MPHYCC-6 Electrodynamics and Plasma Physics Course

Objectives:

l . To apprise the students regarding the concepts of electrodynamics and its use in various situations.

The End Semester Examination will be of 3 hour duration and will carry 70 marks. The Question paper will be divided into three parts A, B and C. Part A will have ten compulsory questions (multiple choice type) covering the whole syllabus with 2 from each unit (10 X 2 = 20). Part B will have five short answer questions, with one question from each unit. The student is required to answer any four out of them (4 X 5 = 20). Part C will have five long answer questions with one question from each unit. The student is required to answer any three out of them (3 X 10 = 30).

Unit 1: Electromagnetic wave equation and field vectors: Maxwell's equations in free space, Planc wave in free space. Dispersion of electromagnetic waves, Poynting vector in free space. Polarization of electromagnetic waves, electric field vector in terms of scalar and vector potential, Wave equation in terms of scalar and vector potential.

Unit 2: Electromagnetic waves and its Interaction with matter on macroscopic scale: Electromagnetic waves(EMW) in free space, propagation of EMW-in isotropic, anisotropic dielectrics, in conducting media; Boundary conditions, reflection and refraction of EM W, Fresnel formulae, Brewster's law and degree of polarization, total internal reflection and critical angle, reflection froln a metallic surface, Propagation of EM W between conducting planes, Wave guides: TE and TM mode, Transmission lines, Rectangular and cylindrical wave guides, cavity resonator

Unit 3: Fields of moving charges and Radiating System: Retarded Potentials, Lienard Wiechert potentials, field of a point charge in uniform rectilinear motion, in arbitrary motion, Radiation from an accelerated charged particle at low and high velocity. Radiating System: Oscillating electric dipole, radiation from an oscillating dipole, from a small current element, from a linear antenna, Antenna arrays

Unit 4. Relativistic Electrodynamics: Transformation equation for current density and charge density, vector potential and scalar potentials, the electromagnetic field tensor, transformation equation for electric and magnetic field, Covariance of Maxwell equation in four tensor form, covariance of Maxwell and transformation law of Lorentz force.

Unit 5. Plasma Physics: Elementary concepts of plasma, derivation of moment equations from Boltzmann equation. Plasma oscillation, Debye shielding, plasma confinement, magneto plasma. Fundamental equations, hydromagnetic waves: magnetosonic waves, Alfven waves, wave propagation parallel and perpendicular to magnetic field.

Course Outcomes:

Students will have understanding of:

l . Time-varying fields and Maxwell equations.

2. Various concepts of electromagnetic waves.

3. Radiation from localized time varying sources, and the charged particle dynamics.

References:

l. Introduction to Electrodynamics, David J. Griffths, Prentice-Hall of India, Third Edition, 2009.

(5 Credits)

2. Classical Electrodynamics, J. D. Jackson, Wiley Publishing, Newyork, 3rd Edition, Eight Print, 2002.
3. J. A. Bittencourt, Fundamentals of Plasma Physics, Third edition, (Springer Publication, 2004.