University of Texas at El Paso
College of Engineering
Department of Electrical and Computer Engineering

Course Syllabus for

EE-5337
Computational Electromagnetics

Fall 2019 CRN 18668

COURSE INFORMATION

Course Prefix and Number:	EE 5337 (was EE 5390 and EE 5320)
Course Title:	Computational Electromagnetics
Course Website:	https://empossible.net/academics/emp5337/
Meeting day and time:	T/R, 3:00pm – 4:20pm
Room:	UGLC 340
Final exam:	Thursday, December 12, 4:00pm – 6:45pm
CRN:	18668
Credit hours:	3
Lecture hours:	3

Catalog Description – A course covering many of the most popular methods used in modern computational electromagnetics. Methods include transfer matrix method, finite-difference frequency-domain, finite-difference time-domain, beam propagation method, plane wave expansion method, rigorous coupled-wave analysis, method of lines, slice absorption method, finite element method, method of moments, surface propagation methods and optimization.

Course Rationale – This course is intended for the student who is new to electromagnetic simulation methods, but has experience with computer programming, graphics, and computational methods. In addition to the methods, the course teaches best practices and the philosophy of computation. With this course, the student will be able to identify the best method given the device and will be well-equipped to understand and learn new methods on their own.

INSTRUCTOR INFORMATION

Dr. Raymond C. Rumpf
Office: ENGR A-337
Office Hours: W/R, 10:00am – 11:20am
Telephone: (915) 747-6958
E-Mail: rcrumpf@utep.edu

COURSE MATERIALS

The following items are required for this course

- Access to the internet.
- No textbook for this class.
- Access to MATLAB.
  A manual for this tool is available at:
  http://www.mathworks.com/help/techdoc/
- Binder/notebook with course notes, homework, exams, and other handouts.
- Course website: https://empossible.net/academics/emp5337/

Students are required to archive all of the course materials in a well-organized notebook to include syllabus, lecture notes, homework, etc.

PREREQUISITES

By Course:
- MATH 2313 – Calculus III
- MATH 2326 – Differential Equations
- CS 1320 – Computer Programming Sci/Engr
- EE 3321 – Electromagnetic Field Theory
- EE 5303 EM Analysis Using FDTD or EE 4386/5301 Computational Methods in EE

By Topic:
- Maxwell's equations and basic electromagnetic theory,
- Calculus, differential equations, and linear algebra,
- MATLAB and basic computer programming skills.
- Basics of numerical methods including graphics and linear algebra

COREQUISITES

None.

COURSE OUTLINE

Topics covered in this course include:

1. Preliminary concepts in computational electromagnetics
2. Transfer matrix method
3. Scattering matrices
4. Solid state electromagnetics
5. Perfectly matched layer
6. Finite-difference method
7. Finite-difference frequency-domain method
8. Maxwell's equations in Fourier space
9. Plane wave expansion method
10. Rigorous coupled-wave analysis
11. Other methods: beam propagation method, finite-difference analysis of waveguides, method of lines, slice absorption method, variational methods, optimization, surface propagation methods

LEARNING OUTCOMES

After this course, students will demonstrate a rich and deep understanding of computational electromagnetics, including formulation and implementation of several specific methods. The following items are the specific *student learning outcomes* for this course:

1. Student will be able to identify the best numerical method to simulate a given device.
2. The student will be able to formulate and implement the transfer matrix method.
3. The student will be able to formulate and implement the finite-difference frequency-domain method.
4. The student will be able to formulate and implement the plane wave expansion method.
5. The student will be able to formulate and implement rigorous coupled-wave analysis.

Contribution to Professional Component

This is a prerequisite for the "21st Century Electromagnetics" course that teaches the most advanced topics in electromagnetics with specific attention to 3D printed electromagnetics.

TEACHING METHODOLOGIES

Teaching will be primarily through lectures, but information will be supplemented with excerpts from textbooks and journal articles. The course is intended to have a close relationship between the student and professor, especially when getting computer codes to work. The notes are highly visual to better understand the underlying mathematics.

REMOTE STUDENTS

THIS IS NOT AN ONLINE CLASS *!!!!*

Some lectures and course materials may be made available through the internet to help remote students, but this not an online class. Provision of these materials is not guaranteed and quality may be insufficient for learning the course material. Remote students will be held to the same standards as non-remote students and should be prepared to learn the course material independently. All policies apply equally to remote and non-remote students including due dates for projects and assignments as well as dates and duration of exams. The recorded lectures are not a replacement of lectures in the classroom. Non-remote students are still expected to attend class.

