

## **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