

**COLORADO STATE UNIVERSITY**  
**DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING**

**ECE 342 – *Electromagnetic Fields & Devices II*, Spring 2020**

**COURSE SYLLABUS**

**(1) Course Details:**

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

E-mail: [notaros@colostate.edu](mailto:notaros@colostate.edu), Web: [www.engr.colostate.edu/~notaros](http://www.engr.colostate.edu/~notaros)

**Class Meetings:** Monday/Wednesday 4 PM – 5:15 PM, Stadium 1204

**Office Hours:** Monday 3:15–3:45 pm and 5:30–6:00 pm, Wednesday 3:15–3:45 pm and 5:30–6:00 pm,  
or by appointment

**Textbook:** - *Electromagnetics*, Branislav M. Notaros, PEARSON Prentice Hall, 2010

Companion Website for the book: [www.pearsonhighered.com/notaros](http://www.pearsonhighered.com/notaros)  
Conceptual Questions  
MATLAB Exercises

**Additional References:**

- *MATLAB-Based Electromagnetics*, Branislav M. Notaros, PEARSON Prentice Hall, 2013
- *Conceptual Electromagnetics*, Branislav M. Notaros, CRC Press, Taylor and Francis, LLC, 2017

**Class Web page:** Canvas

**Teaching Assistant:** Pranav Athalye, Electromagnetics Lab (Engr B110), [athalye@rams.colostate.edu](mailto:athalye@rams.colostate.edu)

**TA's Office Hours:** Tuesdays 12:30–1:30 pm and Thursdays 12:30–1:30 pm, in Electromagnetics Lab

**(2) Course Description:**

*Fundamentals of electromagnetic waves, propagation, and radiation.* A continuation of ECE 341. The course reviews general Maxwell's equations in integral and differential form, and electromagnetic boundary conditions. Lorenz potentials and Poynting's theorem are studied. Topics include propagation of uniform plane electromagnetic waves in free space and in various media, wave reflection, transmission, and refraction, skin effect, transmission-line theory using frequency- and time-domain analysis, analysis of waveguides and electromagnetic resonators, and fundamentals of radiation, antennas, and wireless communication systems.

**(3) Course Topics:**

	<i>No. of Weeks (tentative), order tentative</i>
1. Rapidly Time-Varying Electromagnetic Field (Chapter 8)	2
2. Uniform Plane Electromagnetic Waves (Chapter 9)	2

3. Reflection and Transmission of Plane Waves (Chapter 10)	2
4. Field Analysis of Transmission Lines (Chapter 11)	1
5. Circuit Analysis of Transmission Lines (Chapter 12)	3
6. Waveguides and Cavity Resonators (Chapter 13)	1
7. Antennas and Wireless Communication Systems (Chapter 14)	1

#### (4) **Homework:**

- Homework will be assigned weekly. Homework assignments will be posted on Canvas.
- Homework will be due at the specified time (typically the following week) in the ECE342 drop box, in BC Infill.
- Late homework is not allowed and will not be collected.
- The solutions to homework problems will be posted on Canvas.
- Graded homework can be seen and picked up from the TA during TA's office hours.

#### (5) **Evaluation of Students and Grading Policy:**

- Homework (20%)
- Pre-Class Quizzes (5%) (Extra Credit)
- KI Activities (10%)
- Exam 1 (22.5%)
- Exam 2 (22.5%)
- Final Exam (25%)
- Math Foundation (2%) (Extra Credit)

The final exam is cumulative (covers all topics of the course), but will have an appropriate weight on the topics covered after Exam 2.

The KI activities will be worth 10% of the grade for each course. Students will get the same KI grade for each course they are enrolled in. KI grades are made up of Video review: 3%; Pre-work: 4%; Video submission: 3%.

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;

#### (6) **Exams:**

- Exam 1 – Monday March 9, 2020, in class
- Exam 2 – Monday April 27, 2020, in class
- Final Exam – see the Spring 2020 Final Exam Schedule on the CSU web

All exams are closed book, closed notes. One sheet with **hand-written formulas** prepared by the student is allowed per each partial exam, and two sheets for the final exam.

## **(7) Additional Requirements:**

Note 1: Regular attendance in class is required.

Note 2: Preclass work is required.

Note 3: Demonstrating competency in each learning studio module (LSM) of the course is required. Competency is assessed through Assessment 1 (Exam 1), 2 (Exam 2), and 3 (Final Exam), for LSMs covered in individual assessments. Students who do not demonstrate competency in an LSM will be notified after the corresponding assessment and will be given the opportunity to gain competency by completing remedial course-related work, assigned by the instructor. Completing the remedial work in a satisfactory fashion establishes the student's competency in the corresponding LSM, but does not affect the student's grade.

Note 4: Math foundation extra credit consists of two components: attending lectures and solving problems sets. (1% extra credit for any student who attends at least seven math foundation lectures; 1% extra credit for any student who receives an average grade of 85% or more on math foundation problem sets)

Note 5: Please see the LSM/KI Schedule for Spring 2020.

