

## Core III

### Semester – II Electricity and Magnetism

#### Course Outcomes

- To understand the basic concepts of Electricity and Magnetism
- To Understand the various phenomena in Electricity and Magnetism
- To Understand Circuit analysis and network theorems
- To Explain the Dynamics of Charged Particles
- To Apply the acquired knowledge in Experiment.

#### Unit 1 : Electric Field and Electric Potential

- **Electric field:** Electric field lines, Electric flux, Gauss Law with applications to charge distributions with spherical, cylindrical and planar symmetry, Conservative nature of Electrostatic Field. Electrostatic Potential, Potential and Electric Field of a dipole, Force and Torque on a dipole, Potential calculation in different simple cases, Laplace and Poisson equations, The Uniqueness Theorem, Method of Images and its application to (1) Plane Infinite Sheet and (2) Sphere.
- Electrostatic energy of system of charges, Electrostatic energy of a charged sphere, Conductors in an electrostatic Field, Surface charge and force on a conductor.

#### Unit II Magnetic Field

- Magnetic Force, Lorentz Force, Biot Savarts Law, Current Loop as a Magnetic Dipole and its Dipole Moment (analogy with Electric Dipole), Amperes Circuital Law and its application to (1) Solenoid (2) Toroid (3) Helmholtz coil, Properties of curl and divergence, Vector Potential, Ballistic Galvanometer: Torque on a current Loop, Current and Charge Sensitivity, Electromagnetic damping, Logarithmic damping, CDR.

## Unit III

**Dielectric Properties of Matter:** Electric Field in matter, Polarization, Polarization Charges, Electrical Susceptibility and Dielectric Constant, Capacitor (parallel plate, spherical, cylindrical) filled with dielectric, Displacement vector  $D$ , Relations between  $E$ ,  $P$  and  $D$ , Gauss Law in dielectrics. **Magnetic Properties of Matter:** Magnetization vector ( $M$ ), Magnetic Intensity ( $H$ ), Magnetic Susceptibility and permeability, Relation between  $B$ ,  $H$ ,  $M$ , Ferromagnetism, B-H curve and hysteresis. **Electromagnetic Induction:** Faradays Law, Lenz's Law, Self -Inductance and Mutual Inductance, Reciprocity Theorem, Energy stored in a Magnetic Field, Introduction to Maxwell's Equations.

## Unit IV

- **Electrical Circuits:** AC Circuits: Kirchhoffs laws for AC circuits, Complex Reactance and Impedance, Series
- **LCR Circuit:** (1) Resonance (2) Power Dissipation (3) Quality Factor, (4) Band Width, Parallel LCR Circuit.
- **Network theorems:** Kirchoff's law for electrical circuits, Ideal Constant-voltage and Constant-current Sources.
- **Network Theorems:** Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem, Applications to DC circuits. Transient Currents Growth and decay of current in RC and LR circuits.

### Text Books:

- ✓ *Introduction to Electrodynamics – D.J. Griffiths (Pearson, 4th edition, 2015)*
- ✓ *Foundations of Electromagnetic Theory-Ritz and Milford (Pearson)*

### Reference Books:

- ✓ *Classical Electrodynamics, J. D. Jackson (Wiley).*
- ✓ *Electricity and Magnetism D. C. Tayal (Himalaya Publishing house)*
- ✓ *Electricity, Magnetism and Electromagnetic Theory- S. Mahajan and Choudhury (Tata McGraw Hill)*
- ✓ *Feynman Lectures Vol.2, R. P. Feynman, R. B. Leighton, M. Sands ( Pearson)*
- ✓ *Electricity and Magnetism, J. H. Fewkes and J. Yarwood. Vol. I (Oxford Univ. Press)*
- ✓ *Classical Electromagnetism, H.C.Verma, Bharati Bhawan*

**LAB: Credit-1**  
**(Minimum of 6 experiments are to be done)**

Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, c)DC Current, (d) Capacitances, and (e) Checking electrical fuses.

1. To study the characteristics of a series RC Circuit.
2. To determine an unknown Low Resistance using Potentiometer.
3. To determine an unknown Low Resistance using Carey Fosters Bridge.
4. To compare capacitances using DeSauty's bridge.
5. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
6. To verify the Thevenin and Norton theorems.
7. To determine self-inductance of a coil by Andersons bridge.
8. To study response curve of a Series LCR circuit and determine its (a) Reso- nant frequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
9. To study the response curve of a parallel LCR circuit and determine its (a)
10. Anti-resonance frequency and (b) Quality factor Q.

**Reference Books:**

- ✓ Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- ✓ A Text Book of Practical Physics, I.Prakash and Ramakrishna, 11th Ed., 2011, Kitab Mahal
- ✓ Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
- ✓ A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.