ECE 3313 – Electromagnetics I

Textbook: Fundamentals of Applied Electromagnetics, 2004 Media Ed., Fawwaz T. Ulaby

Detailed Course Outline

I. Introduction to Electromagnetics

II. Vector Analysis

- A. Vector Algebra
- B. Vector Operations
  1. Dot Product
  2. Cross Product
- C. Coordinate Systems
  1. Rectangular Coordinates
  2. Cylindrical Coordinates
  3. Spherical Coordinates
- D. Integrals Involving Vectors
  1. Line Integral
  2. Surface Integral

III. Static Electromagnetic Fields

- A. Electric Charge and Coulomb's Law
- B. Electric Field
- C. Electric Flux Density
- D. Gauss's Law for Electric Fields
- E. Voltage and Potential
- F. Capacitance and Electric Energy
- G. Current and Magnetic Flux Density
- H. Ampere's Law
- I. Gauss's Law for Magnetic Fields
- J. Inductance and Magnetic Energy
- K. Forces Produced by Charge and Current

IV. Time Varying Electromagnetic Fields

- A. Faraday's Law
- B. Ampere's Law
- C. Gauss's Laws
- D. Conservation of Charge
- E. Maxwell's Equations
- F. Power Density and the Poynting Vector
- G. Boundary Conditions
- H. Method of Images
- I. Phasor Analysis

V. Wave Propagation

A. Uniform Plane Waves
   1. Lossless media
   2. Lossy media
B. Power Flow and Skin Depth
C. Plane Wave Behavior at Plane Material Boundaries
D. Snell's Laws

VI. Transmission Lines

A. The Transmission Line Equations
B. Time Domain Analysis of Transmission Lines
C. Phasor Analysis of Transmission Lines
   1. Reflection and Transmission Coefficients
   2. Voltage and Current Along the Line
   3. VSWR and Matching
D. The Smith Chart
E. Lumped Element Approximate Models
F. Lossy Transmission Lines
G. Applications of Transmission Lines