



EE370L: Electromagnetics for Engineering Systems (two sessions)

Units: 4

Term: Fall 2023

**Lecture: Tue & Thu, 14:00-15:20 o'clock (31010R, Prata)
Mon & Wed, 14:00-15:20 o'clock (31015D, Lazzi)**

**Labs: Fri, 08:00-09:50 o'clock (31011R, Prata)
Fri, 10:00-11:50 o'clock (31012R, Lazzi)**

Location: Lectures: SOS B46 (31010R, Prata)
Lectures: THH 210 (31015D, Lazzi)
Laboratories: OHE 230

Instructor (31010R): Aluizio Prata

Office Hours: Thu, 10:00-11:45 o'clock, in PHE 618, or by appointment

Contact Info: prata@usc.edu

Instructor (31015D): Gianluca Lazzi

Office Hours: Mon & Wed, 11:00 AM -12:00 PM o'clock, in MCB 270B, or by appointment (in person or Zoom)

Contact Info: lazzi@usc.edu

Course Producers (alphabetically): Matthew Ai

Jerry Appelhans

Will Durban

Greg Sarandi

Keshav Sriram

Siyang Wang

Office Hours: Matthew Ai: Wed, 15:30-17:15 o'clock, in PHE 530
Jerry Appelhans: Fri, 12:00-14:00 o'clock, in PHE 530
Will Durban: Tue, 14:00-16:00 o'clock, in PHE 530
Greg Sarandi: Tue, 13:00-15:00 o'clock, in PHE 530
Keshav Sriram: Mon, 12:00-14:00 o'clock, in PHE 530
Siyang Wang: Thu, 12:30-14:30 o'clock, in PHE 530

Contact Info: Matthew Ai: msai@usc.edu
Jerry Appelhans: appelhan@usc.edu

Will Durban: urban@usc.edu
Greg Sarandi: sarandi@usc.edu
Keshav Sriram: sriramk@usc.edu
Siyang Wang: wangsiya@usc.edu

Course Description

Theoretical and experimental aspects of the high-frequency behavior of common circuits, transmission lines, electromagnetic waves and their propagation and interactions with simple media, transmission and reception of wireless signals in complex environments, and antennas.

Learning Objectives

Students who successfully complete EE 370L will be able to: 1) Calculate and measure the high-frequency behavior of common circuit elements; 2) Calculate and measure voltages, currents, waves, and impedances in transmission lines; 3) Calculate and measure the relevant practical parameters of transmission lines; 4) Perform time domain analysis and measurements (including bounce diagrams) and phasors domain analysis (including Smith Chart) of transmission lines; 5) Design and experimentally verify matching systems for circuits and transmission lines; 6) Develop a solid working knowledge of Maxwell's Equations; 7) Calculate the energy of electromagnetic fields and apply it to determine impedances; 8) Calculate the electric and magnetic fields, as well as the propagation characteristics, of plane waves; 9) Calculate electric and magnetic fields of plane waves reflected and transmitted at flat boundaries; 10) Handle electromagnetic radiation and apply it to both transmitting and receiving antennas; 11) Calculate the input impedance and fields radiated by elementary dipoles and dipoles of arbitrary length; 12) Design dipole antennas and calculate and measure their electric characteristics; 13) Compute and experimentally verify the link budget of simple wireless communication systems, and understand how the environment affects the received power.

Prerequisite(s)

PHYS 172 or PHYS 162.

Recommended Preparation

Knowledge of circuit theory and software packages to process and plot data (e.g., Matlab, Excel).

A USC (free) Matlab student license available at <http://software.usc.edu/>

A USC (free) MS-Excel student license available at <https://itservices.usc.edu/officestudents/>

Course Notes

Supplemental materials, assignments, laboratory manuals, and any suggested additional reading will be posted on the Blackboard website.

Required Readings and Supplementary Materials

Textbook: F. T. Ulaby and U. Ravaioli, *Fundamentals of Applied Electromagnetics* (8th Ed), ISBN 9780135199008, Required.

Other References (useful but not required): Kraus, *Electromagnetics with Applications*; U. Inan and A. Inan, *Electromagnetic Waves*; Hayt and Buck, *Engineering Electromagnetics*; D. K. Cheng, *Field and Wave Electromagnetics* (2nd Ed); Haus and Melcher, *Electromagnetic Fields and Energy* (<http://ocw.mit.edu>)

Description and Assessment of Assignments

Eight homework sets and 7 laboratory exercises will be assigned. These should all be turned in before class or discussion/laboratory, on the days these are due, as indicated on the assignments. All homeworks and laboratories have been designed to be completed at the student own time and convenience (i.e., not necessarily at USC's facilities). Although laboratory sessions are provided throughout the semester, their intent is mainly to stimulate the discussion of relevant laboratory details, as all laboratories are to be completed at home, using the USC provided laboratory kits.

