Approval: 10th senate meeting

Course Name	: Electromagnetic Theory
Course Number	: PH521
Credits	: 4-0-0-4
Prerequisites	: Basic undergraduate physics courses and faculty consent
Intended for	: I-Ph.D, M.Sc., B.Tech 3rd and 4th Year
Distribution	: Core for I-Ph.D. and elective for others
Semester	: Even

Preamble: The course is intended for the physics students at the advanced undergraduate level, or beginning graduate level. It is designed to introduce the theory of the electrodynamics, mainly from a classical field theoretical point of field.

Course outline: The course content includes electrostatics and magnetostatics and their unification into electrodynamics, gauge symmetry, and electromagnetic radiation. The special theory of relativity has been included with four vector fields, and covariant formulation of classical electrodynamics.

Modules:

1. Overview of Electrostatics & Magnetostatics: Differential equation for electric field, Poisson and Laplace equations, Boundary value problems, Dielectrics, Polarization of a medium, Electrostatic energy, Differential equation for magnetic field, Vector potential, Magnetic field from localized current distributions [10]

3. Maxwell's Equations: Maxwell's equations, Gauge symmetry, Coulomb and Lorentz gauges, Electromagnetic energy and momentum, Conservation laws. [8]

4. Electromagnetic Waves: Plane waves in a dielectric medium, Reflection and Refraction at dielectric interfaces, Frequency dispersion in dielectrics and metals, Dielectric constant and anomalous dispersion, Wave propagation in one dimension, Group velocity, and Metallic wave guides. [12]

6. Electromagnetic Radiation: Electric dipole radiation, Magnetic dipole radiation, Radiation from a localized charge, The Lienard-Wiechert potentials [10]

5. Relativistic Electrodynamics: Michelson–Morley experiment, Special theory of relativity, Relativistic kinematics, Lorentz transformation and its consequences, Covariance of Maxwell equations, Radius four-vector in contravariant and covariant form, Four-vector fields, Minkowski space, Covariant classical electrodynamics. [14]

Textbooks:

1. Classical Electrodynamics by J.D. Jackson (John Wiley & Sons Inc, 1999)
2. Introduction to Electrodynamics by D.J. Griffiths (Prentice Hall, 1999)

References:

1. Classical theory of fields, by L.D. Landau, E.M. Lifshitz and L.P. Pitaevskii (Elsevier, 2010)
2. The Feynman Lectures on Physics, by Feynman, Leighton, Sands (CALTECH, 2013)
3. Classical Electrodynamics by W. Greiner (Spinger, 1998)
4. Foundations of Electromagnetic Theory by J.R. Reitz, F.J. Milford and R.W. Christy (Addition-Wesley, 2008)