ECSE-2100: Fields and Waves I

Course Instructor and Coordinator: James J.-Q. Lu, Professor, Office Rm: CII-6229, Phone: x2909

Course Catalog Description: Development and application of Maxwell’s equations in free space and within materials. Introduction to vector calculus and computer-aided analysis and design methods in electromagnetics. Applications include calculation of lumped circuit elements from field theory, plane wave propagation in various materials, and reflection from boundaries. Transmission line concepts, Smith charts, and other design tools for distributed circuits.

Topics Covered:
1. Transmission Lines
2. Electrostatics
3. Magnetostatics & Magnetodynamics
4. Plane Electromagnetic Waves

Pre-Requisite Courses: ECSE-2010 Electric Circuits and MATH 2010 Multivariable Calculus and Matrix Algebra

Co-Requisite Courses: None

Prerequisites by Topic:
1. Ohm’s Law
2. Passive Circuit Analysis
3. Thevenin and Norton Equivalent Circuits
4. Transformers
5. Frequency Response
6. Phasors
7. Familiarity with PSpice
8. Elementary static field theory
9. Elementary wave theory
10. First and second order differential equations
11. Multivariable and Vector Calculus


Supplemental Materials: http://www.ecse.rpi.edu/courses/F18/ECSE-2100/ & LMS Course Homepage

Overall Educational Objective: To prepare junior EE and EPE majors to utilize basic electromagnetic field concepts

Course Learning Outcomes: Students will be able to:
1. Obtain solutions to Laplace’s and Poisson’s equations for simple configurations of materials and sources.
2. Determine the capacitance of simple practical systems of conductors
3. Determine the self and mutual inductance of simple practical current carrying systems
4. Apply the basic principles of electromagnetic motors and generators
5. Determine the transmission of power by low loss TEM transmission lines from a simple source to a passive load
6. Determine the reflection and transmission of power for uniform plane waves incident on planar material boundaries for low loss or conducting media

Computer Usage: Students use the RPI Mobile Studio Hardware/Software Platform, PSpice to analyze transmission lines, Excel to solve Poisson’s and Laplace’s Equations,
Laboratory & Design Experiences:

1. Introduction to Electromagnetics Lab: Coaxial cable transmission line, artificial transmission line, electromagnetic noise measurement, two-wire line capacitive coupling, building and characterizing a simple transformer, simple magnetic motion sensor
2. Cable TV Channel Blocker – Application of Transmission Line Concepts, measurement of frequency response at CATV frequencies
3. Building a small DC motor, measuring motor speed, circuit modeling of the motor

Independent Learning Experiences:

Some research required for projects and homework

Class/Lab Schedule:

Monday and Thursday Lectures from 4:00 – 5:50 am, Wednesday Recitation or Studio Session (2 Hrs each section)

Course Grading:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>3 Tests</td>
<td>34.5%</td>
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<tr>
<td>8 Homework Assignments</td>
<td>18.4%</td>
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<tr>
<td>22 Online Quizzes</td>
<td>12.6%</td>
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<tr>
<td>2 Design Projects</td>
<td>11.5%</td>
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<tr>
<td>Final Exam</td>
<td>23%</td>
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Attendance Policy: Attendance at all lectures and lab sessions is required. A student who has to miss part or all of a session should submit a confirmation of the absence from the Student Experience office either prior to class or upon returning to class. Students are responsible for all missed content and work.

Academic Integrity: We follow Rensselaer general Academic Policies and Procedures and Student Handbook. Student-instructor relationships are built on trust. For example, students must trust that instructors have made appropriate decisions about the structure and content of the courses they teach, and instructors must trust that the assignments that students turn in are their own. Acts, which violate this trust, undermine the educational process. All instances of academic dishonesty will at a minimum result in a zero score for that assignment, exam, etc., and will be referred to the Dean of Students for consideration of further action.

ABET Outcomes Supported:

( x ) • An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
( x ) • An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
(   ) • An ability to communicate effectively with a range of audiences.
(   ) • An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
( x ) • An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
( x ) • An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
( x ) • An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Prepared by: James J.-Q. Lu
Date: 2 August 2018