Late homework assignments or laboratory reports will not be accepted. However, the lowest homework grade in the semester will not be used to calculate average final homework scores, providing an opportunity to miss turning in a homework without grade consequence. Similarly, the lowest laboratory grade in the semester will not be used to calculate average final laboratory scores, providing an opportunity to miss turning in a laboratory report without grade consequence. Notice, however, that the course has been designed so that the lectures, homeworks, and laboratories heavily complement each other (e.g., often materials covered in the classes or laboratories are discussed only in the classes or laboratories, respectively). It is then critical for satisfactory progress that all homework and laboratory be completed anyways before moving on to the subsequent homework or laboratory.

All homework assignments and laboratory exercises are to be completed on your own. You are allowed, and encouraged, to consult with other students in the current class regarding the general approach to solving problems and doing experiments, but all work submitted by you must be your work alone. You are not allowed to possess or in any way derive advantage from existing solutions prepared in previous years by former students, earlier professors, or from on-line sources.

In addition to homework and laboratory assignments, there will be 2 midterms and a final exam. You will be tested on all material covered in class, on the assigned readings, on the laboratories, and on the homework problems and problems similar to those. Please bring your USC ID card to each exam; it may be checked during the exam. You must take the exams at the scheduled times: if you are absent during an exam, you will receive a grade of zero unless you have a valid reason for your absence *and* you have discussed it with the instructors *prior* to the exam.

Grading Breakdown

Grading will be based on the following weights:

- Homework assignments 15%
- Laboratory assignments 25%
- Midterm No. 1 20%
- Midterm No. 2 20%
- Final Exam 20%

Important Dates

- First day of class Aug. 21, 2023 (Mon)
- Labor Day (holiday) Sep. 04, 2023 (Mon)
- Fall Recess Oct. 12, 2023 – Oct. 13, 2023 (Thu-Fri)
- First midterm exam Sep. 28, 2023 (Thu), 14:00-15:20 o'clock (31010R, Prata)
Sep. 27, 2023 (Wed), 14:00-15:20 o'clock (31015D, Lazzi)
- Second midterm exam Nov. 09, 2023 (Thu), 14:00-15:20 o'clock (31010R, Prata)
Nov. 08, 2023 (Wed), 14:00-15:20 o'clock (31015D, Lazzi)
- Veterans Day (non-instructional) Nov. 10, 2023 (Fri)
- Thanksgiving Break Nov. 22, 2023 – Nov. 26, 2023 (Wed-Sun)
- Last day of class Dec. 01, 2023 (Fri)
- Final exam Dec. 07, 2023 (Thu), 14:00-16:00 o'clock (31010R, Prata)
Dec. 08, 2023 (Fri), 14:00-16:00 o'clock (31015D, Lazzi)

Class Schedule (31010R + 31011R, Prata)

Week	Lecture, Lab Dates	Instructor	Chapters, Section Covered, Lab Topics	Exam Dates	HW due	Previous Lab due
01	Aug. 22, Aug. 24	Prata	1, 2.1-2.2			
	Aug. 22	Prata	HWK 01 starts			
	Aug. 25	Prata	Laboratory 01 starts			

02	Aug. 29, Aug. 31	Prata	2.3-2.5		Aug. 31	
	Aug. 31	Prata	HWK 02 starts			
	Sep. 01	TBD	Laboratory 01 continuation			
	Sep. 04		Holiday, Labor Day			
03	Sep. 05, Sep. 07	Prata	2.6-2.7			
	Sep. 08	Prata	Laboratory 02 starts			Sep. 08 (Lab.01)
04	Sep. 12, Sep. 14	Prata	2.8		Sep. 14	
	Sep. 14	Prata	HWK 03 starts			
	Sep. 15	TBD	Laboratory 02 continuation			
05	Sep. 19, Sep. 21	Prata	2.9			
	Sep. 22	Prata	Laboratory 03 starts			Sep. 22 (Lab. 02)
06	Sep. 26, Sep. 28	Prata	2.10	Sep. 28	Sep. 26	
	Sep. 26	Prata	HWK 04 starts			
MIDTERM I: Thursday, Sep. 28, 14:00-15:20 o'clock						
	Sep. 29	TBD	Laboratory 03 continuation			
07	Oct. 03, Oct. 05	Prata	2.11-2.12			
	Oct. 06	TBD	Laboratory 04 starts			Oct. 06 (Lab 03)
08	Oct. 10	Prata	3.1-3.4		Oct. 10	
	Oct. 10	Prata	HWK 05 starts			
FALL RECESS: Oct. 12 to Oct. 13						
09	Oct. 17, Oct. 19	Prata	3.5-3.7			
	Oct. 20	Prata	Laboratory 05 starts			Oct. 20 (Lab.04)
10	Oct. 24, Oct. 26	Prata	7.1-7.6		Oct. 26	
	Oct. 26	Prata	HWK 06 starts			
	Oct. 27	TBD	Laboratory 05 continuation			
11	Oct. 31, Nov.02	Prata	8.1-8.5			
	Nov. 03	Prata	Laboratory 06 starts			Nov. 03 (Lab.05)
12	Nov. 08, Nov.10	Prata	9.1-9.6	Nov. 09	Nov. 07	
	Nov. 07	Prata	HWK 07 starts			
MIDTERM II: Thursday, Nov 09, 14:00-15:20 o'clock						
	Nov. 10		Holiday, Veterans Day			
13	Nov. 14, Nov.16	Prata	9.9			
	Nov. 17	Prata	Laboratory 07 starts			Nov. 17 (Lab.06)
14	Nov. 21	Prata	9.10-9.11		Nov. 21	
	Nov. 21	Prata	HWK 08 starts			
Thanksgiving Break: Nov. 22 to Nov. 26						
15	Nov. 28, Nov.30	Prata	8.6-8.8		Nov. 30	
	Dec. 01	Prata	Laboratory kits return			Dec. 01 (Lab.07)
FINAL EXAM: Thursday, Dec. 07, 14:00-16:00 o'clock						

