

ANTENNA THEORY AND DESIGN
University of Massachusetts Amherst
ECE 687

Instructor	Do-Hoon Kwon
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Class meetings	TuTh 2:30–3:45 PM in E-Lab II 115 Simultaneously via zoom at https://umass-amherst.zoom.us/j/93501253938 (must be signed in to UMass to access the meetings)
Office hours	By appointment. Send an email to the instructor.

Course Objectives

In this course, the student will acquire the following skills. He/she should be able to:

1. Understand and use the standard antenna parameters
2. Understand and compute near- and far-field quantities from several common antennas
3. Design simple antennas to achieve specified electrical performance
4. Design antenna arrays with required radiation pattern characteristics
5. Understand self/mutual impedances
6. Critically evaluate requirements and potential design options for applications

Prerequisites

Basic EM analysis, plane waves, transmission lines, rectangular waveguides and resonators, and radiation from current filament.

Course Website

Moodle at <https://umass.moonami.com>

Textbook

C. A. Balanis, *Antenna Theory: Analysis and Design*, 4th ed., Hoboken, NJ: Wiley, 2016.

References

W. L. Stutzman and G. A. Thiele, *Antenna Theory and Design*, 3rd ed., Hoboken, NJ: Wiley, 2013.

J. L. Volakis, Ed., *Antenna Engineering Handbook*, 5th ed., New York: McGraw Hill, 2018.

C. A. Balanis, Ed., *Modern Antenna Handbook*, Hoboken, NJ: Wiley, 2008.

Course Topics

1. Fundamental quantities of antennas (ch. 2) [3 lectures]
2. Basic wire antennas: dipole, loop (ch. 4, 5) [4 lectures]
3. Method of Moments (ch. 8) [1 lecture]
4. Antenna arrays (ch. 6) [5 lectures]
5. Antenna synthesis (ch. 7) [4 lectures]
6. Aperture antennas (ch. 12, 13) [4 lectures]

7. Reflector antennas (ch. 15) [3 lectures]
8. Broadband/wideband antennas (sec. 10.3) and microstrip patch antennas (ch. 14) [2 lectures]

Course Requirement

Homework	10 %
Midterm Exam	30 %
Antenna Project	30%
Final Exam	30 %

Homework assignments are due for in-person or online submission at the beginning of the class period on the due date. Late homework will NOT be accepted. Late submissions under extenuating circumstances (e.g. a research-related travel) should be arranged in advance with the instructor.

Antenna Design and Simulation Project

An individual antenna project will have the following components:

1. Selecting a target application
2. Reducing the application requirement to antenna specifications
3. Selecting the antenna type
4. Designing size, shape, material, and feeding details
5. Investigating the impedance and radiation characteristics using simulation
6. Writing an IEEE-style report and making a presentation to the class

Computer Simulation Tools

- PCAAD (Personal Computer Aided Antenna Design)
- CST Studio Suite by Dassault Systèmes (<https://www.3ds.com/products-services/simulia/products/cst-studio-suite>; available for install for Windows)
- FEKO by Altair Engineering, Inc. (<https://www.altair.com/feko>; available for install for Windows and linux)
- High Frequency Structure Simulator by Ansys, Inc. (<https://www.ansys.com/products/electronics/ansys-hfss>; available for install for Windows and linux)
- Note:
 - All tools are available on E-Lab 307 computers
 - Access to license servers for CST, FEKO, and HFSS requires VPN to UMass network

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.

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. They provide a lot of resources beyond individual therapy. Check-out some of their great, free resources, including Togetherall and Welltrack. 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>).

Within the College, you may reach out to myself, your academic advisor, the Office of Student Affairs (<http://engineering.umass.edu/current-students/academics-advising>) or the Office of Diversity, Equity, and Inclusion (engindiversity@umass.edu). I encourage you to contact support services on campus that stand ready to assist you. Remember that as your instructor, I am here to help you find the resources you need.

Academic Honesty.

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).
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 departmental DEI Committee – <https://ece.umass.edu/ece-diversity-equity-inclusion> (scroll down for feedback link)

We are all members of an academic community with a shared responsibility to cultivate a climate where all individuals are valued and where both they and their ideas are treated with respect.

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. Please kindly correct me and fellow classmates when we make mistakes. To learn more, please see this resource:

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. If you or someone you know has experienced sexual assault, sexual misconduct, or sexual discrimination please see <https://www.umass.edu/titleix/> for information about resources and reporting options. A report to the Title IX Coordinator, Kerri Thompson Tillett, J.D., may be made at any time through the online reporting tool, the Title IX Coordinator's email (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.