Antenna Systems

EEL 4461 Section CAMP
Class Periods: MWF | Period 8 (3:00 PM - 3:50 PM)
Location: CSE E122
Academic Term: Fall/ 2021

Instructor:
Jenshan Lin
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352-392-4929
Office Hours: MWF 4:05 PM – 4:55 PM (after the class) in NEB 559, or schedule a Zoom meeting by email

Teaching Assistant/Peer Mentor/Supervised Teaching Student:
N/A

Course Description
EEL 4461 Antenna Systems, 3 Credits
Grading Scheme: Letter Grade
Electromagnetic field theory and its application to antenna design.

Course Pre-Requisites / Co-Requisites
Prerequisite: EEL 3472C

Course Objectives
The objective of this course is to introduce the fundamental principles of antenna and to apply them to the design and analysis of antenna systems. Students will learn how to characterize antennas, how to use antennas, and how to design antennas through electromagnetic simulation tools. Different types of antennas and their applications will be introduced, with focus on linear wire antennas, loop antennas, microstrip patch antennas, antenna arrays, and the design considerations of using antennas in wireless systems.

Materials and Supply Fees
N/A

Relation to Program Outcomes (ABET):
The table below is an example. Please consult with your department's ABET coordinator when filling this out.

Outcome	Coverage*
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Medium
3. An ability to communicate effectively with a range of audiences	
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5. An ability to function effectively on a team whose members together provide leadership, create a	

collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks and Software

- See below for recommended textbook.
- Additional lecture notes developed by the instructor will also be used.
- This course will use ANSYS HFSS 3D Layout for antenna design and simulation. The software is installed on computers in ECE Computer Lab and remote access is available through UF VPN: https://www.ece.ufl.edu/resources/it/ece-student-computing-access/ The course will have several tutorials on how to use this EDA software to model and simulate the antennas.

Recommended Materials

- ANTENNA THEORY: ANALYSIS AND DESIGN
- Balanis
- 3rd edition (2005) or 4th edition (2016). Feel free to use either edition. Homework problems adopted from textbook will be retyped on Canvas. There will also be homework problems designed by me.

Course Schedule

Week 1 (8/23-8/27): Fundamental principles of antenna. Different types of antennas and their applications. Review of vector analysis and Maxwell's equations.
Week 2 (8/30-9/3): Radiation pattern, power density, and intensity. Far field and near field. Antenna beamwidth and directivity.
Week 3 (9/8-9/10): (M: Holiday) Antenna gain and efficiency. EDA tutorial #1 – how to model and simulate a simple antenna on PCB substrate.
Week 4 (9/13-9/17): Antenna polarization and EM wave polarization. Quiz #1.
Week 5 (9/20-9/24): Antenna input impedance. Effective aperture of antenna.
Week 6 (9/27-10/1): Friis transmission equation and radar range equation. RF propagation and weather effect.
Week 7 (10/4-10/8): Overview of dipole antennas. Radiated field of infinitesimal dipole. Review before Exam.
Week 8 (10/11-10/15): Exam #1. Small dipole. Half-wavelength dipole. EDA tutorial #2 – design and simulate a printed dipole on PCB substrate.
Week 9 (10/18-10/22): Quarter-wave monopole antenna. Ground effect on dipole. EDA tutorial #3 – frequency response of impedance and frequency tuning of a printed dipole.
Week 10 (10/25-10/29): Loop antennas. Quiz #2.
Week 11 (11/1-11/5): Microstrip patch antennas. EDA tutorial #4 – design and simulate a rectangular patch.
Week 12 (11/8-11/12): Frequency response of patch antenna. Patch antenna equivalent circuit.
Week 13 (11/15-11/19): Impedance matching using microstrip quarter-wave transformer. EDA tutorial #5.
Week 14 (11/22): (WF: Holidays) Circularly polarized patch.
Week 15 (11/29-12/3): Antenna array and feed network. Frequency-independent antenna.
Week 16 (12/6-12/8): Review before Exam. Exam #2.

Attendance Policy, Class Expectations, and Make-Up Policy

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Click here to read the university attendance policies: https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework Sets (6)	100 each	30%

Quizzes (2)	100 each	10%
Exams (2)	100 each	40%
Final Project	100	20%
		100%

Grading Policy

The following is given as an example only.

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
86.7 - 89.9	A-	3.67
83.3 - 86.7	B+	3.33
80.0 – 83.3	B	3.00
76.7 - 79.9	B-	2.67
73.3 - 76.7	C+	2.33
70.0 – 73.3	C	2.00
66.7 - 69.9	C-	1.67
63.3 - 66.7	D+	1.33
60.0 - 63.3	D	1.00
50.0 - 60.0	D-	0.67
0 - 49.9	E	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Conduct Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect

students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: https://counseling.ufl.edu, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling; https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall*,* 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/;https://care.dso.ufl.edu.

On-Line Students Complaints*:* http://www.distance.ufl.edu/student-complaint-process.