Class Schedule (31015D + 31012R, Lazzi)

Week	Lecture, Lab Dates	Instructor	Chapters, Section Covered, Lab Topics	Exam Dates	HW due	Previous Lab due
01	Aug. 21, Aug. 23	Lazzi	1, 2.1-2.2			
	Aug. 21	Lazzi	HWK 01 starts			
	Aug. 23	Lazzi	Laboratory 01 starts			
02	Aug. 28, Aug. 30	Lazzi	2.3-2.5		Aug. 30	

	Aug. 30	Lazzi	HWK 02 starts			
	Sep. 01	TBD	Laboratory 01 continuation			
	Sep. 04		Holiday, Labor Day			
03	Sep. 06	Lazzi	2.6-2.7			
	Sep. 08	Lazzi	Laboratory 02 starts			Sep. 08 (Lab.01)
04	Sep. 11, Sep. 13	Lazzi	2.8		Sep. 13	
	Sep. 13	Lazzi	HWK 03 starts			
	Sep. 15	TBD	Laboratory 02 continuation			
05	Sep. 18, Sep. 20	Lazzi	2.9			
	Sep. 22	Lazzi	Laboratory 03 starts			Sep. 22 (Lab. 02)
06	Sep. 25, Sep. 27	Lazzi	2.10	Sep. 27	Sep. 25	
	Sep. 25	Lazzi	HWK 04 starts			
MIDTERM I: Wednesday, Sep. 27, 14:00-15:20 o'clock						
	Sep. 29	TBD	Laboratory 03 continuation			
07	Oct. 02, Oct. 04	Lazzi	2.11-2.12			
	Oct. 06	TBD	Laboratory 04 starts			Oct. 06 (Lab 03)
08	Oct. 09, Oct. 11	Lazzi	3.1-3.4		Oct. 09	
	Oct. 09	Lazzi	HWK 05 starts			
FALL RECESS: Oct. 12 to Oct. 13						
09	Oct. 16, Oct. 18	Lazzi	3.5-3.7			
	Oct. 20	Lazzi	Laboratory 05 starts			Oct. 20 (Lab.04)
10	Oct. 23, Oct. 25	Lazzi	7.1-7.6		Oct. 25	
	Oct. 25	Lazzi	HWK 06 starts			
	Oct. 27	TBD	Laboratory 05 continuation			
11	Oct. 30, Nov.01	Lazzi	8.1-8.5			
	Nov. 03	Lazzi	Laboratory 06 starts			Nov. 03 (Lab.05)
12	Nov. 06, Nov.08	Lazzi	9.1-9.6	Nov. 08	Nov. 06	
	Nov. 06	Lazzi	HWK 07 starts			
MIDTERM II: Wednesday, Nov 08, 14:00-15:20 o'clock						
	Nov. 10		Holiday, Veterans Day			
13	Nov. 13, Nov.15	Lazzi	9.9			
	Nov. 17	Lazzi	Laboratory 07 starts			Nov. 17 (Lab.06)
14	Nov. 20	Lazzi	9.10-9.11		Nov. 20	
	Nov. 20	Lazzi	HWK 08 starts			
Thanksgiving Break: Nov. 22 to Nov. 26						
15	Nov. 27, Nov.29	Lazzi	8.6-8.8		Nov. 29	
	Dec. 01	Lazzi	Laboratory kits return			Dec. 01 (Lab.07)
FINAL EXAM: Friday, Dec. 08, 14:00-16:00 o'clock						

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Academic integrity:

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the [student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Student and Disability Accommodation:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-5086 or (213) 821-8298

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.