

**ECE 561: Engineering Electromagnetics (Secs. 001 and 002)**  
**Spring 2025**  
**MW 9:30-10:45 DSH 318**  
*(Updated 01/18/2025)*

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Office Hours: TuTh 9:30-10:30

**Catalog Description:** “Maxwell’s equations, electromagnetic interaction with materials, the wave equation, plane wave propagation, wave reflection and transmission, vector potentials and radiation equations, electromagnetic field theorems, wave propagation in anisotropic media and metamaterials, periodic structures, dielectric slab waveguides.”

Canvas Course Supplement: <http://canvas.unm.edu> (you need to be registered for the course; use your UNM NetID and password to access).

NOTE: Advanced topics in Electromagnetics will be taught every two years as ECE 661.

Prerequisites: ECE 360 and ECE 555. Note: ECE 555 is *Foundations of Engineering Electromagnetics* and is taught each Fall Semester. If you have not taken ECE 555 please take it Fall 2024.

Text: C.A. Balanis, *Balanis’s Advanced Engineering Electromagnetics, 3<sup>rd</sup> Ed.* (John Wiley & Sons, New York, NY, 2024),

There will be a problem set each week (on average). There will be three exams and a final (exams will be closed book, except for the final, which will be open book). You will be allowed to bring a sheet of paper with notes to each in-class exam. Your final grade will be based on:

Exam 1 (Chaps. 1-3) 20%  
Exam 2 (Chaps. 4/5) 20%  
Exam 3 (Chap. 6/periodic structures) 20%  
Final (Cumulative, emphasize Chap. 8.7) 30%  
Problem Sets 10%  
**Grade 100%**

Roughly, we will cover Chapters 1-7, 8.7, in Balanis’s book. References will be provided for topics not covered in Balanis. Emphasized topics are:

- Review of Maxwell’s equations and EM fundamentals
- Electrical properties of materials, now including metamaterials
- The wave equation and its solutions
- Wave propagation in isotropic media
- Polarization
- Reflection and transmission, including metamaterials
- Electromagnetic vector potentials and radiation integrals



## ENGINEERING

- Periodic structures
- Dielectric slab waveguides

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### Syllabus - Lecture No. and Topics<sup>†</sup>

1. 1/20 Dr. Martin Luther King Jr. Day – No Classes **Week 1**
2. 1/22 **Introduction to the course**
3. 1/27 **Time-varying/time-harmonic electromagnetic fields - Intro (Chap. 1)** **Week 2**
4. 1/29 Chap. 1 (cont'd)
5. 2/03 **Electrical properties of matter (Chap. 2)** **Week 3**
6. 2/05 Chap. 2 (cont'd)
7. 2/10 Chap. 2 (cont'd) **Week 4**
8. 2/12 Chap. 2 (cont'd)
9. 2/17 **Wave equation (Chap. 3)** **Week 5**
10. 2/19 Chap. 3 (cont'd)/what to expect on Exam 1
11. 2/24 **Exam 1 [Chaps. 1-3]** **Week 6**
12. 2/26 **Wave propagation and polarization (Chap. 4)**
13. 3/03 Chap. 4 (cont'd) **Week 7**
14. 3/05 Chap. 4 (cont'd)
15. 3/10 **Introduction to Metamaterials** **Week 8**
16. 3/12 **Reflection and transmission (Chap. 5)**

*Spring Break Week 3/16-23*

17. 3/24 Chap. 5 (cont'd) **Week 9**
18. 3/26 Chap. 5 (cont'd) – What to expect on Exam 2
19. 3/31 **Exam 2 [Chaps. 4/5]** **Week 10**
20. 4/02 **Auxiliary vector potentials and scattering equations (Chap. 6)**
21. 4/07 Chap. 6 (cont'd) **Week 11**
22. 4/09 Chap. 6 (cont'd)
23. 4/14 Chap. 6 (cont'd) **Week 12**
24. 4/16 **Periodic structures**
25. 4/21 Periodic structures (cont'd) – What to expect on Exam 3 **Week 13**
26. 4/23 **No Class – Study Period for Exam 3**
27. 4/28 **Exam 3 [Chap. 6/periodic structures]** **Week 14**
28. 4/30 **Dielectric slab waveguides (Chap. 8.7)**
29. 5/05 Chap. 8.7 (cont'd) **Week 15**
30. 5/07 Final Prep - Recap

**Final Exam: TBD**

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<sup>†</sup> subject to minor changes. Additional topics will probably be included. Use this syllabus as a guide to read the textbook in advance of the lectures.



## ENGINEERING

Required Syllabus Language: UAP 2720 and 2740. Our classroom and university should always be spaces of mutual respect, kindness, and support, without fear of discrimination, harassment, or violence. If you ever need assistance or have concerns about incidents that violate this principle, please access campus support resources. These include confidential services at LoboRESPECT Advocacy Center, the Women’s Resource Center, and the LGBTQ Resource Center. The University of New Mexico prohibits discrimination on the basis of sex (including gender, sex stereotyping, gender expression, and gender identity). UNM faculty and graduate teaching assistants are considered “responsible employees.” “Responsible employees” must communicate reports of sexual harassment, sexual misconduct and sexual violence to Compliance, Ethics and Equal Opportunity. For more information on the campus policy regarding sexual misconduct, reporting, and reporting for “responsible employees,” please see [UAP 2720](#) and [UAP 2740](#).

Support Language: “Student Support” in green introduces information that you may want to include for students. “Instructor Support” in purple offers context and resources of use to instructors. Branch campus instructors will want to substitute branch-specific references in green “student support” text areas.

Artificial Intelligence and Academic Integrity: An [AI Resource](#) to support faculty in addressing student and classroom use of AI has been developed by the Center for Teaching and Learning and significantly enhanced with support from a College of Arts & Sciences faculty task force led by Heather Sweetser and Kirsten Thomson. We owe them all a big thank you! It includes approaches to syllabus language callibrated to the different degrees of student AI use that may be optimal for different courses.

Classroom Community: At the end of this document, you will find information about how to anticipate and address classroom and campus climate issues by developing community in your academic setting, as well as handling concerning behavior directly. Building a well-connected community in your class can alleviate stress and ensure respect and kindness. Normalizing the use of support resources can enable all of us to take advantage of UNM care options (for students: [Student Health and Counseling](#) (SHAC) and [Timely Care](#); for faculty and staff: [Counseling, Assistance, and Referral Services](#)).

Credit-Hour Statement: This is a three credit-hour course. Class meets for two 75-minute sessions of direct instruction for fifteen weeks during the Spring 2025 semester. Please plan for a *minimum* of six hours of out-of-class work (or homework, study, assignment completion, and class preparation) each week.