ECE 340 Electromagnetic Fields

Instructor Edward Wheeler, Moench C-203A **Office hours** 2nd and 8th MR

Text *Applied Electromagnetics* by Stuart Wentworth (Wiley)

Coverage

1. Electric and magnetic fields. Laws of Coulomb, Gauss, Joule, Biot-Savart, Ampere, and Faraday. Motional and transformer EMF. Potential, energy and force.
2. Gradient, divergence, and curl. Divergence and Stoke's theorems. Line and surface integrals.
3. Conductivity, permittivity and permeability. Resistance, capacitance, and inductance.
4. Displacement current, Maxwell's equations, introduction to wave propagation in the time and frequency domains.

Grading *

exams	35%	A	90– 100%	C	70 – 75
homework & quizzes	20%	B+	85 – 90	D+	65 – 70
modeling	10%	B	80 – 85	D	60 – 65
final exam	35%	C+	75 – 80	F	below 60

**The exam component of the grade (exams and final exam) must be above 60% for the homework to be included in the overall grade.*

Homework

"One must learn by doing the thing; for though you think you know it, you have no certainty until you try.". . . Sophocles.

HW assignments may include some answers. Detailed solutions to drill problems and some chapter problems are available on text website as are a variety of MATLAB resources. You may consult and discuss homework with others, but be sure that the work you turn in is your own. ***To score well on exams/quizzes, be sure that you thoroughly understand homework solutions and class discussions.***

Rose-Hulman Institute of Technology does not tolerate plagiarism or cheating in any form. From the Rose-Hulman student handbook:

> *"The Institute values its reputation for moral leadership as much as its reputation for academic excellence and expects all persons associated with it to maintain the reputation. The Institute's Code of Ethics is simple and direct: Rose-Hulman expects its students to be responsible adults and to behave at all times with honor and integrity. All students are expected to abide by this Code and to aid in its enforcement by reporting violations of it."*

Homework format

1. A problem statement which could be the homework problem statement as handed out. If I were doing the problems, I would usually cut and paste from the HW handouts.

2. Include a brief, but complete, discussion of your solution strategy and method with each problem--perhaps one sentence for a simple problem, maybe two or three sentences for a more involved one. Explain so that the grader can readily see that you truly understand the concepts and are working with a real understanding. Descriptions should be clear and complete and stated so that they may be easily understood.

3. Simply put, your work should be that of a professional in training. Homework should be done in a clear and neat manner which can readily be followed, including descriptions in and diagrams. **Box all answers and give proper units. Use vector notation properly.** *Sloppy or incomplete work will be downgraded, beginning with a minimum of 20%.*

Paper and simulation problems

There will likely be simulation assignments during the term with a term paper. The simulation problems will CST microwave studio, an electromagnetic simulation package widely used in industry and research or other numerical package. Please load CST on your laptop.

Exams and quizzes

- **Exam 1** – October 8th **Exam 2** – November 12th
- Exams are closed book and notes. A calculator and a single-sided 8½" x 11" formula sheet are permitted. The formula sheet will be provided.
- There will be concept quizzes on many Thursday's—closed book and notes for quizzes. To score well on quizzes be sure that you thoroughly understand the homework and class discussions.
- Notes and videos are on the "courseware" page on the course website, rose-hulman.edu/~wheeler as well as at rose-hulman.edu/maxcab
- Exams and quizzes missed due to an unauthorized absence may not be made up.

Course learning objectives

After successfully completing this course you should be able to:

1. Find the electrostatic potential and field by using superposition integrals/sums given the charge distribution or to Gauss' law, given sufficient symmetry in the charge distribution.
2. Determine and electrostatic field from a given electrostatic potential.
3. Determine the potential difference between two points given the electric field.
4. Determine whether an electric field is conservative or non-conservative.
5. From a given current distribution, find the magnetic field by using Biot-Savart or, given sufficient symmetry, Ampere's law.
6. Use Faraday's law to calculate voltages induced in moving and stationary coils in constant and time-varying magnetic fields.
7. Be familiar with the vector operations of gradient, divergence, and curl. Be able to calculate, analytically and numerically, quantities involving them and know their physical significance.
8. Compute—by analytically, numerically, and graphically means—the terminal and external characteristic behavior of such common devices as resistors, capacitors, and inductors. Know the physical mechanisms involved in transformers and magnetic circuits.
9. Describe TEM electromagnetic waves in the time and frequency domain.
10. Find the electric/magnetic vector from properties of a TEM wave.