

COLORADO STATE UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
ECE 540 – *Computational Electromagnetics*, Fall 2021
COURSE SYLLABUS

(1) Course Details:

Instructor: BRANISLAV M. NOTAROS, Professor, Eng C101C, Phone: (970) 491-3537

E-mail: notaros@colostate.edu, Web: www.engr.colostate.edu/~notaros

Class Meetings: Tuesday, Thursday 12:30pm–1:45pm, Engineering B2

Office Hours: Tuesday 2:00-3:00pm and Thursday 2:00-3:00pm, or by appointment

Textbook: - No required textbook
- Lecture notes provided by the instructor.

Reference Texts:

- Jianming Jin, Theory and Computation of Electromagnetic Fields, Wiley, Dec. 2010
- Karl F. Warnick: “Numerical Methods for Engineering: An Introduction Using MATLAB and Computational Electromagnetics Examples,” SciTech Publishing, 2010
- Matthew N.O. Sadiku: “Numerical Techniques in Electromagnetics with MATLAB,” Third Edition, CRC Press
- A. F. Peterson, S. L. Ray, and R. Mittra, “Computational Methods for Electromagnetics” (IEEE Press, New York, 1998).
- R. F. Harrington, “Field Computation by Moment Methods”, IEEE PRESS Series on Electromagnetic Waves, Piscataway, 1993.
- J. M. Jin, “The Finite Element Method in Electromagnetics”, 2nd ed., John Wiley & Sons, New York, 2002.
- A. Taflove and S. C. Hagness, “Computational Electrodynamics: The Finite-Difference Time-Domain Method”, 3rd ed., Norwood, MA: Artech House, 2005.
- Warren L. Stutzman and Gary A. Thiele, “Antenna Theory and Design,” Second Edition, John Wiley & Sons, 1998.
- Branislav M. Notaros, “Electromagnetics,” PEARSON Prentice Hall

Class Web Page: Canvas

(2) Course Description:

Computational techniques for practical applications in electromagnetic fields, devices, scattering, propagation, and radiation. Most popular classes of computational EM methods for analysis and design based on differential and integral equations are studied. Solution techniques include the method of moments, finite difference method, finite element method, and hybrid methods, as well as CAD approaches. Applications cover static and quasi-static problems, transmission lines, wireless propagation, scattering, radiation problems, EM compatibility, and signal integrity. The course includes about 10 computational EM projects in different techniques and different applications, using MATLAB (or another programming language).

(3) Evaluation of Students and Grading Policy:

- Homework and Weekly Projects (~60%)
- Midterm Project (~20%)
- Final Project (~20%)

Grades will be assigned from A+ through F, including plus and minus categories (no C-, D+, and D-), according to the following grading rubric:

$97 \leq x \leq 100$ A+; $93 \leq x < 97$ A; $90 \leq x < 93$ A-; $87 \leq x < 90$ B+; $83 \leq x < 87$ B; $80 \leq x < 83$ B-; $77 \leq x < 80$ C+; $70 \leq x < 77$ C; $60 \leq x < 70$ D; $x < 60$ F;

(4) Course Topics:

*No. of Weeks (tentative,
not necessarily in this order)*

1. Review of Electromagnetic Theory	1
2. Analytical Techniques	1
3. Surface Integral-Equation Techniques and Method of Moments	1
4. Computational Analysis and Design of Transmission Lines in PCB Designs	2
5. Volume Integral-Equation Techniques, Induction Furnace Computation	1
6. Computational Analysis and Design of Wire Antennas and Scatterers	1
7. Finite-Difference Techniques	2
8. Finite-Element Techniques	2
9. Computational Analysis and Design of Wave Propagation and Wireless Transfer	1
10. Computational Analysis and Design of Waveguides and Cavity Resonators	1
11. Computation of Multi-Conductor Transmission Lines and Signal Integrity	2

(5) Course Objectives/Outcomes:

This course will be suitable for graduate students in Electrical and Computer Engineering as an introductory level course for the technical areas of applied electromagnetics, radar, remote sensing, electronic devices, and lasers and optics, as well as for undergraduate seniors in ECE as a Technical Elective. The learning objectives of the course can be summarized as follows:

- The course will provide students with an overview of the state-of-the-art in applied computational electromagnetics, covering basic classes of computational techniques and CAD approaches for solving complex electromagnetic problems, in computational electromagnetics analysis and design.
- Students will develop computational skills in applied electromagnetics and related disciplines and ability not only to effectively use electromagnetic software, but also to understand the foundations of various commercial and research codes, including industry standards in the discipline.
- The course will expose students to examples of real-world applications of modern computational tools in electromagnetic scattering, propagation, and radiation.
- The course will enable students to identify interesting and important research topics in the discipline.