

# ECE 333 - Fields and Waves I

Department of Electrical and Computer Engineering  
University of Massachusetts Amherst

## Syllabus

Fall 2022

### **Instructor**

Prof. Amir Arbabi

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### **Teaching Assistants**

Mr. Zheshun Xiong (Homework assignments 1-4)

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### **Time and Location**

Lecture: 11:30AM-12:45PM TuTh, Engineering Lab. 303

Instructor office hours: 2:00PM-2:50PM TuTh, Knowles 113D

TA office hours: 5:30PM-6:30PM Mondays, Marcus 205

### **Prerequisites**

Math 233 and ECE 244.

### **Course Objectives**

In this course, students should acquire the following skills. They should:

1. Understand basic principles of waves and transmission lines/distributed circuits.
2. Understand the basic principles of electromagnetism including, electromagnetic wave propagation, absorption, transmission, and reflection.
3. Understand the interaction of electromagnetic fields with materials.
4. Be able to apply these principles to analyze and design simple electrical engineering components/devices, interconnects, or systems.

### **Resources**

#### **Textbook:**

F. T. Ulaby and U. Ravaioli, *Fundamentals of Applied Electromagnetics*, 7th ed., Prentice Hall, 2014.

Note: 8<sup>th</sup> edition of the book is also available and is similar to the 7<sup>th</sup> edition. 5<sup>th</sup> and 6<sup>th</sup> editions of the book and paperback versions have similar contents as the 7<sup>th</sup> edition.

#### **Other resources:**

D. K. Cheng, *Field and Wave Electromagnetics*, 2nd ed., Addison-Wesley, 1992.

## **Grading**

|                 |   |
|-----------------|---|
| Homework: 20%   | Approximately 11 sets, plus extra-credit optional computational exercises |
| Midterm I: 25%  | 7:00PM-9:00PM, Tuesday, 11 Oct. 2022, <u>Engineering Lab. II 119</u>      |
| Midterm II: 25% | 7:00PM-9:00PM, Monday, 14 Nov. 2022, <u>Location TBD</u>                  |
| Final Exam: 30% | 1:00PM-3:00PM, Tuesday, 20 Dec. 2022, <u>Engineering Lab. 303</u>         |

## **Homework Policies**

Weekly problem sets (approximately 11 sets) will be assigned. Assignments will be posted on Moodle (<https://moodle.umass.edu/>) and Gradescope (<https://www.gradescope.com/>) and are due at the beginning of the class on the due date, and must be uploaded to Gradescope. Late homework assignments will **not** be accepted. Assignment solutions will be posted on Moodle after their due dates.

## **Exam Policies**

The class will have two midterms and a final exam. The exams are closed-book and closed-notes, but students are allowed to bring one double-sided page of handwritten notes. The use of calculators is allowed.

## **Course Topics**

1. Fields, waves, and phasors (Chapter 1)
  - Electric and magnetic fields, units
  - Traveling waves, complex numbers
  - Lossless and lossy media
2. Transmission lines (Chapter 2)
  - Transmission line models and geometries, TL equations
  - Wavelength and propagation constant, loaded transmission lines
  - Reflection coefficient, standing waves, power flow
  - Transients on transmission lines
3. Review of vector analysis (Chapter 3)
  - Coordinate systems
  - Vector algebra and vector calculus (gradient, divergence, curl)
4. Time-varying fields and Maxwell's equations (Chapter 6)
  - Maxwell's equations, boundary conditions, continuity equation
  - Magnetic induction, Faraday's law, displacement current
  - 3D wave equation, time-harmonic fields, Helmholtz equation
  - Poynting theorem and electromagnetic energy
5. Electromagnetic waves (Chapters 7 and 8)
  - Plane waves in lossless and lossy media, polarization, Poynting vector
  - Plane wave reflection at conductive and dielectric boundaries
  - Introduction to guided waves (time permitting)

## **Health and Wellbeing**

You are not alone at UMass – many people care about your wellbeing and many resources are available to help you thrive and succeed. The College recognizes that coursework is challenging and that classes are not the only demand in your life. Success in this course and the College of Engineering depends heavily on your personal health and wellbeing. Recognize that while stress is an expected part of the college experience, it can be compounded by unexpected setbacks or life changes outside the classroom. Strive to reframe challenges as an unavoidable pathway to success. Reflect on your role in taking care of yourself throughout the term, before the demands of exams and projects reach their peak. Please feel free to reach out to me about any difficulty you may be having that may impact your performance as soon as it occurs and before it becomes too overwhelming. I encourage you to contact support services on campus that stand ready to assist you. You can learn about the confidential mental health services available on campus by calling the Center for Counseling and Psychological Health (CCPH) by visiting their website at [umass.edu/counseling](http://umass.edu/counseling). Within the College, you may reach out to your academic advisor, the Office of Student Affairs (<http://engineering.umass.edu/current-students/academics-advising>) or the Office of Community Equity and Inclusion ([rees@umass.edu](mailto:rees@umass.edu)). There are many other resources on campus for students facing personal, financial or life challenges to find support, stay in school, and graduate (<https://www.umass.edu/studentlife/single-stop>). Please reach out to me for support finding the resources you need.

