ECE 3001: Electromagnetic Fields and Waves

Credits and contact hours: 3 Credits (Two 75-minute lectures per week)

Instructor: Yang Cao

Textbook: Fundamentals of Applied electromagnetics, 7/E, F. Ulaby, U. Ravaioli (2014)

a. *Other supplemental materials*: Selected reference materials/articles/notes posted online

***Specific course information*:**

a. *Catalog Description*: Application of electric and magnetic field theory to engineering problems involving conductors, dielectrics, semiconductors, magnetic materials, the motion of charged particles, and wave propagation. Relationship between fields and circuit parameters in the context of transmission lines and radiation.

b. *Prerequisite*: MATH 2110 and 2410 and either PHYS 1402Q or 1502Q or 1230 or 1530.

c. *Required, elective, or selected elective:* Required (EE)

***Specific goals for the course*:**

a. *Specific outcomes of instruction*: Students will be able to

- apply electric and magnetic field theory to solve problems involving conductors, dielectrics, semiconductors, magnetic materials, the motion of charged particles, and wave propagation.
- use phasor-analysis technique to solve for the wave propagation in free space and transmission lines.
- describe the basic operation of various electromagnetic systems such as motors, generators, transmission lines, optical fibers and antennas.

b. *ABET Criterion 3 Student Outcomes addressed by the course*:

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
Students learn to apply techniques of vector analysis and multivariable calculus to solve electromagnetic problems. While students learn the analytical techniques to solve simplified electromagnetic problems, they develop essential knowledge of these fundamental equations for future complex engineering problem solving by using modern computational tools.

(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

Students learn how to design and analyze electromagnetic components such as capacitors, inductors, coaxial cables and transmission lines, using realistic materials parameters and voltage and current levels. In addition, students learn to recognize the impact of several electromagnetic systems such as wireless and optical fiber communications, motors and generators, x-ray tomography, sensors (resistive, inductive, piezo, lasers, radar) on modern technological, environmental and healthcare infrastructures, as well as their societal effects.

(3) an ability to communicate effectively with a range of audiences
n/a

(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
n/a

(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
n/a

(6) an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
n/a

(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
Students use the web, internet, library databases, and other resources to solve and submit their homework assignments.

Topics covered:

- Introduction to electricity and magnetism
- Review of Vector Algebra and Vector Calculus
- Electrostatics
- Magnetostatics
- Maxwell's Equations for Time-Varying Fields
- Plane-Wave Propagation
- Transmission Lines
- Wave Reflection and Transmission
- Radiation and Antennas