PHY 215: Classical Mechanics
Spring 2025

Dimitrios Vavylonis
Department of Physics
415 Lewis Lab
vavylonis@lehigh.edu

Time and Location:
Monday, Wednesday and Friday 10:45 AM - noon, Lewis Laboratory Room 514
Office hours: TBD, Lewis Laboratory Room 415

Description

Textbooks:
Classical Mechanics, John R. Taylor, University Science Books
Python for Classical Mechanics, Charlotte Christensen and Paul Tjossem, University Science Books

We will cover the following topics:

Chapter 1. Newton's Laws of Motion.
Chapter 2. Projectiles and Charged Particles.
Chapter 3. Momentum and Angular Momentum.
Chapter 4. Energy.
Chapter 5. Oscillations.
Chapter 6. Calculus of Variations.
Chapter 7. Lagrange's Equations.
Chapter 8. Two-Body Central-Force Problems.
Chapter 9. Mechanics in Noninertial Frames.
Chapter 10. Rotational Motion of Rigid Bodies.
Chapter 11. Coupled Oscillators and Normal Modes.

If time permits, we will also cover,
Chapter 12. Nonlinear Mechanics and Chaos.
Chapter 13. Hamiltonian Mechanics.

New for 2025: Python for Classical Mechanics

Computational exercises in python will be added to lectures and homework, following the new book "Python for Classical Mechanics" written as an addition to Taylor's book.

Initial Competencies

• Introductory Physics at the level of Physics 10/13 and 11/21
• Knowledge of calculus.
• Students should either already have taken Linear Methods (Math 205), or be taking it concurrently.

Final Competencies

• Expand the type and complexity of physics problems that you are able to solve (using paper and pencil or computers).
• Apply Newton's second law to construct differential equations of motion, including damped and driven oscillating systems.
• Use vector operations and multiple coordinate systems to solve mechanics problems using conservation of energy, linear momentum, and angular momentum.
• Learn how to apply Hamilton's principle, Lagrange's equations, and Hamilton's equations.
• Develop equations of motion for a variety of physical systems using both Lagrangian and Hamiltonian dynamics.

Grading

There will be homework, in class problems, two midterm exams and one final exam (scheduled during finals week). Grades will be computed as follows:

Homework: 45%
In-class problems: 5%
Midterm 1,2: 20%
Final exam: 30%

We will have 11 assigned homeworks. Notice that homework is a very important part! The purpose of this course is to expand your ability to attack problems with a variety of mathematical techniques, and consistent practice is the most important part of gaining this skill. It is your responsibility to make sure you understand how to do the homework problems and you should submit your own work. However, you are encouraged you to work together to complete the homework whenever possible.

After the due date, you may turn in a homework assignment for 50% of the possible points. However, please contact the instructor for an extension if something out of the ordinary occurs that prevents you from completing an assignment on time.

On certain lecture days, in-class quiz/problems will be assigned. You will be able to make up any missed quiz points in ways that we will announce in class.

Midterm exam 1 will cover the material of Homeworks 1-4 and Midterm exam 2 the material of Homeworks 4-8. The Final exam will cover all topics covered in the course. All exams will be open notes/book.

Slack, Course Site and Scheduling

We will use Slack for course announcements, questions, links, ideas, and group activities. Students are expected to check it regularly and submit any course-related communication to the instructor or to other students there. It's much easier to quickly answer questions or requests on Slack. So please use Slack instead of email; if you send me a course-related email, I will respond back on slack!

Homework will be submitted and graded on Course Site.

Because of research presentations at the American Physical Society March meeting and invited seminars, we will have no class on January 31, February 12 and on March 17 and 19. The time assigned to this class by the Registrar slightly exceeds that of a 4-credit course (even after taking out a 5 min break per class). We will use this extra time to make up for the canceled lectures (approximately two lectures) and the rest by make up lectures, possibly by two pre-recorded lectures. A calendar will be posted on course site.

University Policies

Accommodations for Students with Disabilities:
Lehigh University is committed to maintaining an equitable and inclusive community and welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact Disability Support Services (DSS), provide documentation, and participate in an interactive review process. If the documentation supports a request for reasonable accommodations, DSS will provide students with a Letter of Accommodations. Students who are approved for accommodations at Lehigh should share this letter and discuss their accommodations and learning needs with instructors as early in the semester as possible. For more information or to request services, please contact Disability Support Services in person in Williams Hall, Suite 301, via phone at 610-758-4152, via email at indss@lehigh.edu, or online at https://studentaffairs.lehigh.edu/disabilities.

Bias, Discrimination, Harassment, Retaliation, and Sexual Misconduct:
Lehigh University upholds the Principles of Our Equitable Community and is committed to an educational, working, co-curricular, social, and living environment for faculty, staff, and students. The University does not discriminate in its admissions practices, employment practices, or educational programs or activities on the basis of age, color, disability, ethnicity, familial status, gender expression, gender identity, genetic information, marital status, national origin (including shared ancestry), pregnancy or related conditions, race, religion, sex,

sexual orientation, and veteran or military status. Harassment or discrimination is unacceptable behavior and will not be tolerated. The University strongly encourages (and, depending upon the circumstances, may require) students, faculty, or staff who experience or witness harassment or discrimination, or have information about harassment or discrimination in University programs or activities, to immediately report such conduct.

If you have questions about Lehigh's Policy on Harassment and Non-Discrimination or need to report harassment or discrimination, contact the Equal Opportunity Compliance Coordinator (Alumni Memorial Building / 610 758 3535 / eocc@lehigh.edu)

Academic Integrity:

All members of the Lehigh community have a responsibility to maintain academic integrity. Resources and details of expectations at Lehigh are available on the Provost's website. It is expected that all students will abide by these standards throughout the course (e.g., homework, quizzes, papers, exams, projects, etc.). Academic integrity case studies will be discussed on the first day of class, and students are encouraged to ask questions for further clarity throughout the semester. Violations of academic integrity standards will not be tolerated and will be handled according to the guidelines in the University's Student Conduct System.