Semester	V
Course	**Physics (Major)**
Paper Code	**C3PH230511T**
Paper Title	**EM Theory II & Mathematical Methods III**
No. of Credits	**4**
Theory / Practical / Composite	**Theory**
Minimum No. of preparatory hours per week a student has to devote	4
Number of Modules	2
Syllabus	**Group A** **Maxwell's equations**, transverse nature of EM waves. EM waves in vacuum, EM boundary conditions, dielectric medium and conductors, skin depth. Reflection and refraction of EM waves at the interface of two media. Poynting's vector and Poynting's theorem. **[10 lectures]** **Polarization**: EM theory perspective, Fresnel's formula, Brewster's angle. **[4 lectures]** **Dispersion**: Dispersion of light in material media, Drude-Lorentz harmonic oscillator model, optical constants, dispersion relations, Cauchy equation. **[6 lectures]** **Waveguides**: TE and TM waves in a rectangular waveguide. **[4 lectures]** **Group B** **Partial Differential Equations:** Solutions to partial differential equations using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for a Rectangular membrane. **[6 lectures]** **Vector space and inner product space**: Axiomatic definition, completeness, linear independence, basis and dimension, Change of basis, Representation of vector in a basis, Inner product, norm, orthogonality, Linear Operators, Representation of Linear Operators in a basis, Eigenvalues and Eigenvectors, Diagonalization. **[6 lectures]**

	Fourier Series: Dirichlet Conditions, Harmonic functions, Complex Exponential form, Orthogonality. Determination of Fourier coefficients. Parseval Identity. **[4 lectures]** **Fourier Transforms**: Fourier Integral theorem. Examples: Fourier transform of trigonometric, Gaussian, finite wavetrain and other functions. Representation of Dirac delta function as a Fourier integral. Properties of Fourier transforms. Convolution Theorem – statement only. **[8 lectures]**
Learning Outcomes	**Group A** 1. The student will learn about Maxwell's equations. 2. Properties of electromagnetic waves will be taught. 3. Dispersion of light waves in material media will be explained. 4. Basic ideas of waveguides will be introduced. **Group B** 1. Exposes students to the method of solving partial differential equation by separation of variables technique and offers an overview of their applications in physics. 2. In the second section of this course, students will be exposed to the concept of a finite-dimensional vector space. 3. Students will be able to appreciate the relevance of learning the language of linear vector space as the mathematical tool to frame the theory of quantum mechanics. 4. Students will learn about Fourier Series and Fourier Transform and be able to appreciate their wide application in different areas of Physics

Reading/Reference Lists	**Group A** **Textbooks**: 1. Introduction to Electrodynamics by David J. Griffiths (PHI Learning) 2. Foundations of Electromagnetic Theory by J. R. Reitz, F. R. Milford and R. W. Christy (Narosa) 3. Principles of Electricity and Magnetism by S. Palit (Narosa) 4. Principles Of Electromagnetics, by Matthew N.O. Sadiku, OUP **Group B** 1. Mathematical Methods in the Physical Sciences, M.L. Boas, Wiley. 2. Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, Cambridge University Press. 3. Mathematical Methods: For Students of Physics and Related Fields by Sadri Hassani, Springer 4. Fourier Analysis, M.R. Spiegel, Tata McGraw-Hill. 5. Mathematical Physics, Binoy Bhattacharyya, New Central Book Agency. 6. Mathematical Physics, P.K. Chattopadhyay, New Age International Publishers.

Evaluation	Theory CIA: 30 (2 x 10 + 5/assignment+ 5/attn.) Semester Exam:70	Practical (if applicable) CA: Semester Exam:
Paper Structure for Theory Semester Exam	For each module of 35 Marks: 15 Marks from 3 marks questions (5 out of 7) 20 Marks from 10 marks questions (2 out of 3)	