ECE 202 – Fall 2006

Introduction to Engineering Electromagnetics (3)

Lecture Time: Fall 2006, Monday-Wednesday-Friday at 10:10-11:00 pm

Location: Whitaker Lab 207

Problem Solving Session (Optional): To be Determined (if necessary)

Office Hours: Monday at 3:00-4:00 pm
Wednesday at 3:00-4:00 pm

Instructor: Prof. Nelson Tansu
ECE & COT, Lehigh University
Office: Sinclair Laboratory Room 218
Lab: MOCVD Laboratory, Room 251 Sinclair Lab.
7 Asa Drive, Bethlehem, PA 18015
Email: Tansu@Lehigh.Edu
www.ece.lehigh.edu/~tansu

TA / Grader: Mr. Jeff K. Karper
ECE, Lehigh University
Office: Sinclair Laboratory Room 218C
7 Asa Drive, Bethlehem, PA 18015
Email: jkk3@lehigh.edu

Required Reading Textbook:

1. N. Ida, *Engineering Electromagnetics*, Springer (2003). *I consider this as the best undergraduate ECE 202-type textbook.*
2. Nelson Tansu, *Additional Lecture Notes on EM Theory and Waves.*

Recommended *Elementary/Intermediate* Textbook:

1. D. Cheng, *Fundamental of Engineering Electromagnetics, Prentice Hall (2003). Nice and concise treatment of elementary EM theory.*
2. N. Rao, *Elements of Engineering Electromagnetics*, *Prentice Hall (2005). About the same level with Cheng's EM book.*
3. D. Griffiths, *Introduction to Electrodynamics, Prentice Hall (1999). An alternative method of treatment of EM theory for physics undergraduate students.*
4. U. S. Inan, and A. S. Inan, *Electromagnetic Waves*, Prentice Hall (2000). *Among the most advanced EM textbook for ECE 203-level.*
5. D. H. Staelin, Ann. W. Morgenthaler, J. A. Kong, *Electromagnetic Waves*, Prentice Hall (1994). *Among the most advanced textbook for ECE 203-level, comparable with textbook by Inan and Inan.*

Additional *Advanced* Textbooks:

Fundamentals

1. J. A. Kong, *Electromagnetic Wave Theory*, EMW (2002).
2. C. Balanis, *Advanced Engineering Electromagnetics,* Wiley (1989).
3. J. D. Jackson, *Classical Electrodynamics*, Wiley (1999).

Applications – Optoelectronics / Photonics

4. E. Rosencher, and B. Vinter, *Optoelectronics,* Cambridge (2002).
5. J. Liu, *Photonic Devices*, Cambridge (2005).
6. S. L. Chuang, *Physics of Optoelectronics Devices*, Wiley (1995).
7. R. Boyd, *Nonlinear Optics*, Academic Press (2003).

Computational EM

8. A. Taflove, S. C. Hagness, *Computational Electrodynamics: The Finite-Difference Time-Domain Method*, Artech (2005).

Course Abstract:

The ECE 202 course is the first sequence of the engineering electromagnetics course, which will be followed by ECE 203 (Electromagnetics Waves, EM II). The first introductory electromagnetics course ECE 202 covers the vector algebra / calculus, electrostatic, boundary value problems, magnetostatic, electric fields and magnetic fields in materials, and time-varying EM theory. Several emphasis includes the general concepts of Gauss' Law, Ampere's Law, Faraday's Law, absence of magnetic monopole, and boundary value problems. We will present the relevance of EM theory in the modern applications, in particular in wireless communications, optical communications, photonics, optoelectronics, nanophotonics, and biotechnology.

Intended Levels:

The ECE 202 course is intended for intermediate- and upper-level undergraduate (sophomore/junior/senior) in engineering (Electical and Computer Engineering, Material Science Engineering, and other related engineering) and applied physics areas, who are intending to understand the Maxwell's electromagnetic theory, in particular on vector algebra / calculus, electrostatic, boundary value problems, magnetostatic, and time-varying EM theory.

Prerequisites:

1. Physics: Students should have the knowledge of the classical Newtonian mechanics, classical electromagnetic theory, and wave theory from general physics courses (PHY 11 and PHY 21)
2. Mathematics: Students should have the knowledge of calculus, differential equations, linear algebra, geometry, vector analysis, and vector calculus.
3. Computing: Students should have the knowledge of <u>one</u> of the programming or numerical programs (ie. MatLab, MathCad, Mathematica, Maple, C language, Fortran language, or other numerical programs).

The course will cover all the chapters in the textbook with the following topics:

I.Introduction
1. Electromagnetisms in the 21st Century and Beyond!

II. Vector Algebra and Calculus
2. Vector Algebra
3. Vector Calculus

III. Electrostatic
4. Coulomb's Law and Electric Field
5. Gauss' Law and Electric Potential
6. Boundary Value Problems: Analytical Methods

IV. Magnetostatic
7. Steady Electric Current
8. Static Magnetic Field
9. Magnetic Materials and Properties

V. Time-Varying Electromagnetics
10. Faraday's Law and Induction
11. Maxwell's Equations

Structure of the Course Grading:
The structure of the course will consist of weekly homework assignments, two midterm exams, and a final exam with the following proportion toward the final grade:
1. Problems – 30 % (approximately 10-12 homework sets)
2. Midterm Exam I – 20 %
3. Midterm Exam II – 20 %
4. Final Exam – 30 % (scheduled by the Registrar Office)

Homework and Exam Policy:
1. Homework is given on every Monday, and due on the following Monday before class. (a week later)
2. No late homework is accepted, unless there is a medical emergency or permissions given in advance.
3. Working together in homework is encouraged, but not copying!
4. Academic Dishonesty will be subject to disciplinary action by Lehigh University.

Accommodations for Students with Disabilities:
If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, University Center 212 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.