COURSE INFORMATION

PHYS 670: *Electromagnetic Theory I*

Course **Blackboard Learn** *website available @* webcourses.niu.edu!

General Information

Location: FR 205
Time: Spring Semester of 2016, Mondays and Wednesdays, 2:00 – 3:15 pm
Instructor: Dr. Bela Erdelyi
E-mail: berdelyi@niu.edu
Phone: (815) 753-6484
Office hours: after Monday class, 3:15 – 5:00pm in LT 225; or
contact me by email; or
set up an appointment
Duration: 15 weeks, i.e. 27 lectures + Midterm + Final
Credits: 3
Contact hours: 2.5
Laboratory: n/a;
Exams:
- *1 midterm*, during regular class – March 21, 2016
- *1 final*: comprehensive, emphasizing 2nd part – May 09, 2016 @ 2:00 – 3:50 pm in FR 205

Sources for Exams: the exams will be closed book/electronics. You may bring up to 4 pages (2 sheets, 4 sides) of helping material with you to the exams.
Grading: 40% homework + 25% midterm + 35% final
Letter Grades: an aggregate numerical value of at least 50% of the total points is required to pass the course with a C, with no component (homework, midterm, final) worse than 25%. The cutoff for an A grade will be approximately 85%, and lower grade level cutoffs every 5-10% (A-: 80%, B+: 75%, B: 70%, B-: 65%, C+: 60%, C: 50%, C-: 40%, D: 25%)
Homework Assignments: 6 sets (one set after each chapter), with clearly defined due dates/times. Late turn in of homework permissible only under unusual circumstances.
Course Expectations: read assigned material before lectures, attend the lectures, participate in discussions, read the appropriate sections of the textbook again after lectures, complete and turn in homework in a timely manner, solve as many problems as you can, take the exams. Expect to spend 6-9 hours per week outside classes on this course. You are encouraged to set up study groups, work together on problems, but the solutions turned in must be your own. Cite any material you used from publications, the web, etc. Homework turned in should be professional, clearly legible, showing all work, steps involved, derivations, etc. It is recommended to type up all homework solutions in Latex, Word, or Mathematica, etc.

Course Description

This course aims at providing a rigorous foundation for advanced classical electrodynamics and some of its applications. Particular focus is given to time-dependent phenomena stemming from the axiomatic definition of electrodynamics based on the microscopic Maxwell equations, and their consequences in vacuum and matter; and for source distributions and their associated fields and waves.
At the end of the course, students will understand charged particle and electromagnetic fields dynamics, interactions, physical phenomena arising in applications, and their mathematical treatment; and will have developed skills in problem solving utilizing, analyzing, and synthetizing these concepts.

Catalog description: Maxwell's equation, plane waves in isotropic and anisotropic dielectrics, conducting media, wave guides and plasmas, dipole radiation and diffraction.
Prerequisites: PHYS 570
Required textbook: J.D. Jackson, Classical Electrodynamics, 3rd edition, Wiley, 1999, ISBN 0-471-30932-X. We will develop selected topics from Chapters 6-10, with a, hopefully, slightly more modern perspective.
Optional Readings. For a deeper understanding, you may also want to consult these:

J. Franklin, Classical Electromagnetism
L.D. Landau and E.M. Lifshitz, The Classical Theory of Fields
W. Panofsky and M. Philips, Classical Electricity and Magnetism

Syllabus

Chapter 1. Mathematics of Electrodynamics

Lecture 1. Scalar, Vector and Tensor Fields, Vector Analysis, and Integral Identities
Lecture 2. Special Functions, Complex Notation, and Fourier Transforms

Chapter 2. (Jackson Chapter 6)

Lecture 3. Introduction to the course and a brief review of electricity and magnetism.
Lecture 4. Microscopic Maxwell equations, associated potentials and various gauges.
Lecture 5. Green functions and retarded solutions for the fields.
Lecture 6. Macroscopic Maxwell equations.
Lecture 7. Conservation theorems in electrodynamics.
Lecture 8. Transformation properties of electromagnetic fields and sources.

Chapter 3. (Jackson Chapter 7)

Lecture 9. Plane waves.
Lecture 10. Polarization.
Lecture 11. Reflection and refraction.
Lecture 12. Frequency dispersion.

Lecture 13. Superposition of waves, group velocity, and pulse spreading.
Lecture 14. Causality in electrodynamics.

Midterm.

Lecture 15. Problem solving session
Lecture 16. Exam
Lecture 17. In-class exam solutions

Chapter 4. (Jackson Chapter 8)

Lecture 18. Introduction to waveguides and cavities, fields on/in conductors.
Lecture 19. Waveguides and their modes; energy flow and attenuation.
Lecture 20. Resonant cavities.
Lecture 21. Normal mode expansions.

Chapter 5. (Jackson Chapter 9)

Lecture 22. Fields and radiation of localized sources, dipole radiation.
Lecture 23. Multipole expansions for localized sources.
Lecture 24. Multipole expansions for electromagnetic fields and their properties.
Lecture 25. Sources of multipole radiation; multipole moments.

Chapter 6. (Jackson Chapter 10)

Lecture 26. Scattering at long wavelengths.
Lecture 27. Scattering at medium and short wavelengths.

Course Review

Lecture 28. Fun with E&M.
Lecture 29. Review for Final; Q&A.

Accessibility Statement

Northern Illinois University is committed to providing an accessible educational environment in collaboration with the Disability Resource Center (DRC). Any student requiring an academic accommodation due to a disability should let his or her faculty member know as soon as possible. Students who need academic accommodations based on the impact of a disability will be encouraged to contact the DRC if they have not done so already. The DRC is located on the 4th floor of the Health Services Building, and can be reached at 815-753-1303 (V) or drc@niu.edu.

Dated: January 4, 2016