Syllabus
ECE 6310 – Spring 2013
Advanced Electromagnetic Fields
3.0 Credits

Pre-requisites:	ECE 3300
Time:	Mon/Weds/Fri 11:50 AM-12:40 PM
Location:	WEB 1248

Instructor:	David Schurig
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Office Location & Hours:	MEB 2274, Arranged

Course Overview
Review of Maxwell's macroscopic equations in integral and differential forms including boundary conditions, power and energy computations, and time-harmonic formulations. Macroscopic-electrical properties of matter. Oblique incidence plane-wave propagation and polarization in multi-layered media. Separation of variable solutions of the wave equation in rectangular, cylindrical and spherical coordinates. Vector potential theory and the construction of solutions using Green's theorem. Electromagnetic theorems of duality, uniqueness, reciprocity, reaction, and source equivalence. Waveguide, cavity, antenna, and scattering applications in rectangular, cylindrical, and spherical geometries.

We will also be learning how to solve analytical problems and visualize solutions and concepts using Mathematica.

Course Objectives
In this course, students will obtain:
1. Familiarity with Maxwell's macroscopic equations in integral and differential form.
2. Ability to formulate and solve well-posed electromagnetic boundary value problems in the standard coordinate systems.
3. Understanding of the electromagnetic response of materials including their physical origin.
4. Familiarity with some standard solutions for waveguides, cavities and antennas.
5. Ability to use Mathematica in the symbolic solution of problems, and visualize their solutions.

Required Texts
Advanced Engineering Electromagnetics (2nd Edition), by Constantine A. Balanis.
If you already own the first edition that will probably be fine, but you may need to reference the 2nd edition due to problem renumbering or changes. The second edition does have brand new material, including topics on metamaterials.

Required Software
You will need to purchase Mathematica if you do not already have access to it. Student pricing is available here. I will reimburse you for the price of the semester edition when you present me with a purchase receipt.

Teaching and Learning Methods
Class meeting time will used for deriving core concepts (in real time on the board), working through problems, and exploring interactive demonstrations developed in Mathematica. Students are encouraged to bring laptop computers to class to interact with the downloadable demonstrations while in class. The majority of learning will occur as students work out the assigned problem sets, out of class. Students are encouraged to work together on these.

Policies

Exams:

There will be two take-home exams. The second is not a final, and will not cover material from the first half of the course. Each exam will count toward your grade equally. You will have at least a few days to complete them. You may consult any printed or online resources for the exams, but you may not work with or consult other people.

Academic Integrity:

Students may work together on assignments, but every student must be able to explain their submitted work. Students may not work together on exams. Students are expected to exhibit integrity in their conduct and are subject to the University of Utah Code of Student Rights and Responsibilities (http://www.regulations.utah.edu/academics/6-400.html).

Americans with Disabilities Act (ADA) Statement

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All information in this course can be made available in alternative format with prior notification to the Center for Disability Services. (www.hr.utah.edu/oeo/ada/guide/faculty/)

Wellness Statement

Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University of Utah. For helpful resources contact the Center for Student Wellness - www.wellness.utah.edu; 801-581-7776.

Assignments

Problem Sets:

There will be about six or seven problem sets. You may work together on these but every student is responsible for being able to explain their submitted work. Please consider the importance of aesthetics and clarity when submitting your work. Typeset solutions will be greatly appreciated. Also, work the problems analytically to a reasonable conclusion before plugging in the numbers. Always do numerical evaluation with Mathematica. (Calculators are not really useful for reliable evaluation and debugging of complex evaluations.) I will indicate where symbolic processing with Mathematica will be helpful and outline how you should proceed and what functions you may need. When plotting results, you should thoroughly label your plots.

Grading Policy (Evaluation Methods & Criteria)

Grades will be based on the exams (50%) and problem sets (50%). I do not anticipate any substandard grades being given out, unless you egregiously neglect the assignments.

Tentative Schedule

Time-Varying and Time-Harmonic Electromagnetic Fields	Chapter 1	3 lectures
Electrical Properties of Matter	Chapter 2	4 lectures
Wave Equation and its Solutions	Chapter 3	3 lectures
Wave Propagation and Polarization	Chapter 4	4 lectures
Reflection and Transmission	Chapter 5	5 lectures
Auxiliary Vector Potentials, etc.	Chapter 6	4 lectures
Electromagnetic Theorems and Principles	Chapter 7	4 lectures
Rectangular Cross-Section Waveguides and Cavities	Chapter 8	6 lectures
Circular Cross-Section Waveguides and Cavities	Chapter 9	4 lectures
Scattering	Chapter 11	5 lectures