Course: Core paper III - HPHCR2032T & HPHCR2032P

Semester	II
Paper Number	**HPHCR2032T & HPHCR2032P**
Paper Title	Electricity & Magnetism
No. of Credits	06 (Theory – 4, Lab – 2)
Theory/Composite	Composite
No. of periods assigned	Th: 4 periods/week Pr: 3 periods/week
Name of Faculty member(s)	
Course description/objective	The objective of the course is to teach Electrostatics and Electrodynamics to the students at the introductory level. This course will make the students familiar with the basic laws and their applications in electricity and Magnetism. The experiments in the practical paper are connected to the topics of the theory paper.
Syllabus	As enclosed
Texts	As enclosed
Reading/Reference Lists	As enclosed
Evaluation	Total – 100 (Theory – 60, Practical – 40) Theory – CIA – 10 Semester Examination – 50 Group A (25 marks) — Group B (25 marks) One 10 marks qs out of two qs — One 10 mark qs out of two qs Three 5 mark qs out of five qs — Three 5 mark qs out of five qs

Syllabus :

HPHCR2032T - ELECTRICITY AND MAGNETISM (Credits-Theory-04, Practicals-02)

Module – A [26 lectures]

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. **[5 Lectures]**

Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole. [**5 Lectures]**

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to a plane infinite sheet.

[9 Lectures]

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 dielectric **[7 Lectures]**

Module – B [26 Lectures]

Magnetic Field: Magnetic force between current elements and definition of Magnetic Field B. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to solenoid and toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. **[8 Lectures]**

Magnetic Properties of Matter: Magnetization vector (M). Magnetic Intensity (H). Magnetic Susceptibility and permeability. Relation between B, H and M. Ferromagnetism. B-H curve and hysteresis. **[4 Lectures]**

Electromagnetic Induction: Faraday's Law. Lenz's Law. Self Inductance and Mutual Inductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current. **[5 Lectures]**

Electrical Circuits: **AC Circuits**: Kirchhoff's laws for AC circuits. Reactance and Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3) Quality Factor, and (4) Band Width. Parallel LCR circuits **[3 Lectures]**

Network theorems: 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. **[3 Lectures]**

Ballistic Galvanometer: Torque on a current Loop. Ballistic Galvanometer: Current and Charge Sensitivity. Electromagnetic damping. Logarithmic damping. CDR. **[3 Lectures]**

Reference Books:

1. Electricity, Magnetism& Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press
6. Electricity and Magnetism, J.H.Fewkes & J.Yarwood.Vol.I, 1991, Oxford Univ. Press.

HPHCR2032P - Electricity and Magnetism Lab – Credits – 2 (39 periods)

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances.

2. To determine an unknown Low Resistance using Carey Foster's Bridge.

3. To verify the Thevenin and Norton theorems using Wheatstone's bridge.

4. To verify the Superposition, Reciprocity and Maximum power transfer theorems.

5. To determine self-inductance of a coil by Anderson's bridge.

6. To study response curve of a series LCR circuit and determine its (a) resonant frequency, (b) impedance at resonance, (c) quality factor Q (d) band width.

7. To determine the mutual inductance between a pair of coils using a ballistic galvanometer.

8. To draw B-H loop of a given specimen and to estimate the hysteresis loss.

Reference Books:

1. Advanced Practical Physics (Volume-1 & 2) by B. Ghosh & K.G. Majumder, Sreedhar Publishers
2. Practical Physics by Chattopadhyay and Rakshit,
3. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia• Publishing House
4. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
5. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition,• reprinted 1985, Heinemann Educational Publishers
6. Engineering Practical Physics, S.Panigrahi and B. Mallick, 2015, Cengage Learning.•
7. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.