B.Sc. Multidisciplinary with Physics

2nd Semester

Physics DSC-121(a)**: Electricity and Magnetism**

Instructions for Paper Setters and Candidates:

1. *The question paper will consist of five sections: Section A(compulsory, covering whole syllabus from all the units), Section B from Unit 1, Section C from Unit II, Section D from Unit III and Section E from Unit IV. Examiner will set nine questions in all, question number 1 will be compulsory and two questions from each Unit, i.e., I, II, III and IV, respectively. Each question will carry 10 marks. Question Number 1 (Section A) will consist of seven sub-short answer type questions carrying 02 (two) marks each and candidate has to attempt any five (5) questions. Each Question must include at least 20% numerical problems.*
2. *Candidate will have to attempt five questions in all, i.e., selecting one question from each sections B, C, D &E.* From the *Compulsory section A candidate has to attempt any five(5) out of seven (7) questions. The duration of the examination will be 3 hours.*

Unit-I

Vector Analysis: Review of vector algebra (properties of vectors, scalar product, vector product, scalar triple product and vector triple product), Field and its classification (Scalar and Vector field), Differentiation of a vector, Partial Differentiation of Vector and Scalar, Differential (Del operator) and Laplace's operator, Gradient of scalar field (Physical Meaning), Integration of Vectors, Flux of a vector, Divergence of vector field and its physical interpretation, Gauss Divergence theorem, Curl of vector field and its physical significance, Stoke's Theorem, Green's theorem. **(7 Lectures)**

Electrostatics: Differential form of Gauss's law, Applications of Gauss's Law (i) electric field due to point charge, (ii) infinite line of charge, (iii) uniformly charged spherical shell and (iv) solid sphere, (v) plane charged sheet, Electrostatic potential and electrostatic potential energy. Equipotential surface, Potential Gradient, Electric potential due to a dipole and quadrupole, Electric field as a gradient of a scalar potential, Poisson and Laplace equations. **(5 Lectures)**

Unit-II

Electrostatic Fields in Dielectrics: Dielectrics, Classification of Dielectrics, Response of Dielectric to external electric field, Polarization vector and Susceptibility, Atomic polarizability, Dielectric constant, Dielectric Strength, Electric susceptibility, Relation between dielectric constant and electric susceptibility, Gauss's law in dielectric, Integral form of Gauss's law for dielectrics, Differential form of Gauss's law for dielectrics, Displacement vector, Energy stored in a dielectric medium. Claussius - Mossotti relation. Difference between piezoelectric, pyroelectric, ferroelectric materials and electrets (Qualitative idea). **(6Lectures)**

Magnetism: Magnetic field Biot-savarot's law, Magnetic flux, Divergence and curl of magnetic field, Magnetic field of a moving point charge, Ampere circuital law and its applications: (i) current carrying wire (ii) long solenoid, (iii) toroid. Differential form of Ampere's Law, Magnetic vector potential and its divergence. **(5 Lectures)**

Unit-III

Magnetic Fields in Matter: Classification of Magnetic Materials, Magnetization, magnetic induction (self induction and mutual induction, Magnetic permeability and susceptibility and their interrelation. Diamagnetism and Langevin's theory of diamagnetism. Paramagnetism and origin of atomic magnetic moment. Domain theory of ferromagnetism, magnetization curve, Hysteresis loss and its applications. **(5 Lectures)**

Electric current and Field of Moving Charges:
Electric current and current density, Equation of continuity and conservation of charge, Atomic theory of conductivity (Microscopic form of Ohm's Law), Moving charge particle in (i) uniform electric, (ii) uniform magnetic field, (iii) crossed uniform electric and magnetic field. **(5 Lectures)**

Unit-IV

Maxwell`s equations & electromagnetic waves: Displacement current, Maxwell's equations and their derivation, Electromagnetic waves equation, Transverse nature of EM waves, Poynting vector, Poynting theorem, relation between electric and magnetic field vectors in EM waves. **(5 Lectures)**
Electromagnetic wave propagation: Propagation of EM waves in vacuum, isotropic and dielectric medium EM waves in conducting medium, skin depth, normal and anomalous dispersion. Reflection and Transmission of EM waves at a boundary of two dielectric media for normal and oblique incidence. **(7 Lectures)**

Reference Books:

1. Electricity and Magnetism, Edward M. Purcell, 1986, McGraw-Hill Education.
2. Electricity and Magnetism, J.H. Fewkes& J. Yarwood. Vol. I, 1991, Oxford Un. Press.
3. Electricity and Magnetism, D C Tayal, 1988, Himalaya Publishing House.
4. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
5. Introduction to Electrodynamics, D.J. Griffth,.
6. Electricity and Magnetism, Brij Lal and Subramanium, S. Chand. Edition, Prentice Hall of India.
7. Electricity and Magnetism, A S Mahajan and A A Rangwala, Tata McGraw Hill Company. Co. Ltd.

Physics DSC-121(a)**: Electricity and Magnetism**

Course Outcomes:

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

- **Understand the fundamental concepts of vector algebra,** including scalar and vector products, and apply these concepts to solve physical problems.
- **Derive and apply Gauss's Law** in both its differential and integral forms to determine electric fields from various charge distributions.
- Develop a deep understanding of electrostatic potential and electrostatic potential energy, and will be able to compute the electric potential due to dipoles and quadrupoles.
- **Classify and analyze dielectric materials**, understand their polarization behavior under the influence of external electric fields.
- Apply Gauss's law in the context of dielectrics, with a focus on the displacement vector and energy stored within dielectric materials.
- **Understand and apply fundamental laws of magnetism**, including Biot-Savart's Law and Ampere's Circuital Law.
- **Gain a comprehensive understanding of magnetization and magnetic properties of materials**, including the analysis of diamagnetism, paramagnetism, and ferromagnetism.
- Develop an understanding of Maxwell's equations and their role in the description of electromagnetic phenomena.
- Analyze and solve problems involving electromagnetic wave propagation, ensuring a strong grasp of the theoretical foundation of modern electromagnetism.

2nd Semester
DSC-PHYP- 121(b): Electricity and Magnetism Laboratory

Note:

1. ***Teacher should give a lecture on error analysis before practical classes.***
2. ***A student has to perform minimum ten (10) experiments.***
3. ***Error analysis should be done in each experiment.***
4. ***External examiner for the end semester practical exam should be deputed by the H. P. University and should not be from the same college. University has to depute from any other college affiliated to the University.***

List of Experiments:

1. Use a Multi-meter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer:
   (i) Measurement of charge and current sensitivity,
   (ii) Measurement of Critical Damping Resistance (CDR)
3. Determine high resistance by Leakage Method
4. To compare capacitances using De'Sauty's bridge.
5. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx).
6. To study a series LCR circuit and determine its (a) Resonant Frequency and Quality Factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and
   (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To determine unknown capacitance by flashing and quenching method
10. To find frequency of ac supply using an electrical vibrator.
11. To study the induced EMF as a function of the velocity of the magnet.
12. To measure the resistance using wheatstone bridge.
13. To measure the capacitance using AC bridge.
14. To draw the magnetic lines of force of bar magnet and find magnetic length.
15. To determine the low resistance by Kelvin double Bridge.
16. CRO and its applications.

Reference Books

1. Advanced Practical Physics for students, B.L.Flint & H.T.Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.
3. Engineering Practical Physics, S.Panigrahi & B.Mallick,2015, Cengage Learning India Pvt. Ltd.
4. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
5. B.Sc. Practical Physics C.L. Arora, S. Chand and company Ltd.