(Answer any five questions. Each question carries 4 marks.)

8. Explain Gauss's law for spherical charge distribution.
9. Derive the expression for potential energy of a dipole in an electric field.
10. Derive the equation for capacitance of a parallel plate capacitor with a dielectric medium.
11. Explain Ampere's Circuital Law and its application to an infinite straight wire.
12. Derive the expression for self-inductance of a solenoid.
13. Explain the working principle of a ballistic galvanometer.
14. Discuss Kirchhoff's laws for AC circuits.

Section C: Long Answer / Numerical Problems ( $1 \times 10 = 10$  Marks)

(Answer any one question. Each question carries 10 marks.)

15. Derive Poisson's and Laplace's equations in electrostatics and discuss their applications.
16. A coil with 500 turns has a self-inductance of 0.2 H. Calculate the induced emf when the current changes from 5 A to 1 A in 0.1 s.

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### Question Paper - Set 2

**Instructions: Answer all questions. Marks are indicated against each question. Assume missing data if necessary and justify your assumptions.**

Section A: Short Answer Questions ( $2 \times 5 = 10$  Marks)

1. Define electric potential and its unit.
2. What is electric susceptibility?
3. Define magnetic field intensity (H).
4. Write down the reciprocity theorem.
5. What is Lenz's law?
6. Define resonance in LCR circuits.
7. What is hysteresis loss?

Section B: Medium Answer Questions ( $5 \times 4 = 20$  Marks)

8. Explain the Uniqueness theorem in electrostatics.
9. Derive the energy stored in a charged capacitor.
10. Prove that the magnetic field inside a toroid is uniform.
11. Derive the expression for mutual inductance between two coils.
12. Explain growth and decay of current in an L-R circuit.
13. What is the Thevenin theorem? Explain with an example.
14. Derive the expression for torque on a current loop in a magnetic field.

Section C: Long Answer / Numerical Problems ( $1 \times 10 = 10$  Marks)

15. Derive the expression for the magnetic field due to a circular loop using Biot-Savart's law.
16. A coil of resistance  $20\Omega$  and inductance  $0.5\text{ H}$  is connected to a  $220\text{V}$ ,  $50\text{Hz}$  AC source. Find the current and power factor.

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### Question Paper - Set 3

**Instructions: Answer all questions. Marks are indicated against each question. Assume missing data if necessary and justify your assumptions.**

#### Section A: Short Answer Questions (2 × 5 = 10 Marks)

1. Define electric dipole moment.
2. What is Gauss's law in dielectrics?
3. Define vector potential in magnetism.
4. State Faraday's laws of electromagnetic induction.
5. What is the power factor of an AC circuit?
6. Define superposition theorem.
7. What is logarithmic damping in galvanometers?

#### Section B: Medium Answer Questions (5 × 4 = 20 Marks)

8. Derive the expression for energy stored in an electric field.
9. Explain the concept of displacement current.
10. Derive the expression for the magnetic force on a current-carrying conductor.
11. Explain the working principle of an LCR circuit.
12. State and prove Norton's theorem.
13. Discuss eddy currents and their applications.
14. Explain the M-B-H curve and its importance in magnetization.

#### Section C: Long Answer / Numerical Problems (1 × 10 = 10 Marks)

15. Derive the expression for torque on a magnetic dipole in a uniform magnetic field.
16. A solenoid has 1000 turns per meter and carries a current of 5 A. Find the magnetic field inside the solenoid.

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### Question Paper - Set 4

**Instructions: Answer all questions. Marks are indicated against each question. Assume missing data if necessary and justify your assumptions.**

#### Section A: Short Answer Questions (2 × 5 = 10 Marks)

1. Define electric intensity and its SI unit.
2. What is Gauss's law for magnetism?
3. Define induced emf and its unit.
4. What is the difference between active and reactive power?
5. Define ballistic galvanometer sensitivity.
6. What is mutual inductance?
7. Write down the maximum power transfer theorem.

#### Section B: Medium Answer Questions (5 × 4 = 20 Marks)

8. Derive the expression for electric field intensity due to a dipole.
9. Discuss the concept of electric polarization in dielectrics.
10. Explain the magnetic field due to a solenoid using Ampere's circuital law.
11. Derive the equation for AC voltage across a capacitor.
12. Explain the concept of energy stored in an inductor.
13. Derive the relation between B, H, and M for a magnetic material.
14. Explain the logarithmic decrement method in ballistic galvanometers.

#### Section C: Long Answer / Numerical Problems (1 × 10 = 10 Marks)

15. Discuss the growth and decay of charge in an L-C circuit with derivation.
16. A coil with an inductance of 2 H and resistance of  $50\Omega$  is connected to a 100 V DC supply. Calculate the time constant and the current after 2 seconds.