E C E 219, Analytical Methods for Electromagnetics Engineering

1. **Credits :** 1  
   **Contact Hours :** 2
2. **Textbook and Materials :** "ECE 219 Course Notes and Online video lecturettes", 2012
3. **Other Supplemental Materials :** None

- **Specific Course Information :**

  a. **Brief description of the content of the course (Course Catalog Description) :** Reviews basic calculations in electromagnetic engineering upon which all higher level concepts and physical model construction are based. It emphasizes quantitative calculation mastery in three spatial dimensions and/or time-frequency analysis. Applies analysis tools from vector calculus and complex exponentials to the calculation and prediction of electrical system properties. Examples include calculating electric and magnetic fields, electric potentials, or electric flux from change or current sources, and calculating the amplitudes and phases of electric or magnetic fields due to time-oscillating sources.

  b. **Pre-requisites or Co-requisites :** Math 234 or concurrent registration; ECE 203 or concurrent registration

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

- **Specific Goals for the Course :**

  a. **Course Outcomes :**

    1. Students will be able to apply vector calculus operations and concepts to the computation of electromagnetic quantities, including total charge and currents (from densities), work on charges in electric fields, circulation of magnetic fields, and electrostatic potential.
• **ABET Student Learning Outcomes:**

(a) Ability to apply mathematics, science and engineering principles.
(e) Ability to identify, formulate and solve engineering problems.
(i) Recognition of the need for and an ability to engage in life-long learning.
(k) Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

• **Brief List of Topics to be Covered:**

1. Orthogonal coordinate systems and transformations
2. Infinitesimals and their use in modeling electromagnetic systems
3. Calculating total charge from charge distributions
4. Calculating electric fields from charge distributions
5. Line integrals, work and circulation of electric and magnetic fields
6. Flux of electric and magnetic fields and calculation of currents.
7. Partial derivatives and gradients
8. Divergence of electric and magnetic fields
9. Curl of electric and magnetic fields
10. Differential forms of static electric and magnetic field postulates
11. Electrostatic potential function and the electric field
12. Calculating electric potential from voltages on surfaces