Syllabus for Electrodynamics I

Revised for Hurricane Irma

(PHY5346)

Fall 2017

University of Central Florida

Department of Physics

**Basics**

Instructor: Prof. Robert E. Peale

Office location: PS423

Office hours/Discussion: TBD

Email: [Robert.peale@ucf.edu](mailto:Robert.peale@ucf.edu)

Class website: https://physics.ucf.edu/~rep/EDI/EDI.html

Class time: TuTh 3:00-4:15 p.m.

Class location: MSB 306

**Course information**

Credits**:** 3(3,0).

Prerequisites**:** PHY3323 & PHY4324 Electricity and Magnetism I & II, or equivalent

Course Description: This required core graduate course for the MS and PhD programs in physics will cover relativistic electrodynamics of point charges in vacuum and classical field theory.

Goals and objectives: Learn theory of, and develop problem solving tools for, Special Relativity, Relativistic Mechanics, Charges in Electromagnetic Fields, Electromagnetic Field Equations, Constant Electromagnetic Fields, Electromagnetic Waves, Propagation of Light, Fields of Moving Charges, and Radiation of Electromagnetic Waves. Specific subtopics are listed in the course schedule below.

Required text: L.D. Landau and E.M. Lifshitz, Classical Theory of Fields, 4th revised edition (Elsevier Butterworth Heinemann, 1975).

**Course calendar**

### Date Section/Event

Aug 22 Section 1 Velocity of propagation of interaction

Section 2 Intervals

Aug 24 Section 3 Proper time

Section 4 The Lorentz transformation

Aug 29 Section 5 Transformation of velocities

Section 6 Four-vectors

Aug 31 **Football game**

Sep 5 Section 6 Four-vectors

Sep 7 - 14 **Hurricane Irma**

Sep 19 Section 7 Four-dimensional velocity

Section 8 The principle of least action

Section 9 Energy and momentum

Sep 21 Section 15 Elementary particles in the theory of relativity

Section 16 Four potential of a field

Sep 26 Section 17 Equations of motion of a charge in a field

Section 18 Gauge invariance

Sep 28 Section 19 Constant electromagnetic field

Section 20 Motion in a constant uniform electric field

Oct 3 Section 21 Motion in a constant uniform magnetic field

Section 22 Motion in constant uniform electric and magnetic fields

Oct 5 Section 23 The electromagnetic field tensor

Section 24 Lorentz transformation of the field

Oct 10 Section 25 Invariants of the field

Section 26 The first pair of Maxwell's equations

**Oct 12 Exam 1,2**

Oct 17 Section 27 The action function of the electromagnetic field

Section 28 The four-dimensional current vector

# Oct 19 Section 29 The equation of continuity

Section 30 The second pair of Maxwell equations

Oct 24 Section 31 Energy density and energy flux

Section 32 The energy-momentum tensor

Oct 26 Section 33 Energy momentum tensor of the electromagnetic field

Section 36 Coulomb's law

Oct 31 Section 37 Electrostatic energy of charges

Section 38 The field of a uniformly moving charge

Nov 2 Section 39 Motion in the Coulomb field

Section 40 The dipole moment

Nov 7 Section 42 System of charges in an external field

Section 43 Constant magnetic field

Section 44 Magnetic moments

**Nov 9 Exam 2**

Nov 14 Section 46 The wave equation

Section 47 Plane waves

Nov 16 Section 48 Monochromatic plane waves

Section 49 Spectral resolution

Nov 21 Section 62 The retarded potentials

Section 63 The Lienard-Wiechert potentials

Nov 23 **No class (Thanksgiving)**

Nov 28 Section 66 The field of a system of charges at large distances

Section 67 Dipole radiation

Nov 30 TBD

# Dec 7 Thursday Final Exam 1-3:50 pm

Course assignments (assignments and exams): Homework will be assigned every class to be turned in during the next class. There will be three exams, including the final, based on a set of problems that will be posted on the course webpage. You will be allowed to use your textbook, mathematical tables, and a calculator, but no other books or notes, during exams.

Methods of evaluation: Homework presentations will be graded and will count for 30% of the final grade. Exams count for 20% of the final grade each. Participation will count for 10%. + and – grades will be given. The final course grade will be available on myucf.

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**Other Policies**

Missed work policy: It is the policy of the Department of Physics that making up missed work will only be permitted for University-sanctioned activities and bona fide medical or family reasons. Authentic justifying documentation must be provided in every case (and in advance for University-sanctioned activities). At the discretion of the instructor, the make-up may take any reasonable and appropriate form including (but not limited to) the following: giving a replacement exam, replacing the missed work with the same score as a later exam, allowing a dropped exam, replacing the missed work with the homework average.

Late homework: Homework that is handed in late for reasons other than an excusable absence will receive zero points and will be counted toward the average. An excusable absence is one that can be documented to be caused by illness, death in the immediate family, serious family emergencies, travel related to your graduate work, court-imposed legal obligations, or observation of a religious holiday. In case of an excusable absence, late homework will be accepted by the instructor no more than one week after the official due time.

Golden Rule: Many incidents of plagiarism result from students’ lack of understanding about what constitutes plagiarism. However, they are expected to familiarize themselves with UCF’s policy. Please read this information at the website http://goldenrule.sdes.ucf.edu UCF Creed: Please read this information at the website http://creed.sdes.ucf.edu

Disabilities and access statement: The University of Central Florida is committed to providing reasonable accommodations for all persons with disabilities. This syllabus is available in alternate formats upon request. Students with disabilities who need accommodations in this course must contact the professor at the beginning of the semester to discuss needed accommodations. No accommodations will be provided until the student has met with the professor to request accommodations. Students who need accommodations must be registered with Student Disability Services, Student Resource Center Room 132, phone (407) 823-2371, TTY/TDD only phone (407) 823-2116, before requesting accommodations from the professor.

Collaboration policy: Students are encouraged to discuss assignments and form study groups, but must develop and write their own solutions to problems and questions. It must be obvious on that paper that the result has not been copied from another source. In particular, if a student collaborates with someone to work on problem sets, the onus is on the student to prove to the grader that he/she wrote down his/her derivations and answers independently. Copying from another student’s paper is very obvious in a class of this size, and will immediately result in zeros on the assignment for all parties involved.