## **Disability Accommodation and Inclusive Learning Statement**

Your success in this class is important to me. We all learn differently and bring different strengths and needs to the class. The University of Massachusetts Amherst is committed to making reasonable, effective and appropriate accommodations to meet the needs of students with disabilities and help create a barrier-free campus. If you have a qualifying disability and require accommodations while participating in this course, please work with Disability Services to have an accommodation letter sent to me in a timely manner. If you have a disability but are not yet affiliated with Disability Services, please register with Disability Services (<https://www.umass.edu/disability/students>). Information on services and materials for registering are also available on their website [www.umass.edu/disability](http://www.umass.edu/disability). If you are eligible for exam accommodations, your exams can be administered by the exam proctoring center or I can administer the exam if you wish and is possible for me. Contact Disability Services immediately, and comply with their exam scheduling policies, including the requirement that you book your exams at least seven days in advance of the exam date. *It is incumbent upon you to contact me during the first few weeks of the semester, or shortly following registration with Disability Services, to ensure that your accommodations are being sufficiently met, including extra time and note-taking access, as applicable.* Finally, beyond disability accommodations, if there are aspects of the course that prevent you from learning or make you feel excluded, please let me know as soon as possible. Together we'll develop strategies to meet both your needs and the requirements of the course.

## **Academic Integrity**

Maintaining the integrity of scholarship and research within institutions of higher education requires a cultural commitment. The University Academic Honesty Policy Applies in this and all courses. This policy can be found on the University Web Page (<https://www.umass.edu/honesty/>). Academic dishonesty includes but is not limited to cheating, fabrication, plagiarism, and abetting or facilitating dishonesty. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent. Concerns about academic dishonesty may be reported to the course instructor, another trusted faculty or staff member, the

department head, or anonymously through the department (refer to departmental webpage) or College's classroom experience form (<https://tinyurl.com/UMassEngineerClassroom>).

## **Inclusivity**

Everyone should feel that they are an integral part of the community and that all individuals and their perspectives are respected. A diversity of perspective and experience provides a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued or respected for any reason, please speak with me privately. If you wish to communicate with someone else in the College or University, there are several ways to do so anonymously or to provide contact information if you so choose:

1. Notify the University Diversity, Equity, and Inclusion Office through the "Report a Climate Incident" form: <https://www.umass.edu/diversity/incident-report-form>  
Note that this form requires sharing name and contact information.
2. Speak with Assistant Dean Dr. Paula Rees ([rees@umass.edu](mailto:rees@umass.edu)).
3. Report an incident anonymously to the College of Engineering Diversity, Equity, and Inclusion Office
  - Climate Concerns and Suggestions:  
<https://tinyurl.com/UMassEngineerClimate>
  - Classroom Experience - <https://tinyurl.com/UMassEngineerClassroom>
4. Reach out to the ECE DEI Committee. Anonymous ECE feedback form: <https://ece.umass.edu/ece-diversity-equity-inclusion> (scroll down for feedback link)

## **Pronouns and Names**

Everyone has the right to be addressed by the name and pronouns that they use for themselves. Students can indicate their preferred/chosen first name and pronouns on SPIRE, which appear on class rosters. Please let me know what name and pronouns I should use for you if they are not on the roster. A student's chosen name and pronouns are to be respected at all times in the classroom. To learn more, read the Intro Handout on Pronouns:

[https://www.umass.edu/stonewall/sites/default/files/pronouns\\_intro.pdf](https://www.umass.edu/stonewall/sites/default/files/pronouns_intro.pdf)

## **Gender Respect and Title IX**

The University of Massachusetts Amherst aspires to be a university environment that is free of discrimination, sexual harassment, and sexual violence. Faculty have the responsibility to inform students of resources and reporting options. If you or someone you know has experienced sexual assault, sexual misconduct, or sexual discrimination, please see <https://www.umass.edu/titleix/what-to-do> for information about resources and reporting options. A report to the Title IX Coordinator may be made at any time (including during non-business hours) by using the Title IX Coordinator's email ([TitleIXCoordinator@umass.edu](mailto:TitleIXCoordinator@umass.edu)), telephone number (413) 545-3464 or mail. UMass Amherst is committed to supporting community members who report concerns of prohibited conduct. Please reach out to me if you would like assistance connecting with any of these resources/options.