Electrodynamics II

Physics 931 **KSU**
TU 9:30 - 10:45 Spring 2016
3 credit hours Cardwell 130

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Goals of Course

1. Analyze and apply electric and magnetic field concepts.
2. Learn and use advanced mathematical physics techniques.

Concepts

1. Radiation from oscillating sources.
2. Scattering and multipole radiation fields.
3. Special Relativity and Maxwell's equations.
4. Radiation from accelerated charges.
5. Interaction of charges with radiation.

Techniques

1. Green function for wave equation.
2. Lagrangian formalism for charge in a field.
3. Lagrangian formalism for continuum fields.
4. Invariance under transformations.
5. Spherical wave expansions.

Grading

Grades will be determined mostly from three exams, as follows:

Task:	Points:	Grading scale:
a) Exam 1, Chs. 9, 10	250	A: 1000–880
b) Exam 2, Chs. 11, 12	250	B: 880–760
c) Exam 3, Chs. 14, 16	250	C: 760–640
d) Homework+Presentations	250	D: 640–520

There will be around 12 homework assignments, intended for applying your understanding of the topics. You can abtain credit for doing the HW by presenting solutions orally in the problem sessions (about once per week) with each problem worth up to 50 points. I hope everyone could present at least four during the semester; the total HW scores will be scaled to 250 points. Concise and clear explanations are expected; avoid excessive algebra or other tedious details.

Importance of Electrodynamics

Electromagnetic effects occur in nearly all natural phenomena, although there may not always be obvious macroscopic effects. Where macroscopically observable effects occur, the idea of fields is extremely useful and conceptually necessary to describe the situation. Knowledge of the physics and math used for EM fields can be generalized to gravity and other fields.

ED theory is the most well-known example of a classical theory that is conceptually unified by the field concept. Furthermore, it has an essential relevance to relativity. The mathematical techniques used are applicable to many other problems, especially quantum mechanics. Finally, an understanding of ED at the classical level is the basis for following any quantum field theories.

Disabilities

Students with disabilities who need classroom accommodations, access to technology, or information about emergency building/campus evacuation processes should contact the Student Access Center and/or their instructor. Services are available to students with a wide range of disabilities including, but not limited to, physical disabilities, medical conditions, learning disabilities, attention deficit disorder, depression, and anxiety. If you are a student enrolled in campus/online courses through the Manhattan or Olathe campuses, contact the Student Access Center at accesscenter@k-state.edu, 785-532-6441; for Salina campus, contact the Academic and Career Advising Center at acac@k-state.edu, 785-826-2649.

Plagiarism

As scientists in training, high professional standards of integrity and ethics are expected of you. While you are encouraged to discuss questions with me or with other students, what you hand in must be your own work. Copying from others, textbooks, internet, is considered plagiarism. Assignments are intended to be written out individually, unless I have stated that an assignnment is collaborative.

University Statement Regarding Academic Honesty

Kansas State University has an Honor System based on personal integrity, which is presumed to be sufficient assurance that, in academic matters, one's work is performed honestly and without unauthorized assistance. Undergraduate and graduate students, by registration, acknowledge the jurisdiction of the Honor System. The policies and procedures of the Honor System apply to all full and part-time students enrolled in undergraduate and graduate courses on-campus, off-campus, and via distance learning. The honor system website can be reached via the following URL: www.k-state.edu/honor. A component vital to the Honor System is the inclusion of the Honor Pledge which applies to all assignments, examinations, or other course work undertaken by students. The Honor Pledge is implied, whether or not it is stated: "On my honor, as a student, I have neither given nor received unauthorized aid on this academic work." A grade of XF can result from a breach of academic honesty. The F indicates failure in the course; the X indicates the reason is an Honor Pledge violation.

Statement Defining Expectations for Classroom Conduct

All student activities in the University, including this course, are governed by the Student Judicial Conduct Code as outlined in the Student Governing Association By Laws, Article V, Section 3, number 2. Students who engage in behavior that disrupts the learning environment may be asked to leave the class.

Copyright Notification

Course Schedule

The textbook for the course is *Classical Electrodynamics*, by J. D. Jackson, 3rd edition, 1999. An approximate schedule of the topics to be covered is as follows:

Lecture/Date	Topic	Sections
1. 1-19	Localized oscillating radiating sources	9.1-9.2
2. 1-21	Dipole and quadrupole radiation	9.3-9.4
3. 1-26	Spherical scalar waves, EM multipoles	9.6-9.7
4. 1-28	Energy, angular momentum, power distribution	9.8-9.9
5. 2-02	Multipole moments, atomic, nuclear	9.10-9.11
6. 2-04	Linear center-fed antenna	9.12
7. 2-09	Scattering at long wavelengths by dipoles	10.1
8. 2-11	Scattering by a continuous medium	10.2
9. 2-16	Spherical vector plane waves	10.3
10. 2-18	Spherical scatterers	10.4
Friday 2-26	**Time TBA. First Exam.**	**Chs. 9, 10**
11. 2-23	Relativity, Lorentz transformation and kinematics	11.1-11.3
12. 2-25	4-vectors, velocity addition, energy-momentum	11.4-11.5
13. 3-01	Lorentz group and mathematical notation	11.6-11.7
14. 3-03	Thomas precession for spin	11.8
15. 3-08	Covariance of electrodynamics	11.9
16. 3-10	Transformation of EM fields	11.10
3-15, 3-17	Spring Break, no class.	
17. 3-22	Lagrangian, Hamiltonian for charge in field	12.1
18. 3-24	Motion in uniform fields	12.2-12.3
19. 3-29	Motion in nonuniform fields	12.4-12.5
20. 3-31	Darwin Lagrangian, EM field Lagrangian	12.6-12.8
21. 4-05	Stress tensors, conservation laws	12.10
22. 4-07	Covariant wave equation Green function	12.11
Friday 4-15	**Time TBA. Second Exam.**	**Chs. 11, 12**
23. 4-12	Liénard-Wiechert potentials, accelerated charge	14.1-14.2
24. 4-14	Angular distribution of radiation, synchrotrons	14.3-14.4
25. 4-19	Frequency distribution of radiation	14.5-14.6
26. 4-21	Thomson scattering of radiation	14.8
27. 4-26	Radiation damping concepts	16.1-16.2
28. 4-28	Abraham-Lorentz self force	16.3-16.4
29. 5-03	Covariant EM energy-momentum	16.5-16.6
30. 5-05	Spectral line properties of radiating oscillators	16.7-16.8
Tuesday 5-10	**2:00 - 3:50 pm, Third Exam.**	**Chs. 14,16**