RULES AND POLICIES

Attendance Policy

Attendance is required and is assumed and expected. Students missing more than two lectures should seriously reflect on their commitment to this course, as missing classes is highly correlated with poor performance. Students absent from lecture are still held responsible for all information discussed, homework assigned, and exams administered during that missed lecture. In some cases, absence can be forgiven if coordinated with the course instructor well before the lecture is missed.

Homework Policy

Homework will be assigned on a weekly basis and graded on a 100-point scale. **Show all work!** Homework is due by midnight on the assigned due date. In order to provide solutions in a timely manner, no homework assignments will be accepted after three days following the due date and 10 points will be deducted per 24 hours past the due date/time. Late penalties start immediately following the due date/time. Homework must be completed with a high level of professionalism and be formatted properly. Points will be deducted for sloppy work, incorrect formatting, or if not all of the work is shown. You must do your own work and not copy from other students.

Format – Unless otherwise indicated, all homework assignments will be submitted as a single paper document stapled in the upper left corner with no additional binding. Remote students shall submit their assignments via e-mail as a single PDF document. The first page must be a cover sheet with the student's name, student's 800 number, date of the assignment, course information, and assignment number. No problems or work should appear on the cover sheet. Homework shall be neat, well organized, and the writing clear. Answers to the homework questions must be provided in the order they were asked. Final answer(s) must be clearly boxed and given proper units. All graphics should be properly formatting and labeled. Finish all calculations. For example, answer with '±4' instead of $\pm\sqrt{5^2-9}$. Students may include computer codes if they wish, but the codes must be placed at the end of the assignment in an appendix.

Exam Policy

Exams during the semester will be given in class or given as take home assignments. Remote students may have their exams administered by a proctor that is approved by the course instructor prior to the exam. No exam will be given earlier than

scheduled. Duration of the in-class exams will be strictly limited to the duration of the class. For in-class exams students are permitted to have a calculator and a standard 8.5×11" sheet of paper with whatever they wish to have on it. Information tested on the midterm exams will be mostly focused on the material covered since the last exam. The final exam will be comprehensive.

A missed exam can be made-up ONLY IF: (1) the reason for missing the exam is beyond the student's control, e.g. such as a medical excuse, jury duty, death in the family or automobile accident, or (2) prior consent must be obtained from the instructor for missing the exam based on a non-frivolous excuse, e.g. such as a job interview or out-of-town job related travel. In either case, the student must submit a written and signed statement describing the reasons for missing the exam, with appropriate documentation, and petition for a makeup exam. **A missed exam will carry zero grade if these conditions are not met**.

Project Policy

The purpose of the project for this class is to learn something outside of what is taught in the class or apply what is taught in class to something not discussed in class, and to share this experience with the class. Project topics and the submission materials must be approved by the instructor by the middle of the semester (see schedule of topics for specific date). It is highly recommended to begin working on your project early. The instructor's availability will be limited in the few days prior to the due date. All materials for the project must be submitted to the course instructor or a score of zero will be given. The project must be presented during the final exam session and the student must be present for the entire final exam session or until the students are released by the instructor.

Participation Policy

The following items are expected from students as part of their participation grade:

- Ask questions*!* Despite how "silly" or "dumb" you may think your question is, it is very likely that other students have the same question. Confusion on even small details in course material can cause bigger problems and hold you back. If you are truly embarrassed by your question, send an anonymous e-mail to the course instruction. I promise I will respond*!*
- Respond honestly to poles and provide real-time feedback to instructor about the course. This will contribute greatly to the quality of the course and your success in it.
- Visit the course instructor during office hours, or by appointment, if needed.
- Treat e-mail correspondence as a professional exchange of information.
- Turn off cell phones, pagers, or anything else that may distract the class.
- Complete any reading assignments or activities before class.
- Bring all of your course materials (textbook, course notes, pens/pencils, paper, etc.) to every class.
- Show proper etiquette during class. Do not talk, make excessive noise, or otherwise distract the class. You will be asked to leave and it will affect your grade.
- Maintain your notebook. Keep everything well organized. This may be inspected periodically during the semester and will count toward your participation grade.

Grading Policy

Student achievement in the course objectives will be assessed using a combination of homework, a final project, and participation. Student grades are protected by the Privacy Act of 1974. Your course grade will be determined by your weighted performance in the following categories:

Homework/Projects 50%	90% – 100%→ **A**
Final Project 30%	80% – 89% → **B**
Participation 20%	70% – 79% → **C**
.....	60% – 69% → **D**
.....	0% – 59% → **F**

Homework/Projects – Each assignment/project will be graded out of 100 points. The assignments are due at the start of lecture on the due date. Late assignments will be deducted 10 points per 24 hours late and will be given zero points after 72 hours. Penalties begin immediately after the due date/time.