## **(8) Academic Integrity Policy:**

- This course will adhere to the CSU Academic Integrity Policy as found in the General Catalog (<http://www.catalog.colostate.edu/FrontPDF/1.6POLICIES1112f.pdf>) and the Student Conduct Code (<http://www.conflictresolution.colostate.edu/conduct-code>). At a minimum, violations will result in a grading penalty in this course and a report to the Office of Conflict Resolution and Student Conduct Services.

## **(9) Course Objectives/Outcomes:**

**Please also see the ECE342 IO Diagram,**

[https://www.engr.colostate.edu/ece/pdfs/i\\_o\\_diagrams/ece342\\_i\\_o\\_diagram.pdf](https://www.engr.colostate.edu/ece/pdfs/i_o_diagrams/ece342_i_o_diagram.pdf)

The objectives of the course are for the students to develop an understanding of electromagnetic-wave fundamentals by emphasizing both mathematical rigor and physical conceptual reasoning, as applied toward practical engineering problems. Students should learn to analyze engineering systems based on high-frequency time-varying electromagnetic fields. Students should gradually develop a solid grasp of fundamental electromagnetic mechanisms that govern signal and energy transmission in wireline and wireless systems, based on Maxwell's equations. By the end of this course, students should be able to:

1. Appreciate waves.
2. Relate electric and magnetic properties of material media to electromagnetic wave propagation through individual media.
3. Solve realistic electromagnetic-wave problems utilizing physical conceptual reasoning and mathematical synthesis of solutions, and not pure formulaic solving.
4. Visualize electromagnetic waves and understand associated abstract wave phenomena.
5. Mathematically model real-life electromagnetic-wave structures.
6. Analyze time-harmonic electromagnetic fields using complex variables.
7. Understand physical sources of signal distortion and degradation as major problems in modern circuit design.
8. Perform transient analysis of transmission lines with arbitrary terminations.
9. Perform propagation analysis of plane electromagnetic waves in the presence of arbitrary boundaries as a basis for indoor and outdoor wireless propagation evaluation.
10. Understand and use the concept of circuits with distributed parameters.
11. Understand radiation and energy transfer in guided and free-space systems.
12. Analyze basic types of antennas and wireless communication systems.

**(10) Detailed Course Topics (tentative):**

**1. High-Frequency Electromagnetic Field**

- Maxwell's Equations for High-Frequency EM Field (Sections 8.1, 8.2, 8.4)
- Field Analysis in Frequency (Complex) Domain (Sections 8.6, 8.7, 8.8)
- Poynting's Theorem, power conservation (Sections 8.11, 8.12)
- Lorenz (High-Frequency) Potentials (Sections 8.9, 8.10)
- Antennas and Radiation (Sections 14.1, 14.2)

**2. Plane Electromagnetic Waves**

- Wave Equations, Uniform-Plane-Wave Solutions (Sections 9.1, 9.2, 9.3)
- Time-Harmonic Uniform Plane Waves and Complex-Domain Analysis (Section 9.4)
- Theory of Time-Harmonic Waves in Lossy Media (Sections 9.7, 9.8)
- Wave Propagation in Good Conductors, Skin Effect (Sections 9.10, 9.11)
- Polarization of Electromagnetic Waves (Section 9.14)

**3. Wave Reflection and Transmission**

- Normal Incidence on a Perfectly Conducting Plane (Section 10.1)
- Normal Incidence on a Penetrable Planar Interface (Sections 10.2, 10.3, 10.4)
- Oblique Incidence on a Perfect Conductor (Section 10.5)
- Oblique Incidence on a Dielectric Boundary (Sections 10.7, 10.8)
- Wave Propagation in Multilayer Media (Section 10.9)

**4. Transmission Lines and Waveguides**

- Field Analysis of Lossless Two-Conductor Transmission Lines (Sections 11.4)
- Attenuation Coefficients for Line Conductors and Dielectric (Sections 11.5, 11.6)
- Evaluation of Circuit Parameters of Transmission Lines (Sections 11.8, 11.9)
- TE and TM Modes in Rectangular Waveguides (Sections 13.4, 13.5, 13.6)
- Power Flow along a Waveguide and Computation of Losses (Sections 13.8, 13.9)

**5. Circuit Analysis of Transmission Lines**

- Telegrapher's Equations and Their Solution in Complex Domain (Section 12.1)
- Complex-Domain Circuit Analysis of Transmission Lines (Sections 12.2, 12.3, 12.4, 12.5, 12.6)
- Short-Circuited, Open-Circuited, and Matched Transmission Lines (Sections 12.8)
- Circuit Analysis of Transmission Lines Using the Smith Chart (Sections 12.11, 12.12)
- Transient Analysis of Transmission Lines, Step & Pulse Responses (Sections 12.15, 12.16, 12.18)