ECE540 Electromagnetic Fields
Spring 2010
Monday and Wednesday 12:50-2:05 PM
1228 EB2
Credits 3
Pre-requisites: ECE422

David Schurig
david_schurig@ncsu.edu
919.975.4937
437 Monteith
Office hour: Friday 12-1PM, 1028 EB2

Teaching Assistant
Xiaodong Li
xli11@ncsu.edu

Textbooks

Required: Antenna Theory (Third Edition) - Constantine A. Balanis
Recommended: Fields and Waves in Communication Electronics (Third Edition) - Simon Ramo, John R. Whinnery, Theodore Van Duzer
Recommended: Electromagnetic Waves - Umran S. Inan, Aziz S. Inan

We will use the required text, Balanis, for about 3/4 of the course, and one of the recommended texts for about 1/4 of the course. If you already have a different advanced undergraduate or graduate text on electricity and magnetism, that may be fine to use instead of either of these recommended texts. If you do not have one, you might want to get Ramo Whinnery Van Duzer. That is the text that I used as an undergraduate and the one that I will follow most closely.

Note that Balanis can be downloaded for free for NCSU students. (This does not seem to work with the Safari browser.)

Learning Objectives

Brief review of Maxwell's Equations, constitutive relations and boundary conditions. Reflection and refraction of plane waves; power and energy relations in isotropic media. Potential functions, Green's functions and their applications to radiation and scattering. Antenna fundamentals: linear antennas, uniform linear arrays and aperture antennas, microstrip antennas. Fundamentals of numerical methods for electromagnetic simulation and antenna design.
Students will learn to use an electromagnetic simulation software package, Microwave Studio, to solve some problems not tractable by analytical methods.

Computer Lab

Microwave Studio is installed in the Windows computer lab, 1028 EB2. I will arrange 24/7 access to this room for all students in the course. There may also be some options for remote access.

Topics

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<td>RVW 3.1-3.8 II 1.1-1.3</td>
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<td>Examples of use of Maxwell’s equations</td>
<td>RVW 3.9-3.18 II 1.4-1.5, 2.1-2.4</td>
<td>3 lectures</td>
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<td>Plane wave propagation</td>
<td>RVW 6.1-6.4 II 2.1-2.6</td>
<td>1 lecture</td>
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<tr>
<td>Plane waves normally incident</td>
<td>RVW 6.5-6.8 II 3.1-3.3</td>
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Plane waves obliquely incident    RWV 6.9-6.12   II 3.4-3.8    1 lecture
Fundamental parameters of antennas    B 2.1-2.14    4 lectures
Radiation integrals and Auxiliary Potentials    B 3.1-3.6    1 lecture
Linear wire antennas    B 4.1-4.7    4 lectures
Linear Arrays    B 6.1-6.8    5 lectures
Aperture antennas    B 12.1-12.8    4 lectures
Microstrip antennas    B 14.1-14.5    3 lectures

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.

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 and then plug in the numbers, preferably with Mathematica, Matlab or a similar tool. I really do not want to see numeric algebra in your solutions. Problem sets will typically include some computational problems to be simulated with Microwave Studio. For these problems I will specify what results should be submitted. These will usually be in graphical form. You should thoroughly and legibly label your plots and the data should be clearly presented.

Grades

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.

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 NCSU Code of Student Conduct Policy (POL11.35.1).

Students with Disabilities

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.1)