University of Wisconsin - Madison  
College of Engineering [EGR]  
Last Offered: 2015-2016 Spring [1164]  
Direct Link to this Syllabus:  
http://aefis.wisc.edu/index.cfm/page/CourseAdmin.ViewABET?coursecatalogid=144&pdf=True

1. **E C E 220, Electrodynamics I**  
2. **Credits :** 3  
   **Contact Hours :** 4.0  
3. **Textbook and Materials :** Fundamentals of Applied Electromagnetics; Fawwaz T. Ulaby, Eric Michiel; 6; 2010  
   a. **Other Supplemental Materials :** None

**Specific Course Information :**

a. **Brief description of the content of the course (Course Catalog Description) :** Potential theory; static and dynamic electric and magnetic fields; macroscopic theory of dielectric and magnetic materials; Maxwell's equations; boundary conditions; wave equation; introduction to transmission lines.  

b. **Pre-requisites or Co-requisites :** Physics 202, ECE 219; ECE 230 or concurrent registration  

c. **This is a Required course.**  

**Specific Goals for the Course :**

a. **Course Outcomes :**

1. This is the first of the two courses on beginning level electrodynamics.  
2. The purpose of the course is to provide sophomore/junior electrical engineering students with the fundamental methods to analyze and understand electromagnetic field problems that arise in various branches of engineering science.  

**ABET Student Learning Outcomes :**
(a) Ability to apply mathematics, science and engineering principles.
(d) Ability to function on multidisciplinary teams.
(k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

- **Brief List of Topics to be Covered**: Introduction to course; Review of vector operations
  - Orthogonal coordinate systems and change of coordinates
  - Integrals containing vector functions
  - Gradient of a scalar field and divergence of a vector field
  - Divergence Theorem
  - Curl of a vector field and Stokes' theorem
  - Theorems and Identities
  - Fundamental postulates of electrostatics and Coulomb's Law
  - Electric field due to a system of discrete charges
  - Electric field due to a continuous distribution of charge
  - Gauss' Law and applications
  - Electric Potential
  - Conductors in static electric field
  - Dielectrics in static electric fields
  - Electric Flux Density, dielectric constant
  - Boundary Conditions
  - Capacitor and Capacitance
  - Method of Images
  - Nature of Current and Current Density
  - Resistance of a Conductor
  - The Equation of Continuity, Relaxation Time
  - Joule’s Law
  - Boundary Conditions for the current density
  - The Electromotive Force
  - The Biot-Savart Law
  - Ampere’s Force Law
  - Magnetic Torque
  - Magnetic Flux and Gauss’s Law for Magnetic Fields
  - Magnetic Vector Potential
  - Magnetic Field Intensity and Ampere’ Circuital Law
  - Magnetic Material
  - Boundary Conditions for Magnetic Fields
  - Energy in a Magnetic Field
  - Magnetic Circuits
  - Inductance