

Physics 9610 – Foundations of Physics

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Location: PAB Room 48

Lectures: Monday and Wednesday, 10:30 – 12:30

We can be reached at our respective offices, especially after class where we will do our best to reserve time to answer your questions (for R. Sica, Monday only). We can also be reached during the week through e-mail for simple inquiries, or to make an appointment. We will try to reply to e-mails within two working days of reception.

Students should regularly check the course's WebCT OWL web site.

Evaluation: There will be four exams, one for each section of the course, and a final exam all worth 20% of your total mark. *The exams will be closed book, and no electronics equipment (e.g., calculators, computers, etc.) will be allowed unless explicitly authorized ahead of time.* Students absent on an examination day may be allowed to take a make-up exam if they present a note from a medical doctor within a reasonable amount of time. Similar consideration may be given under other exceptional circumstances.

Assignments: Four lists of problems (one for each section of the course) will be provided during the semester. Although these problem lists will not be collected or graded, they will provide you the necessary preparation for the exams.

Description

Physics is built on several core pillars. A professional physicist must have knowledge of these fundamental theories beyond the undergraduate level. The course provides an in-depth survey of Classical Mechanics, Quantum Mechanics, Statistical Mechanics and Electrodynamics. These core areas are the foundations material necessary to be prepared for the Department's PhD comprehensive examination.

3 lecture hours / week; half course; one term.

Course Outline

1. Classical Electrodynamics: Electro and magnetostatics; Maxwell's equations and wave propagation (microscopic and macroscopic equations, Lorentz force - Ohm's Law, plane waves, basic plasma effects); Scattering and diffraction; Multipole expansion and radiation (Liénard-Wiechert potentials, Larmor formula).
2. Classical Mechanics: Lagrangian mechanics; Hamilton's equations of motion; Non-inertial frames of reference; Coupled oscillations.
3. Quantum Mechanics: Quantum observables and states; the Schrödinger equation (particle in a box, potential wells and barriers, tunnelling, harmonic oscillator, unitary transformation and different representations); Angular momentum and spin; Identical particles; Perturbations methods (time independent and dependent, interaction with the electromagnetic field).
4. Statistical Physics: Probability as physics; Statistical description of systems of particles; Microscopic theory and macroscopic measurements; Quantum thermodynamics.

Schedule

Class #	Date	Topic
1	9 Jan	Electro- and Magnetostatics
2	11 Jan	Maxwell's Equations and Wave Propagation - I
3	16 Jan	Maxwell's Equations and Wave Propagation - II
4	18 Jan	Scattering and Diffraction
5	23 Jan	Multipole Expansion and Radiation
6	25 Jan	Test 1: Classical Electrodynamics
7	30 Jan	Lagrangian Mechanics
8	1 Feb	Hamilton Equations of Motion - I
9	6 Feb	Hamilton Equations of Motion - II
10	8 Feb	Non-inertial frames
11	13 Feb	Coupled Oscillations
12	15 Feb	Test 2: Classical Mechanics
13	27 Feb	Quantum Observables and States; the Schrödinger Equation - I
14	1 Mar	The Schrödinger Equation - II

Class #	Date	Topic
15	6 Mar	Angular Momentum and Spin
16	8 Mar	Identical Particles
17	13 Mar	Perturbation Methods; Interaction with the Electromagnetic Field
18	15 Mar	Test 3: Quantum Mechanics
19	20 Mar	Probability as Physics
20	22 Mar	Statistical Description of Systems of Particles
21	27 Mar	Microscopic Theory and Macroscopic Measurements
22	29 Mar	Quantum Thermodynamics - I
23	3 Apr	Quantum Thermodynamics - II
24	5 Apr	Test 4: Statistical Mechanics

Bibliography

1. **Classical Electrodynamics**, by J. D. Jackson, 3rd edition (John Wiley and Sons).
2. **Classical Electromagnetism**, by J. Franklin, 1st edition (Pearson - Addison Wesley).
3. **Classical Dynamics of Particles and Systems**, by Stephen T. Thornton, Jerry B. Marion, 5th edition, 2004.
4. **Classical mechanics**, by H. Goldstein, C. P. Poole, and J. L. Safko, 3rd edition (Addison Wesley)
5. **Quantum Mechanics**, by G. Auletta, M. Fortunato and G. Parisi (Cambridge University Press).
6. **Quantum Mechanics** (2 volume set), by C. Cohen-Tannoudji, B. Diu, and F. Laloë, 1996 (New York: Wiley).
7. **An Introduction to Thermal Physics**, by Daniel V. Schroeder. Addison-Wesley, 1999.
8. **Fundamentals of statistical and thermal physics**, by F. Reif. McGraw-Hill, June 1965.

University Policies:

Accessibility: Please contact the course instructor if you require material in an alternate format or if you require any other arrangements to make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Medical accommodation:

- If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or other supporting documentation to the Dean's office as soon as possible and contact your instructor immediately. It is the student's responsibility to make alternative arrangements with their instructor once the accommodation has been approved and the instructor has been informed. In the event of a missed final exam, a "Recommendation of Special Examination" form must be obtained from the Dean's Office immediately. For further information please see:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

- A student requiring academic accommodation due to illness should use the Student Medical Certificate when visiting an off-campus medical facility or request a Records Release Form (located in the Dean's Office) for visits to Student Health Services. The form can be found here:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

- Students who are in emotional/mental distress should refer to Mental Health@Western <http://www.uwo.ca/uwocom/mentalhealth/> for a complete list of options about how to obtain help.

Religious holidays: A student who, due to unavoidable conflicts with religious holidays which (a) require an absence from the University or (b) prohibit or require certain activities (*i.e.*, activities that would make it impossible for the student to satisfy the academic requirements scheduled on the day(s) involved), is unable to write examinations and term tests on a Sabbath or Holy Day in a particular term shall give notice of this fact in writing to his or her Dean as early as possible but not later than November 15th for mid-year examinations and March 1st for final examinations, *i.e.*, approximately two weeks after the posting of the mid-year and final examination schedule respectively. In the case of mid-term tests, such notification is to be given in writing to the instructor within 48 hours of the announcement of the date of the mid-term test. The instructor(s) in the case of mid-term tests and the Dean in the case of mid-year and spring final

examinations will arrange for special examination(s) to be written at another time. In the case of mid-year and spring final examinations, the accommodation must occur no later than one month after the end of the examination period involved. It is mandatory that students seeking accommodations under this policy give notification before the deadlines, and that the Faculty accommodate these requests. The list of approved dates is updated annually and is available at Departmental, Dean and Faculty advising offices.

Academic misconduct:

- **Cheating:** University policy states that cheating is a scholastic offence that can result in an academic penalty (which may include expulsion from the program). If you are caught cheating, there will be no second warning. Complete information on the University policies on academic offenses can be found at http://www.westerncalendar.uwo.ca/2016/print_pg113.html
- **Plagiarism:** Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing (such as footnotes or citations). Plagiarism is a major academic offence. For more details, see http://www.westerncalendar.uwo.ca/2016/print_pg113.html
- Plagiarism or cheating will not be tolerated. Penalties will vary depending on the seriousness of the offence. They can range from a grade of zero on an assignment or essay, to failure of a course, to expulsion from the University.
- If you have any questions at all on this issue, please consult with your instructor.