

## EE 468G – Intro to Electromagnetic Engineering Spring 2016

**Instructor:** John C. Young

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**Phone:** 257-3077

**Office Hours:** TTh 2:00 – 3:00 pm

**TA:** Mehrdad Mizraei, Office TBD, Office Hours TBD

**Meeting time:** M 3:00 – 3:50 pm, TTh, 12:30-1:45 pm

**Location:** FPAT 255 (M), OHR C226 (TTh)

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### Course Summary

Systems affected by electromagnetic fields and waves are all around us: cellular phones, wireless routers, computers, motors and generators, power grids, etc. Electromagnetic theory is the fundamental physical basis on which these systems operate. This course provides a physical and mathematical description of basic electromagnetic theory. Vector calculus will be reviewed as a foundation of electromagnetic theory. The basics of electrostatic and magnetostatic fields will be discussed including fields in materials and devices. The time-varying Maxwell's equations will be developed as an all-encompassing description of electromagnetic phenomena. Maxwell's equations will be applied to characterize wave propagation in materials, transmission lines, waveguides, and antennas.

### Course Goals:

1. To understand the basics of vector calculus
2. To provide knowledge of electrostatics in materials and
3. To provide knowledge of magnetostatic fields and forces as well as magnetic devices
4. To develop Maxwell's equations as a basis for wave propagation
5. To understand the usefulness of electromagnetic analysis in the practical design of transmission lines, waveguides, antennas, and other microwave devices.

### Student Learning Outcomes

By the end of the course, you should be able to:

1. Understand electrostatic, magnetostatic and electromagnetic fields and their interaction with matter.
2. Solve basic canonical electrostatic, magnetostatic and electromagnetic problems.
3. Understand electromagnetic wave propagation.
4. Solve for the reflection and transmission of uniform plane waves at infinite planar interfaces.
5. Evaluate transmission line problems including methods for impedance matching.
6. Use commercial mathematics software for computing and visualizing electrostatic, magnetostatic and electromagnetic field problems.

### Office Hours

Students are encouraged to visit during scheduled office hours or email the instructor when questions arise. You may also stop by outside of office hours, but my availability is not guaranteed.

### Textbook

Required: *Elements of Electromagnetics, 6<sup>th</sup> Ed.*, Matthew Sadiku, 2011, Wiley, ISBN: 9780-19-932138-4  
You may use an earlier edition of the text, but you will be responsible for any differences between previous editions and the 6<sup>th</sup> edition. In other words, for example, if a particular problem is assigned which is different in a previous edition, you are responsible for doing the proper problem from the 6<sup>th</sup> edition.

Text may be supplemented by notes distributed by the instructor.

**Other Required Materials:**

Some homework will require the use of Matlab. Students should make sure they have access to Matlab and know the basic usage of the software.

Calculator: Some tests and homework require complex algebra. You will be responsible for ensuring that you have a calculator (and know how to use it efficiently) that can perform complex arithmetic as well as be able to perform the following operations on complex numbers: square roots, exponentials, and trigonometric functions.

**Exams and Assignments:**

*Exams:* There will be three closed-book, in-class examinations.

*Final Exam:* Thursday, May 5, 1 pm – 3 pm. OHR C226. Final will be comprehensive, closed-book.

*Homework:* Homework will be assigned based on lectures and readings. Due dates and times will be given when the homework is assigned. All assignments are due at the given date and time. The two lowest homework grades will be dropped. Late homework will not be accepted. *For full credit, proper units must be given.* Some homework will require using Matlab. It is the student's responsibility to obtain appropriate software and make sure they can run it to perform the homework. Graphical results are expected to be computer generated and Matlab homework may require a short, written report which will include grammar as part of the grade.

*Style Rules:* Homework must be 1) neat and legible, 2) on one side of the page only, 3) stapled, 4) flat and not folded. If I have to work hard to read your homework, you will be penalized. This includes writing that is too small. Please try to use a darker pencil lead such as HB or 2B. Erase or mark out cleanly anything you do not want graded.

*Graduate Projects:* A graduate project will be assigned during the semester for graduate students or students in the University Scholars Program seeking graduate credit for this course. It is the responsibility of the student to contact me if seeking graduate credit. The project may be a relevant paper review or computer simulation. The project will be assigned around mid-semester with an assigned due date near the end of the semester. Projects must be done individually.

