DETAILED COURSE DESCRIPTION

Course Number PHYS 432

Course Title Electricity and Magnetism

Target audience The course is designed for senior level physics majors; however other engineering and science majors with the correct preparation are very welcome. Nb: this is a course that is NOT mandatory for all Physics Majors. Typically, but not always, this is a course whose audience is composed by students who intend to pursue graduate studies after the BS degree.

Prerequisites PHYS 431

Catalog description Methods of calculation in electrostatics and magnetostatics. Conservation laws. Potentials. Electromagnetic waves. Relativistic electrodynamics. Radiation. This course is targeted toward students who intend to pursue graduate studies in physics.

(RE) Prerequisite(s): 431.

Expected previous knowledge

Concepts. Electricity and Magnetism at the level of PHY 431. Relativity at the level of PHY 312. Waves at the level of PHY 232 or PHY 136 or PHY 138

Skills Familiarity with calculus and calculus concepts (vectors, vector, differential and integral calculus), linear algebra (matrices, determinants etc.), differential equations (ODE, PDE), vector analysis (i.e. Div, Curl, Grad, Div and Stokes' Theorems).

Course Objectives

- **Gain deeper understanding of Electricity and Magnetism**. Consolidate the understanding of fundamental concepts in Electricity and Magnetism more rigorously as needed for further studies in physics, engineering and technology.
- **Advance skills and capability for formulating and solving problems**. Expand and exercise the students' physical intuition and thinking process through

the understanding of the theory and application of this knowledge to the solution of practical problems.

- **Increase mathematical and computational sophistication**. Learn and apply **advanced mathematical techniques** and methods of use to physicists in solving problems. Develop some capabilities for **numerical/computational methods**, in order to obtain solutions to problems too difficult or impossible to solve analytically.

Sample Text "Introduction to Electrodynamics", by David J. Griffiths, Pearson

Minimum Material Covered

Electrostatics and Magnetostatics: Integration techniques for computing fields (line integrals, surface integrals and volume integrals in detail). Boundary value problems. Laplace's and Poisson's equations. Method of images. Solutions of boundary value problems with method of separation of variables etc..

Conservation laws: Continuity equation, Poynting's theorem

Electromagnetic waves: waves in vacuum, waves in matter, absorption and dispersion, dispersion relations, waveguides

Potentials and fields: scalar and vector potentials, gauge transformations (Coulomb and Lorentz gauge), retarded potentials

Electrodynamics and Relativity: Lorentz transformations, Minkowski space-time and its metric, relativistic electrodynamics (magnetism as a relativistic effect, tensors, Electromagnetic Field tensor, Maxwell's equations and equations for the fields in tensor notation)

Radiation: Radiation by point charges, Lienard-Wiechert potentials, fields of moving point charges, antennas