Final Project – The final projects will be presented to the class during the final exam session. A grade of zero will be given if all of the electronic files associated with the project are not submitted, even if the student presented. Attendance at all students' presentations is mandatory.

Participation – The participation grade includes attendance, responsiveness to class polls, and contributions the students makes to the class.

EXPECTATIONS

What should you expect from the course instructor?

- Instructor will do all that they can to ensure your learning and success in this class.
- Instructor will provide students with clear instructions and expectations.
- Homework will be graded and feedback on your performance will be provided with seven days after the due date.
- Solutions to the homework will be provided within three days of the due date.
- Respond to student e-mails within 24 hours.
- The course calendar is a living document and may be adjusted due to events occurring curing the semester. Instructor shall notify students of any such changes or deviations.

What should the instructor expect from students?

- At the start of the course, students shall review the syllabus, calendar, and course material.
- Students should plan to study/work for a minimum of six hours per credit hour each week of the course. This includes reviewing the notes, reading supplemental material, completing the homework, and other assignments.
- Students will be active participants in the class and provide the instructor feedback of their understanding of course material and progress on course assignments.
- Students shall not be a negative distraction during the course lectures.

- Students are expected to behave professionally at all times. Bullying, verbal abuse, insubordination, or personal attacks will not be tolerated in any form. Inappropriate behaviors may result in an administrative withdrawal from the course and/or dismissal from the course and from the program.
- Students shall treat all e-mails and conversations as professional correspondence.

ACADEMIC DISHONESTY

Students are expected to be above reproach in all scholastic activities. As an entity of The University of Texas at El Paso, the Department of Electrical and Computer Engineering is committed to the development of its students and to the promotion of personal integrity and self responsibility. The assumption that a student's work is a fair representation of the student's ability to perform forms the basis for departmental and institutional quality. All students within the Department are expected to observe appropriate standards of conduct. Acts of scholastic dishonesty such as cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in the whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student, or the attempt to commit such acts will not be tolerated. Any case involving academic dishonesty will be referred to the Office of the Dean of Students. The Dean will assign a Student Judicial Affairs Coordinator who will investigate the charge and alert the student as to its disposition. Consequences of academic dishonesty may be as severe as dismissal from the University.

See the Regents' Rules and Regulations, Part One, Chapter VI, Section 3, Student Conduct and Discipline for more information.https://www.utsystem.edu/sites/default/files/offices/board-of-regents/files/historical-regents-rules-regulations/MasterRRR120904.PDF

See the Office of the Dean of Students' homepage (Office of Student Life) at http://studentaffairs.utep.edu/dos for more information.

You can also refer to the IEEE website for information on our code of ethics: http://www.ieee.org/about/corporate/governance/p7-8.html

POLICY RELATING TO DISABILITY/PREGNANCY/CASS

It is the responsibility of the student to inform the Center for Accommodations and Support Services (CASS) so that written guidelines from CASS for accommodations are submitted to the course instructor PRIOR to the start of the course. CASS' staff are the only individuals who can validate and authorize accommodations for students.

The UTEP Disabled Student Services Office was established for the purpose of providing appropriate and reasonable accommodations as mandated in Section 504 of the Rehabilitation Act of 1973 (http://www.dol.gov/oasam/regs/statutes/sec504.htm) and the Americans with Disabilities Act (http://www.ada.gov/).

For addition help, contact the Center for Accommodations and Support Services (CASS):

(915) 747-5148
cass@utep.edu
http://sa.utep.edu/cass/

DISCRIMINATION

I do not discriminate, nor will I allow discrimination, on the basis of age, gender, color, ethnicity, national origin, religion, disability, sexual orientation, or favorite sports team. Members of the UTEP community are protected from discrimination and harassment by the State and Federal Laws.

COURSE SCHEDULE AND OUTLINE

Important Dates

Aug 27	First day of CEM!!! ☺
Sep 2	Labor Day – University closed
Nov 1	Course drop deadline
Nov 28-29	Thanksgiving Holiday – University closed
Dec 6	Dead Day
Dec 12	Final Exam, 4:00pm – 6:45pm

Schedule of Topics

Topic 0 – Course Introduction
Topic 1 – Preliminary Topics
Topic 2 – Transfer Matrix Method
Topic 3 – Concepts for 2D and 3D Simulations
Topic 4 – Finite-Difference Frequency-Domain
Topic 5 – Other Methods Based on Finite Differences
Topic 6 – Plane Wave Expansion Method
Topic 7 – Rigorous Coupled-Wave Analysis
Topic 8 – Other Slicing & Semi-Analytical Methods
Topic 9 – Variational Methods
Topic 10 – Other Numerical Methods