Course Syllabus

E&C-ENG 334 − Fields and Waves II

University of Massachusetts-Amherst

Spring 2020

Description: Intermediate level undergraduate electromagnetics for electrical and computer engineering. Transient transmission line phenomena with arbitrary load and sources. Introduction to Smith chart. Refection and Transmission of waves by planar material interfaces and multilayer media. Two and three dimensional electrostatic and magnetostatic boundary value problems. Introduction to guided waves and waveguides, TE, TM and TEM modes. Electromagnetic properties of materials and artificial materials Introduction of Gaussian and ray optics. **(3 credits)**

Objectives: In this course, the student will:

1. Understand transient wave phenomena on transmission lines and distributed circuits.
2. Understand electromagnetic wave interactions with planar multilayer material interfaces, bulk media, and impenetrable guided wave structures.
3. Understand how electromagnetics reduce to optics and optical phenomena.
4. Formulate and solve physical problems at very low and very high frequencies.
5. Use contemporary electromagnetic analysis and design tools.
6. Apply understanding and principles acquired to design simple electrical engineering components/devices, interconnects or systems.

Lect. Location: Marston 211

Lecture Times: MWF 10:10-11:00AM

Prerequisites: ECE 333-Fields and Waves (or equivalent)

Textbook: *Fundamentals of Applied Electromagnetics*, F. T. Ulaby and U. Ravaioli, 7/E, Prentice-Hall, 2015, ISBN # 13: 978-0-13-335681-6
Note: 8th edition (eText and loose-leaf format) is also acceptable. 5th and 6th editions of the book have similar contents as the 7th edition.

References:

- *Engineering Electromagnetics*, by Umran Inan and Aziz Inan, Addison-Wesley, 1999.
- *Fundamentals of Engineering Electromagnetics*, by D. Cheng, Addison-Wesley, 1993.
- *Field and Wave Electromagnetics*, 2nd Ed. By David K. Cheng, Addison-Wesley, 1992.

Instructor Info:

Name: Marinos N. Vouvakis
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Office: Marcus 215J
Office hours: Tu & Th 11:15-12:30PM or by appointment

Outline:

1. Introduction: Course review and significance. [1 week]
2. Transmission Lines: Transients and Smith chart [2 weeks]
3. Wave Reflection and Transmission: Oblique incidence, planar multilayer media reflection and transmission [2 weeks]
4. Formal Solution of Static Boundary Value Problems: Separation of variables, Laplace equation in 2D, 3D, Poisson equation in 2D and 3D [3 weeks]
5. Guided Waves and Waveguides: Helmholtz equation, Rectangular waveguides TE

and TM modes, dispersion, coaxial cable TEM mode [2 weeks]
6. EM properties of materials: Material polarization and magnetization, permeability and permittivity, anisotropic materials, artificial materials. [1 week]
7. Optics & Photonics: Paraxial wave approximation, Gaussian beams, Eikonal equation, Ray optics [2 weeks]

Policies:

Grading: Homework (15%)
Midterm 1 (30%) Tuesday March 10, 6:30-8:30pm at MRST 211
Final exam (40%) Friday May 1, 10:30am-12:30pm at MRST 211
Projects (15%)
The instructor retains the right to assign 5-10min **pop-up quizzes** depending on **class attendance**. Each quiz will be equivalent to a full homework.

Homework: **Approximately bi-weekly**. Individual. Assigned (posted on Moodle) Fridays and collected two weeks later (**Gradoscope submission**). Each student will have the opportunity to get **one-week extension** for **one** homework of their choice. Other late homework will receive significant late submission penalty. No homework will be accepted after solutions have been posted. HWs from time to time will include scripting in Matlab, Python, etc.

Projects: Two computer projects. Students will use electromagnetic simulation CAD tools (**ANSYS HFSS and Keysight ADS**) to solve problems in Transmission lines and electromagnetic waves. All projects submission shall be typed and emailed in PDF format no later than **3 weeks after the project assignment**. ANSYS HFSS is installed at most ECS computers at the ELab computer lab. Keysight ADS can be downloaded on Windows or Linux computers.

Web Page: Each student registered in the course roster can login into her/his **Moodle** account to view course materials, https://moodle.umass.edu/
All announcements, **Echo360 lecture recordings**, notes, homeworks, HW/Quizz/Exam solutions, project resources will be posted online at Moodle. All submissions will be thought Gradoscope and grades will be posted there.

Accommodation Statement: The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.

Inclusivity Statement: We are all members of an academic community with a shared responsibility to cultivate a climate where all students/individuals are valued and where both they and their ideas are treated with respect. The diversity of the participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued for any reason, please speak with me privately. You may also speak with Dr. Paula Rees, Assistant Dean for Diversity (rees@umass.edu, 413.545.6324, Marston 128), submit a comment to the box on the door of Marston 128, or submit an anonymous comment online http://tinyurl.com/UMassEngineerClimate .

Academic Since the integrity of the academic enterprise of any institution of

Honesty Statement:

higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst.
Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair.
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 (http://www.umass.edu/dean_students/codeofconduct/acadhonesty/).

Prepared by: Marinos N. Vouvakis
Date: January 20, 2020