Government PG College, Ambala Cantt

Session: 2023-2024 (Even semester)

Name of Assistant Professor: Dr. Samiksha Kumari

Class: B.Sc Ist year (Sem-II) Non-Med

Subject: Physics (Paper: Electricity, Magnetism & EM Theory, PHY-201)

SYLLABUS

Max. Marks:100 Minimum Pass Marks: 35

Internal Assessment Marks:30

End Term Exam Marks: 70

Time: 3 hours

Note: Nine questions will be set in total. Question no. 1 will be compulsory and based on the conceptual aspects of the entire syllabus. This question may have 4 parts and the answer should be in brief but not in Yes/No. Four more questions are to be attempted, selecting one question out of two questions set from each unit. Each question may contain two or more parts. All questions will carry equal marks. 20% numerical problems are to be set. Use of scientific (non-programmable) calculator is allowed.

UNIT - I

Vector Background and Electric Field: Gradient of a scalar and its physical significance, Line, Surface and Volume integrals of a vector and their physical significance, Flux of a vector field, Divergence and curl of a vector and their physical significance, Gauss’s divergence theorem, Stoke’s theorem. Conservative nature of Electrostatic Field, Electrostatic Potential, Potential as line integral of field, potential difference Derivation of electric field E from potential as gradient. Derivation of Laplace and Poisson equations. Electric flux, Gauss’s Law, Differential form of Gauss’s law and applications of Gauss’s law. Mechanical force of charged surface, Energy per unit volume.

UNIT - II

Magnetic Field: Biot-Savart law and its simple applications: straight wire and circular loop, Current Loop as a Magnetic Dipole and its Dipole Moment, Ampere’s Circuital Law and its applications to (1) Solenoid and (2) Toroid, properties of B: curl and divergence.

Magnetic Properties of Matter: Force on a dipole in an external field, Electric currents in Atoms, Electron spin and Magnetic moment, types of magnetic materials, Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H and M, Electronic theory of dia and paramagnetism, Domain theory of ferromagnetism (Langevin’s theory), Cycle of Magnetization- B-H curve and hysteresis loop: Energy dissipation, Hysteresis loss and importance of Hysteresis Curve.

UNIT - III

Time varying electromagnetic fields: Electromagnetic induction, Faraday’s laws of induction and Lenz’s Law, Self-inductance, Mutual inductance, Energy stored in a Magnetic field, Derivation of Maxwell’s equations, Displacement current, Maxwell’s equations in differential and integral form and their physical significance.

Electromagnetic Waves: Electromagnetic waves, Transverse nature of electromagnetic wave, energy transported by electromagnetic waves, Poynting vector, Poynting’s theorem. Propagation of Plane electromagnetic waves in free space & Dielectrics.

UNIT - IV

DC current Circuits: Electric current and current density, Electrical conductivity and Ohm’s law (Review), Kirchhoff’s laws for D.C. networks, Network theorems: Thevenin’s theorem, Norton theorem, Superposition theorem.

Alternating Current Circuits: A resonance circuit, Phasor, Complex Reactance and Impedance, Analysis for RL, RC and LC Circuits, Series LCR Circuit: (1) Resonance, (2) Power Dissipation (3) Quality Factor and (4) Band Width, Parallel LCR Circuit.

Recommended Books/e-resources/LMS:

1. Electricity and Magnetism (Berkley, Phys. Course 2), Edward M. Purcell, 1986 McGrawHill Education.

2. Electricity and Magnetism: A.S. Mahajan & A.A. Rangwala (Tata- McGraw Hill), 1988.

3. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw

4. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.

5. Feynman Lectures Vol.2, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education

6. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

7. Electricity and Magnetism, J.H.Fewkes & J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

8. Field and Wave Electromagnetics (2nd Edn.), David K. Cheng , Addison-Wesley Publishing Company.

9. B.Sc. Practical Physics, C.L. Arora, S. Chand Publisher, New Delhi

**COURSE OBJECTIVES:**

* To understand the basic mathematical concepts related to electromagnetic vector fields.
* Students will familiar with nature and types of magnetic materials.
* To understand the properties of permanent magnet and electromagnet.
* To understand the concept of electric and magnetic fields.
* To introduce the concept of different coordinate systems, Maxwell’s equation.
* Define, describe and draw magnetic field lines around a single magnet.
* Understand the basic electronics concepts.

