PHYSICS-12: ELECTROMAGNETIC THEORY

Maxwell Equations: Review of Maxwell's equations. Vector and scalar potentials, gauge transformations: Lorentz and Coulomb gauge. Poynting Theorem and Poynting vector. Electromagnetic field energy density, momentum, angular momentum. (10 Lectures)

Electromagnetic Wave Propagation in Unbounded Media: Plane electromagnetic (EM) waves through vacuum and isotropic dielectric medium, transverse nature of plane electromagnetic waves, refractive index and dielectric constant, wave impedance. Propagation through conducting media, relaxation time, skin depth. Wave propagation through dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere. (10 Lectures)

Polarization of Electromagnetic Waves: Description of linear, circular and elliptically polarised light (analytical treatment). (2 Lectures)

Electromagnetic Wave in Bounded Media: Boundary conditions at a plane interface between two media. Reflection and Refraction of plane waves at a plane interface between two dielectric media- Laws of Reflection and Refraction. Fresnel's Formulae for perpendicular and parallel polarization cases, Brewster's law. Reflection and Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence) (12 Lectures)

Waveguides: Propagation of plane EM waves in planar dielectric waveguides. (3 Lectures)

Electromagnetic Radiation: Wave equation for scalar and vector potentials in the Lorentz gauge. Retarded potentials: simple treatment using spherical waves and Principle of Superposition. Electric dipole Radiation. Power radiated by a dipole. Application: Scattering of light and colour of the sky (qualitative discussion). (6 Lectures)

Electrodynamics and Relativity: Electric and Magnetic fields due to a parallel plate capacitor and a long solenoid viewed in rest and moving frames of reference. Transformations of Electric and Magnetic fields deduced from these examples. (5 Lectures)

Reference Books:

- Introduction to Electrodynamics, David J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
- Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
- Introduction to Electromagnetic Theory, Tai L. Chow, 2006, Jones and Bartlett Learning
- Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
- Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
- Electromagnetic Field Theory for Engineers & Physicists, Gunther Lehner, 2010, Springer

Additional Books for Reference

- Electromagnetic Fields and Waves, P. Lorrain & D. Corson, 1970, W.H. Freeman & Co. Pvt. Ltd.
- Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
- Electromagnetic field theory fundamentals, B.Guru & H.Hiziroglu, 2004, Cambridge Univ. Press

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PHYSICS PRACTICAL-VI

(Students have to perform at least 4 experiments from the section VIA. Additional experiments may be included with the approval of the committee of courses)

PHYSICS LAB.-VIA

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the value of e/m by (a) Magnetic focussing or (b) Bar magnet.
6. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction of light through an ultrasonic grating.
7. To study the reflection, refraction of microwaves
8. To study Polarization and double slit interference in microwaves.
