Phys 361 – Introduction to Electromagnetic Theory – 3 credits

Bulletin Description:

Apply numerous mathematical principles: Fundamental Theorems, Separation of Variables, Maxwell's Equations, Electric and Magnetic Potentials, Fields in media. Prereq: PHYS 252 and MATH 266.

Course Objectives:

The course familiarizes students with the theoretical methods and techniques of electromagnetic theory at an intermediate level. The main objective of the course is to gain familiarity with a wide array of tools and to identify the best tool for determining the Electric and Magnetic Fields for a variety of situations. Among these tools are a variety of mathematical techniques for setting up and solving integrals and differential equations. Students develop problem-solving skills needed to implement the art of selecting the best tool for the problem, applying it appropriately and solving the mathematics correctly in an efficient manner.

Content Listing:

- **Mathematics**: Curvilinear Coordinate Systems, Gradient, Curl, Divergence, Fundamental theorems of Divergences and Curls, Dirac delta function
- **Electrostatics**: Charge, Coulomb's Law, Continuous charge distributions, Guass' Law, Electric Potential, Work and Energy and Conductors
- **Special Techniques**: Laplace's Equation, Method of Images, Separation of Variables, Multipole Expansion
- **Magnetostatics**: Lorentz Force, Magnetic Fields, Biot-Savart Law, Steady Currents, Ampère's Law, Magnetic Vector Potential
- **Electric Fields in Matter**: Polarization, Dipoles, Dielectrics, Bound Charges, Fields of Polarized objects, Gauss' Law, Boundary Conditions, Linear Dielectrics (Susceptibility and Permittivity)
- **Magnetic Fields in Matter**: Magnetization, Magnetic Dipoles, Bound Currents, Auxiliary Fields, Ampère's Law, Boundary Conditions, Linear and Nonlinear Media

If time: Electrodynamics, EMF, Faraday's Law, Inductance, Maxwell's equations, Electromagnatic Waves.