

# SEMESTER-IV COURSE 9: ELECTRICITY AND MAGNETISM

Theory

Credits: 3

3 hrs/week

## **COURSE OBJECTIVE:**

The course on Electricity and Magnetism aims to provide students with a fundamental understanding of the principles of electricity, magnetism, and their interactions

### **LEARNING OUTCOMES:**

On successful completion of this course, the students will be able to:

- 1. Understand the Gauss law and its application to obtain electric field in different cases and formulate the relationship between electric displacement vector, electric polarization, Susceptibility, Permittivity and Dielectric constant.
- 2. To learn the methods used to solve problems using loop analysis, Nodal analysis, Thvenin's theorem, Norton's theorem, and the Superposition theorem
- 3. Distinguish between the magnetic effect of electric current and electromagnetic induction and apply the related laws in appropriate circumstances.
- 4. Understand Biot and Savart's law and Ampere's circuital law to describe and explain the generation of magnetic fields by electrical currents.
- 5. Develop an understanding on the unification of electric, and magnetic fields and Maxwell's equations governing electromagnetic waves.
- 6. Phenomenon of resonance in LCR AC-circuits, sharpness of resonance, Q- factor, Power factor and the comparative study of series and parallel resonant circuits

### **UNIT-I Electrostatics and Dielectrics**

Gauss's law-Statement and its proof, Electric field intensity due to (i) uniformly charged solid sphere, Electrical potential–Equipotential surfaces, Potential due to a uniformly charged sphere. Dielectrics-Polar and Non-polar dielectrics- Effect of electric field on dielectrics, Dielectric strength, Electric displacement D, electric polarization Relation between D, E and P, Dielectric constant and electric susceptibility.

### **UNIT-II Current electricity**

Electrical conduction-drift velocity-current density, equation of continuity, ohms law and limitations, Kirchhoff's Law's, Wheatstone bridge-balancing condition - sensitivity. Branch current method, Nodal Analysis, star to delta & delta to star conversions. Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum power transfer theorem.



# **UNIT-III** Magneto statics

Biot-Savart's law and its applications: (i) circular loop and (ii) solenoid, Ampere's Circuital Law and its application to Solenoid, Hall effect, determination of Hall coefficient and applications.

### **Electromagnetic Induction:**

Faraday's laws of electromagnetic induction, Lenz's law, Self-induction and Mutual induction, Self-inductance of a long solenoid, Magnetic Energy density. Mutual inductance of a pair of coils. Coefficient of Coupling

# **UNIT-IV Electromagnetic waves-Maxwell's equations:**

Basic laws of electricity and magnetism- Maxwell's equations- integral and differential forms Derivation, concept of displacement current. Plane electromagnetic wave equation, Hertz experiment-Transverse nature of electromagnetic waves. Electromagnetic wave equation in conducting media. Pointing vector and propagation of electromagnetic waves

# **UNIT-V Varying and alternating currents:**

Growth and decay of currents in LR, CR, LCR circuits-Critical damping. Alternating current - A.C. fundamentals, and A.C through pure R, L and C. Relation between current and voltage in LR and CR circuits, Phasor and Vector diagrams, LCR series and parallel resonant circuit, Q –factor, Power in ac circuits, Power factor.

### **REFERENCE BOOKS**

- 1. BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
- 2. Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
- 3. Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand & Co.,
- 4. "Electricity and Magnetism" by Brijlal and Subramanyam Ratan Prakashan Mandir, 1966
- 5. "Electricity and Magnetism: Fundamentals, Theory, and Applications" by R. Murugeshan, Kiruthiga Siva prasath, and M. Saravanapandian
- 6. "Electricity and Magnetism: Theory and Applications" by Ajoy Ghatak and S. Lokanathan
- 7. Electricity and Magnetism: Problems and Solutions" by Ashok Kumar and Rajesh Kumar
- 8. Electricity and Magnetism, R.Murugeshan, S. Chand & Co.