

# ELECTROMAGNETIC FIELD THEORY I

EEL 5486 Class # 25334

**Class Periods:** Mon. Weds. Fri., 4<sup>th</sup> Period, 10:40 am to 11:30 am

**Location:** Online Course

**Academic Term:** Spring 2021

## **Instructor:**

Martin Uman

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Office Phone Number: 352-392-4038

Office Hours: Mon. Weds. Fri., following class on zoom, or by zoom appointment or email

## **Course Description**

Rigorous development of fundamental electrostatic, magnetostatic, and electromagnetic behavior, with special attention toward practical applications. Electrostatics: Gauss' law, electric fields, scalar potential, and energy in simple media. Magnetostatics: Ampère's law, Faraday's law, magnetic fields, vector potential, and energy in simple media. Electromagnetics: Maxwell's equations, time-varying fields, and Poynting's theorem.

Prereq: First Undergraduate course in fields and waves. Students may not take EEL 5486 if they have already taken EEL 4473.

Three (3) credits

## **Course Pre-Requisites / Co-Requisites**

Prereq. EEL 3472C or equivalent

Three (3) credits

## **Course Objectives**

Mathematical and physical understanding of Maxwell's Equations and their application to plane waves, guided waves, and radiation.

## **Materials**

All students are required to have a computer with a camera and microphone operating on their computer during class.

## **Required Textbook**

- Title: Elements of Electromagnetics, 7<sup>th</sup> Ed. Oxford
- Author: M.N.O. Sadiku
- Publication date and edition: 2018 - 7<sup>th</sup> Ed.
- ISBN number: ISBN 9780190698614

## **General Course Schedule**

Material To be covered	Number of Lectures (Estimated)	Sections and Chapter in Text (Sadiku)
1. Review of Maxwell's equations	10	4.2, 4.5, 4.6, 4.8, 7.2-7.6, Chap. 9
2. Electromagnetic wave propagation	10	Chap. 10
3. Transmission Lines and Waveguides	11	11.1-11.4, 11.7, Chap. 12
4. Antennas, calculation of fields from sources	9	Section 9.6, Chap. 13, and notes provided
Final Exam – Online	Online	April 29, 2021 from 12:30 pm to 2:30 pm

## **Grading**

There will be 3 or 4 tests that, in total, will count for 50% of the final grade. The final exam will nominally count for the other 50% (or a greater percentage if the results are significantly better than the hour tests). Homework may be assigned. Tests and the final exam will most likely be non-collaborative re humans but otherwise open book and open any other material.

## **Detailed Course Outline**

### 1. Review of Maxwell's equations: Sections 4.2, 4.5, 4.6, 4.8, 7-2.-7.6, Ch. 9

Electromagnetic (EM) field quantities, units, and constants  
Maxwell's equations for static electric and magnetic fields  
Maxwell's equations for time-varying electric and magnetic fields  
Maxwell's equations in the time and frequency domains

### 2. Electromagnetic wave propagation: Ch. 10

- Uniform plane waves (uniform TEM) - waves in general
- Propagation in lossless dielectrics
- Propagation in lossy dielectrics
- Propagation in good conductors
- Plane wave reflection

### 3. Transmission lines and waveguides: Sections 11.1-11.4, 11.7, Ch. 12,

- Transmission lines (non-uniform TEM waves): time and frequency domain fields
- The circuit model for transmission lines
- Transients (time-domain pulses) on transmission lines
- Transverse magnetic (TM) and transverse electric (TE) waves in rectangular waveguides
- Wave propagation as a function of wave frequency in rectangular waveguides
- Cavity resonators

### 4. Antennas, Section 9.6, Ch. 13

- Vector and scalar potentials: calculation of E/H fields
- Hertzian dipole fields in time and frequency domains
- Half-wave dipole antenna and quarter-wave monopole antenna
- Small loop antenna
- Antenna arrays

### ***Online Course Recording***

Our class sessions will be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

### ***Attendance Policy, Class Expectations, and Make-Up Policy***

This class will be presented online using Canvas/Zoom and requires access to a working webcam and stable internet connection. I prefer that students keep their camera on during the class so that I can see you as I would during normal face-to-face classes. Studies show that if we can see each other's faces then we will have more engagement, more student success, and more faculty success.

Excused absences must be consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>) and require appropriate documentation.

### ***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/>.

### ***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 Honor Code (<https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. 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
- Robin Bielling, Director of Human Resources, 352-392-0903, [rbielling@eng.ufl.edu](mailto:rbielling@eng.ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto: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](mailto: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:** <http://www.counseling.ufl.edu/cwc>, 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](mailto:title-ix@ufl.edu), located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto: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 support**, 352-392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu).  
<https://lss.at.ufl.edu/help.shtml>.

**Career Resource Center**, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.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://care.dso.ufl.edu>.

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