Subject: Physics
Semester: Five
Course Name: Electromagnetic Theory
Existing Base Syllabus: HS Physics, Chemistry and Mathematics
Course Level: PHY304
Syllabus showing each unit against class number and marks

Unit no.	Unit content	No. of classes	Marks/Credit
Theory			
Unit I: Maxwell's equations	Maxwell's equations, Displacement Current, Vector and Scaler Potentials, Gauge Transformations: Coulomb and Lorentz Gauge, Boundary Conditions at Interface between Different Media, Poynting Theorem and Poynting Vector.	9	Credit - 3
Unit II: EM Wave Propagation in Unbounded Media	Plane EM Waves through Vacuum and Isotropic Dielectric Medium, Transverse Nature of Plane EM Waves, Refractive Index and Dielectric Constant, Propagation though Conducting Media, Relaxation Time, Skin Depth. Wave Propagation through Dilute Plasma (Basic Concepts).	9	
Unit III: EM wave in Bounded Media	Reflection and Refraction of Plane EM Waves at Plane Interface between two Dielectric Media – Laws of Reflection and Refraction, Fresnel's Formula for Perpendicular Polarization Case, Brewster's Law, Reflection and Transmission Co-efficient, Waveguides: Basic Concepts and Propagation of EM Waves in a Rectangular Waveguide.	9	
Unit IV: Polarization of Electromagnetic Waves	Description of Linear, Circular and Elliptical Polarization, Propagation of EM Waves in Anisotropic Media, Symmetric Nature of Dielectric Tensor, Fresnel's Formula, Uniaxial and Biaxial Crystals, Light Propagation in Uniaxial Crystal, Double Refraction, Polarization by Double Refraction, Nicol Prism; Ordinary & Extraordinary Refractive Indices, Production & Detection of Plane, Circularly and Elliptically Polarized Light; Phase Retardation Plates: Quarter-Wave and Half-Wave Plates, Babinet	11	

	Compensator and its Uses, Analysis of Polarized Light.		
Unit V: Rotary Polarization	Optical Rotation. Biot's Laws for Rotatory Polarization, Fresnel's Theory of Optical Rotation, Calculation of Angle of Rotation, Experimental Verification of Fresnel's Theory, Specific rotation, Laurent's Half-shade Polarimeter.	4	
Unit VI: Optical Fibres	Numerical Aperture, Step and Graded Indices (Definitions Only), Single and Multiple Mode Fibres (Concept and Definition Only)	3	
Laboratory			
	<u>At least four from the following:</u> 1. To verify the law of Malus for plane polarised light. 2. To determine the specific rotation of sugar solution using Polarimeter. 3. To analyze elliptically polarised light by using Babinet's compensator. 4. To study dependence of radiation on angle for a simple Dipole antenna. 5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene etc.) by studying the diffraction through ultrasonic grating. 6. To study the reflection and refraction of microwaves. 7. To study polarization and double slit interference in microwaves. 8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film. 9. To determine the refractive index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece. 10. To study the polarisation of light by reflection and determine the polarizing angle for air-glass interface. 11. To verify the Stefan's law of radiation and to determine Stefan's constant. 12. To determine the Boltzmann constant using V-I characteristic of pn junction diode.		Credit-1

Reading list

1. Introduction to Electrodynamics, D. J. Griffiths.
2. Electromagnetics, B. B. Laud, New Age International Publishers.
3. Elements of Electromagnetics, M. N. O. Sadiku, 2001, Oxford University Press.
4. Introduction to Electromagnetic Theory, T. L. Chow, 2006, Jones & Bartlett Learning.
5. Feynman Lectures Vol. 2, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.
6. Fundamentals of Electromagnetics, M. A. W. Miah, 1982, Tata McGraw Hill.
7. Electromagnetic Field Theory, R. S. Kshetrimayun, 2012, McGraw Hill.
8. Engineering Electromagnetic, Willian H. Hayt, 2012, McGraw Hill.
9. Electricity and Magnetism [With electromagnetic theory and special theory of relativity], D. Chattopadhyay and P. C. Rakshit, 2013, New Central Book Agency (P) Limited.

Graduate Attributes

i. Course Objective

- To lay the foundation of electromagnetism through Maxwell's equations.
- Behaviour of electromagnetic waves as it propagates through vacuum and other media.
- Various effects that occur as electromagnetic waves propagate from one medium to another medium.
- Basic concepts of waveguides and fibre optics.
- Various aspects of electromagnetic wave polarisation

ii. Learning outcome

After the successful completion of the course, students will acquire the concepts of Maxwell's equations, propagation of electromagnetic (EM) waves in different homogeneous-isotropic as well as anisotropic unbounded and bounded media, production and detection of different types of polarized EM waves, general information of waveguides and fibre optics.

Theory Credit: 03 (Three)

Practical Credit: 01 (One)

No. of Required Classes: 45

No. of Contact Classes: 45

No. of Non-Contact Classes:

Particulars of Course Designer (Name, Institution, email id):

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