Semester	**III**
Course	**Major**
Paper Code	**C2PH230311T**
Paper Title	**Electricity and Magnetism**
No. of Credits	**4**
Theory / Practical / Composite	**Full Theory**
Minimum No. of preparatory hours per week a student has to devote	4
Number of Modules	2

Syllabus	**Major Paper - ELECTRICITY AND MAGNETISM** **Module – A :** **Electricity** **[24 lectures]** **Electric field and potential**: Coulomb's law, Principle of superposition, electrostatic field, field lines and flux. Gauss' law with applications to charge distributions with planar, spherical and cylindrical symmetry. [4] Conservative nature of electrostatic field, electrostatic potential. Laplace's and Poisson equations. Multipole expansion of potential. Potential and electric field of a dipole, force and torque on a dipole. [5] 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. Electrostatic energy of a system of charges (discrete & continuous), electrostatic energy of a charged sphere. [4] Earnshaw's theorem, Electrostatic boundary conditions (no applications), Uniqueness theorems; Method of images and its application to a plane infinite sheet. [5] **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. [6] **Module – B : Magnetostatics & Current Electricity** **[24 Lectures]** **Magnetic field**: Magnetic force between current elements and definition of magnetic field B, current density, equation of continuity, Biot-Savart's law and its applications: straight wire & circular loop. Divergence and curl of magnetic field, Ampere's circuital law - applications to solenoid & toroid. [6] Vector potential calculation, Coulomb gauge, magnetostatic boundary conditions, potential and field of a magnetic dipole. Torque on a current loop in a uniform magnetic field. [4]

	Magnetic properties of matter: Free and Bound current. Magnetization vector (M), magnetic intensity (H). Magnetic susceptibility and permeability. Diamagnetic and Paramagnetic response to external magnetic field. Relation between B, H and M. Ferromagnetism. B-H curve and hysteresis**.** [4] **Electromagnetic induction**: Faraday's law, Lenz's law, self inductance, mutual inductance. Reciprocity theorem. Energy stored in a magnetic field. Charge conservation and Displacement current. Maxwell's equations. [4] **AC Circuits**: Kirchhoff's laws for AC circuits. Reactance and impedance. Phasor Diagrams. Series LCR circuit, resonance, power dissipation, quality factor, bandwidth. [3] **Network theorems**: Ideal constant-voltage and constant-current sources. Network theorems: Superposition theorem, Thevenin and Norton theorem,Reciprocity, Maximum power transfer theorem. Applications to dc circuits. [3]
Learning Outcomes	1. Apply Gauss Law for symmetric configurations and understand the connection between Field, Potential and Field Energy with applicable Boundary conditions. 2. Understanding Multipole expansions and dielectric medium. 3. Conceptualize the motion of charged particles in Magnetic fields, its sources (including magnetic materials) and the generation of motional EMF. 4. Being able to handle electrical networks and apply AC/DC analysis.
Reading/Reference Lists	**Reference Books:** 1. Introduction to Electrodynamics, D.J. Griffiths, Cambridge University Press.

	2. Electricity and Magnetism, Edward M. Purcell & D. J. Morin, Cambridge University Press 3. Electricity and Magnetism, Edward M. Purcell, Vol. – II, Berkeley Physics Course. 4. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and S. R. Choudhury, Tata McGraw Hill. 5. Electricity & Magnetism. D.C. Tayal, Himalaya Publishing House. 6. The Feynman Lectures on Physics, Vol. 2, R.P.Feynman, R.B.Leighton, M. Sands, Pearson Education 7. Electricity and Magnetism, J.H.Fewkes & J.Yarwood.Vol.I, Oxford University Press.	
Evaluation	Theory CIA: 30 (2 x 10 + 5/assgn.+ 5/attn.) Semester Exam:70	
Paper Structure for Theory Semester Exam	For each module of 35 Marks: 15 Marks from 3 marks questions (5 out of 7) 20 Marks from 10 marks questions (2 out of 3)	