

UNIVERSITY OF MADRAS
B.Sc. DEGREE COURSE IN PHYSICS
SYLLABUS WITH EFFECT FROM 2020-2021

BPS-CSC08

CORE-VIII: ELECTRICITY AND ELECTROMAGNETISM

(Vector Treatment Only)

(Common to B.Sc.Physics with Computer Applications-VI Sem.)

Lecture: 60 Hours

Tutorial: 15 Hours

Credits:4

Course Objective:

To give the students a firm understanding of the basics of Electricity and Magnetism.

To familiarize the fundamentals of electromagnetic theory and applications of electromagnetic induction

Learning Outcomes:

After the successful completion of this paper, students will be able to:

- Demonstrate Gauss law, Coulomb's law for the electric field and apply it to systems of point charges as well as line, surface and volume distribution of charges
- Understand the principle of capacitors and dielectric properties
- Explain Faraday and Lenz's laws to articulate the relation between electric and magnetic fields
- Use Ballistic Galvanometer with the state of art.
- Apply Maxwell's equations to arrive at different optical constants

UNIT I: ELECTROSTATICS I

(12 Hours)

Properties of charges - Coulomb's law and its Validity –Superposition Principle – Electric field and Electric Potential – Relations between field and potential - Energy consideration – Flux – Gauss law – Linear, Surface and Volume charge distributions – Solutions of Laplace equation – Stability of Charges – Electric dipole – Multipole expansion

UNITII: CONDUCTORS, CAPACITORS AND DIELECTRICS (12 Hours)

Electrical Images and its Applications (Earthed sheet and earthed Spherical conductor) – Capacitance – Energy Consideration – Classical Radius of an Electron –Polarization Density – Polarization Charge Densities – Relation between D, E and P, Gauss's law in the presence of a dielectric – Boundary condition on D and E

UNIT III :MAGNETIC EFFECTS OF AN ELECTRIC CURRENT

(12 Hours)

Biot-Savart's law and its Application to Circular Loop-Helmholtz Galvanometer-Ampere's Circuital Law both in Integral and Differential Form and its Application to Current Carrying Loop, Solenoid and Toroid-Properties of B: Curl and Divergence

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Force on a current element in a magnetic field-Moving coil Ballistic Galvanometer-Damping Correction-Figure of Merit-Determination of Absolute Capacitance of a capacitor

UNIT IV: ELECTROMAGNETIC INDUCTION (12 Hours)

Faraday's law of Electromagnetic Induction (Differential and Integral form)-Lenz's law-Self Inductance- Mutual Inductance – Coefficient of Coupling-Self Inductance of a long solenoid- Mutual Inductance of two coils- Measurement of L and M using Ballistic Galvanometer- Transformers-Construction and working -Efficiency and Energy loss

UNIT V: ELECTROMAGNETIC WAVES (12 Hours)

Types of currents-Concept of Displacement Current – Maxwell's equations – Maxwell's equations in Free Space-Electromagnetic Waves Equations-Velocity of EM wave-Transverse nature of EM wave-Poynting vector and its significance-Reflection and Transmission of electromagnetic waves at an interface of non-conducting medium

Books for Study:

1. Electricity and Magnetism, A S Mahajan, A A Rangwala, McGraw Hill, NewDelhi (2017)
2. Introduction to Electrodynamics, David J. Griffith, PHI, NewDelhi, (2012).
3. Electromagnetic theory, Chopra & Agarwal, K Nath & Co.

Books for Reference:

1. Electricity and Magnetism, E M. Purcell, David Morin (3rd Edition) , Cambridge University Press.
2. Basic laws of Electromagnetism, I E Irodov, New Age International Publishers, New Delhi,(2019).
3. Electricity and Magnetism, NavinaWadhvani, PHI, NewDelhi,(2007).
4. Electricity and Magnetism, K.K Tewari, S Chand & Co, NewDelhi,(2007).
5. Fundamentals of Physics – Electricity and Magnetism, Halliday – Resnick and Walker, Wiley India PvtLtd,(2011).
6. https://swayam.gov.in/nd1_noc20_ph08/preview
7. <https://www.youtube.com/playlist?list=PLQNC9KhS56XwsAtI28BZGC9cEGWGHuEOK>
8. <https://nptel.ac.in/courses/115101005/>
9. <https://nptel.ac.in/content/storage2/courses/115101004/downloads/module1/ed-1-1-new.pdf>