Course Learning Outcomes: After completing this course, the learner will be able to:

1. Explain and differentiate the vector and scalar formalisms of electrostatics. Also be able to apply Gauss’s Divergence & Stokes theorem to solve various problems in electrostatics.

2. Describe the magnetic materials & important properties of magnetic field. Understand the properties and theories of dia-, para- & ferromagnetic materials.

3. Derive Maxwell equations and their physical significance and familiar about the propagation of electromagnetic waves i.e. boundary conditions at the interface between different media. The students will also be able to have basic idea about the propagation of electromagnetic waves in free space and in medium.

4. Understand D.C. and A.C. circuits, able to apply and analyse using networks. Analyze DC/AC circuits consisting of parallel and/or series combinations of voltage sources and resistors and to describe the graphical relationship of resistance, capacitor and inductor.

5. Learn to present observations, results, analysis and different concepts related to experiments of Electricity and Magnetism.

Lesson Plan

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| **S.No.** | **Week** | **Topic** |
| **1** | 15th Feb 2024- 17th Feb 2024 | **Unit 1: Vector Background and Electric Field:** Gradient of a scalar and its physical significance, Line, Surface and Volume integrals of a vector and their physical significance, |
| **2** | 19th Feb 2024- 24th Feb 2024 | Flux of a vector field, Divergence and curl of a vector and their physical significance, Gauss’s divergence theorem, Stoke’s theorem. Conservative nature of Electrostatic Field, Electrostatic Potential, |
| **3** | 26th Feb 2024- 2nd March 2024 | Potential as line integral of field, potential difference Derivation of electric field E from potential as gradient. Derivation of Laplace and Poisson equations |
| **4** | 4th March 2024-9th March 2024 | Electric flux, Gauss’s Law, Differential form of Gauss’s law and applications of Gauss’s law. Mechanical force of charged surface, Energy per unit volume. **Revision & Tests** |
| **5** | 11th March 2024-16th March 2024 | **Unit 2: Magnetic Field:** Biot-Savart law and its simple applications: straight wire and circular loop, Current Loop as a Magnetic Dipole and its Dipole Moment, |
| **6** | 18th March 2024-22nd  March 2024 | Ampere’s Circuital Law and its applications to (1) Solenoid and (2) Toroid, properties of B: curl and divergence, **Magnetic Properties of Matter**: Force on a dipole in an external field, Electric currents in Atoms, Electron spin and Magnetic moment |
| **7** | 23rd March 2024 to 31st March 2024 | **Holi Break** |
| **8** | 1st April 2024 to 6th April 2024 | types of magnetic materials, Magnetization vector (M), Magnetic Intensity (H), Magnetic Susceptibility and permeability, Relation between B, H and M, Electronic theory of dia and paramagnetism, |
| **9** | 8th April 2024 to 13th April 2024 | Domain theory of ferromagnetism (Langevin’s theory), Cycle of Magnetization- B-H curve and hysteresis loop: Energy dissipation, Hysteresis loss and importance of Hysteresis Curve. **Revision & Tests** |
| **10** | 15th April 2024 to 20th April 2024 | **Unit 3: Time varying electromagnetic fields:** Electromagnetic induction, 11 34(578) Faraday’s laws of induction and Lenz’s Law, Self-inductance, Mutual inductance, Energy stored in a Magnetic field, Derivation of Maxwell’s equations, |
| **11** | 22th April 2024 to 27th April 2024 | Displacement current, Maxwell’s equations in differential and integral form and their physical significance. **Electromagnetic Waves:** Electromagnetic waves, Transverse nature of electromagnetic wave, |
| **13** | 29th April 2024 to 4th May 2024 | energy transported by electromagnetic waves, Poynting vector, Poynting’s theorem. Propagation of Plane electromagnetic waves in free space & Dielectrics, **Revision & Tests** |
| **14** | 6th to 11th May 2024 | **Unit 4: DC current Circuits:** Electric current and current density, Electrical conductivity and Ohm’s law (Review), Kirchhoff’s laws for D.C. networks, |
| **15** | 11th to 18thMay 2024 | Network theorems: Thevenin’s theorem, Norton theorem, Superposition theorem. **Alternating Current Circuits:** A resonance circuit, Phasor, Complex Reactance and Impedance, Analysis for RL, RC and LC Circuits, |
| **16** | 20th to 25thMay 2024 | Series LCR Circuit: (1) Resonance, (2) Power Dissipation (3) Quality Factor and (4) Band Width, Parallel LCR Circuit |
| **17** | 27th May 2024 | **House exam, Revision & Tests** |