DETAILED COURSE DESCRIPTION

Course Number PHYS 431

Course Title Electricity and Magnetism I

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 mandatory for all Physics Majors. Therefore, this is a course whose audience is composed by students who intend to pursue graduate studies, but also by students who will want to find a job after the BS degree. Topics of choice must take this fact into consideration.

Prerequisites PHYS 136 or PHYS 138 or PHYS232 or PHYS 251 with a C or better; and PHYS 201 or Math 241 with a C or better.

Catalog description Electrostatics and magnetostatics in vacuum and in matter. Time-dependent electric and magnetic fields. Maxwell's Equations. Required course for all physics majors.

Expected previous knowledge

Concepts. A basic knowledge of electricity and magnetism at the level of physics freshman courses (PHY 232 or PHY 136-138) is expected

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: Coulomb's law, Electrostatic field and its computation, Gauss's law and divergence of E, Electrostatic potential, conductors

Electrostatics in matter: Polarization, dipole fields, electric displacement, Gauss's law in dielectrics, linear dielectrics (susceptibility, permittivity, dielectric constant)

Magnetostatics: Lorentz force, Biot-Savart law, divergence and curl of B, magnetic vector potential

Magnetostatics in matter: magnetization, torque and forces on a magnetic dipole, bound currents, the auxiliary field H, Ampere's law in matter and its differential form, magnetic susceptibility and permeability

Electrodynamics: Electromotive force, Ohm's law, motional emf, electromagnetic induction, Farady-Newmann-Lenz's law, inductance

Maxwell's equations