

ECE 561: Engineering Electromagnetics (Secs. 001 and 002)
Spring 2024
M W 9:30-10:45, MITCH-108
(Updated 11/06/2023)

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Office Hours: TBD

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, *Advanced Engineering Electromagnetics*, 2nd Ed. (John Wiley & Sons, New York, NY, 2012). [Note: *Balanis’s Advanced Engineering Electromagnetics*, 3rd Ed. (John Wiley & Sons, New York, NY, 2024) is supposed to come out in January but these release dates tend to slip so we will use the 2nd Ed. in 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



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- ☐ Wave propagation in isotropic media
- ☐ Polarization
- ☐ Reflection and transmission, including metamaterials
- ☐ Electromagnetic vector potentials and radiation integrals
- ☐ Periodic structures
- ☐ Dielectric slab waveguides

Syllabus - Lecture No. and Topics[†]

1. 1/15 Dr. Martin Luther King Jr. Day – No Classes
2. 1/17 **Introduction to the course**
3. 1/22 **Time-varying/time-harmonic electromagnetic fields - Intro (Chap. 1)**
4. 1/24 Chap. 1 (cont'd)
5. 1/29 **Electrical properties of matter (Chap. 2)**
6. 1/31 Chap. 2 (cont'd)
7. 2/05 Chap. 2 (cont'd)
8. 2/07 Chap. 2 (cont'd)
9. 2/12 **Wave equation (Chap. 3)**
10. 2/14 Chap. 3 (cont'd)/what to expect on Exam 1
11. 2/19 **Exam 1 [Chaps. 1-3]**
12. 2/21 **Wave propagation and polarization (Chap. 4)**
13. 2/26 Chap. 4 (cont'd)
14. 2/28 Chap. 4 (cont'd)
15. 3/04 **Introduction to Metamaterials**
16. 3/06 **Reflection and transmission (Chap. 5)**

Spring Break Week 3/11-17

17. 3/18 Chap. 5 (cont'd)
18. 3/20 Chap. 5 (cont'd)
19. 3/25 Chap. 5 (cont'd) – What to expect on Exam 2
20. 3/27 **Exam 2 [Chaps. 4/5]**
21. 4/01 **Auxiliary vector potentials and scattering equations (Chap. 6)**
22. 4/03 Chap. 6 (cont'd)
23. 4/08 Chap. 6 (cont'd)
24. 4/10 Chap. 6 (cont'd)
25. 4/15 **Periodic structures**
26. 4/17 Periodic structures (cont'd) – What to expect on Exam 3
27. 4/22 **No Class – Study Period for Exam 3**
28. 4/24 **Exam 3 [Chap. 6/periodic structures]**
29. 4/29 **Dielectric slab waveguides (Chap. 8.7)**
30. 5/01 Chap. 8.7 (cont'd)/Final Prep

Final Exam: TBD

[†] 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.