*Extra Credit:* Extra credit will not be given.

**Grading Scheme:**

The final grade percentage will be based on the following rubric:

	<b>Homework</b>	<b>Graduate Project</b>	<b>Exams 1-3</b>	<b>Final Exam</b>
<b>% of Final Grade Undergraduate</b>	15%	N/A	20% each	25%
<b>% of Final Grade Graduate</b>	10 %	5 %	20% each	25%

**Course Grade:**

The final letter grade for the course will be calculated according to the table below. No scaling of grades should be expected although the instructor reserve the right to scale in the students' favor if need arises.

Final Grade	Letter Grade
90% – 100%	A
80% – 89%	B
70% – 79%	C
60% – 69%	D
< 60%	E

**Attendance:**

Attendance will be taken and students are highly encouraged to attend and be on-time for class. Any assignment due during an unexcused absence is still due at the given time and all late penalties will apply. *As participating in lectures is critical to understanding the material, (S.R. 5.2.4.1 & 5.2.4.2) students with excused absences that exceed one-fifth the total class contact hours may be asked to petition to withdraw from the class and students with unexcused absences that exceed one-fifth the total class contact hours may receive a grade of E.* As per UK's policy on excused absences can be found in Student Rights and Responsibilities, Part II, Section 5.2.4.2:

<http://www.uky.edu/StudentAffairs/Code/part2.html>

Acceptable reasons for excused absences include: Serious illness of student or immediate family member, death of a household member or immediate family, university-related trips, and major religious holidays. If a student must be absent for one of these reasons, the student should notify the instructor as soon as possible, but no later than the second absence. Appropriate documentation regarding the nature of the absence will be required. Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing at least one week in advance of an anticipated absence. See <http://www.uky.edu/StudentAffairs/Code/> for additional information.

**Make-Up Opportunities:**

When there is an excused absence with appropriate documentation, students will be given the opportunity to make up missed work without penalty within one week of the excused absence. Assignments missed due to unexcused absences will be graded according to the late policies outlined above.

**Academic Accommodations:**

If you have a documented disability that requires academic accommodations, please see me as soon as possible. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, [jkarnes@uky.edu](mailto:jkarnes@uky.edu)) for coordination of campus disability services available to students with disabilities. We can then collaborate on an appropriate solution.

**Academic Integrity, Cheating and Plagiarism:**

Cheating is claiming another individual's work as your own or permitting another person to claim your work. Plagiarism is claiming another person's work, writing, or ideas as your own. This includes material from the internet or other digital sources. Copying from the solutions manual for the text is cheating. For more information on plagiarism, see

<http://www.uky.edu/Ombud/Plagiarism.pdf>

Students are encouraged to discuss the material in this course, including homework problems, with other

students. But you cannot simply copy another student's homework and hand it in. Working together is important, and it is encouraged. Copying, however, is cheating and both the student who copies and the student who provides the solution will be punished. Students are encouraged to review their Rights and Responsibilities, Part II, Section 6.3 (<http://www.uky.edu/StudentAffairs/Code/part2.html>) for UK's policy on academic integrity.

Any submitted work that is a result of cheating will not be graded and assigned a zero. Repeated violations will be prosecuted according to the rules of the University Senate (linked to above).

**Classroom Behavior, Decorum and Civility:**

Please be respectful to others in the class and engage in civil discourse when we discuss topics that have a diversity of perspectives. Please minimize distractions by not reading newspapers, carrying on conversations, surfing the web, loud typing, etc. Turn mobile phones off during class. Thank you.

**Tentative Course Schedule:**

~# of Lectures	Text	Topic
1	Chapter 1	Vector Analysis
2*	Chapter 2	Coordinate Systems
1*	Chapter 3	Vector Calculus
7	Chapter 4	Electrostatic Fields
3	Chapter 5	Electric Fields in Material Space
3	Chapter 6	Electrostatic Boundary-Value Problems
4	Chapter 7	Magnetostatic Fields
5	Chapter 8	Magnetic Force, Materials, Devices
5	Chapter 9	Maxwell's Equations
5	Chapter 10	Electromagnetic Wave-Propagation
3	Chapter 11	Transmission Lines
?	Chapter 13	Antennas
3		Exams

\* indicates material will be covered as needed throughout course.