PHYS 311: Classical Mechanics I, Fall 2022

University of Tennessee, Knoxville
Prof. Lawrence Lee – llee@utk.edu – Office: Nielsen 503

Welcome to PHYS 311! This is one of my favorite classes and is a real foundational course in your undergraduate physics education. I have the privilege of introducing you to some of the most elegant techniques in the field, and help you move away from "first-year" physics and into more sophisticated methods.

Course Information

Meeting Schedule: M 9:10-11:05 (Nielsen 207), W 9:10-10:00 (Nielsen 306) [3 Credit Hours]

Office Hours: Mon 2-3pm over Zoom (See Canvas) [Please contact in case you'd like to schedule a meeting at another time]

Teaching Assistant: Serajus Chowdhury

Course Description: We will consider the topic of advanced classical mechanics. This will mean the study of how things move classically (here, meaning non-quantum-mechanically). Topics covered in this two-semester track (311+312) include single particle motion, systems of particles, oscillations, motion in the precence of forces, two-body and planetary motion, non-inertial reference frames, rigid bodies, Lagrangian and Hamiltonian mechanics, non-linear dynamics, chaos, and the special theory of relativity. The more advanced topics listed here will be covered in the second semester PHYS 312. Detailed course descriptions are available from the department: http://www.phys.utk.edu/about/course-descriptions.html

Prerequisites: PHYS 136 or 138 or 231; CS 102. Familiarity with calculus and basic linear algebra. Familiarity with introductory programming.

Textbooks

Primary: John Taylor, *Classical Mechanics* (189138922X)

Useful supplement: Anders Malthe-Sørenssen, *Elementary Mechanics using Python* (9783319386843) Freely available online from UT Library, [Link]

Additional resources via Canvas (May include PDFs, YouTube videos, LinkedIn Learning courses, etc)

Problem Sets: Most weeks will have a problem set intended for home. This will involve some combination of programming tasks as well as traditional pencil-on-paper solutions. The primary way to submit these assignments will be via Canvas, with scans of any hand-written solutions. *These will typically be due at 11:59pm (local Knoxville time) on Tuesdays.* If you choose to typeset solutions in LaTeX (submitting a PDF to Canvas), you may attach diagrams separately *and will receive an extra 1-day extension.*

Exams and Quizzes: There will be a single midterm exam, and a final exam at the end of the semester. There will be unannounced quizzes many weeks. Quizzes will be multiple choice and administered via clicker.

Reading Assignments: Reading the text before lecture is a necessary part of learning the material. I ask that you take notes as you read, and submit a picture (phone camera is fine) or copy of your notes on Canvas as an assignment. Any reasonable set of notes will receive full credit. *These will typically be due at 11:59pm (local Knoxville time) on Tuesdays.*

Grading Policy: Tentative grade boundaries are A [93,100], A- [90,93), B+ [87,90), B [83,87), B- [80,83), C+ [77,80), C [73,77), C- [70,73), D+ [67,70), D [63,67), D- [60,63), F[0,60). Final grade boundaries will be informed by class grade distributions *when it would be favorable to the grades.* The composition of the final course grade will be as follows:

30%	Problem Sets
20%	Midterm Exam
20%	Final Exam
20%	Studio Work
5%	In-class Quizzes
5%	Reading Notes

Extra Credit: There will be multiple ways to earn extra credit that should play to your different strengths. These may be more challenging written problems, more challenging programming tasks in the problem sets or in the studio sessions, contributing significantly to discussions on Canvas, or completing supplementary online courses to grow your skillset. Depending on the task, they will contribute to different portions of above categories. The specifics of these tasks will be defined on Canvas.

"Three wishes": Because sometimes life just gets in the way, we will be implementing "three wishes" in this course.

1. Your lowest Problem Set score will be dropped.
2. Your lowest Quiz score will be dropped.
3. You may request to turn in one assignment (Studio or Problem Set) up to one week late.

Late Policy: Unless otherwise excused, Problem Sets turned in:

- (0,7] days late can still earn up to 75% of the original available points
- (7,14] days late... 50%...
- (14,∞) days late... 0%...

Unexcused late quizzes and reading assignments will not be accepted.

Course Structure: This course will be taught in two modes. On Wednesdays, we will meet in a conventional classroom environment where a relatively short lecture is meant to summarize those topics primarily learned in the reading. Students are expected to have read the reading assignment and taken notes as described above. On Mondays, we will meet in a computer lab setup for the *studio* portion of the class where the primary focus is on interactive python notebook activities. In the event that a modality change is needed, this will be communicated.

Computing: Computing is an essential part of modern physics study and this course. Students will be required to create an account on the university's **ISAAC** (formerly ACF) system. Clicker questions will be administered via the **Turning** system, so students will additionally be required to create an account at account.turningtechnologies.com using their UT email address.

Attendance: Regular attendance is essential and expected. **See COVID-19 Policies below.**

Communication: Start any email subject with [**PHYS 311**]. Students are expected to use their UTK email and are expected to check it regularly. Questions of general interest should be asked in the discussion forum, not via private emails to the instructor. Only questions particular to an individual student should be made via email.

Collaboration and Academic Integrity: An effective physics education, just like physics research, is impossible without collaboration, so it is essential that you work together with your classmates in person (if that makes sense for you), over Zoom, via online discussion forums in Canvas, or however leads to the most understanding of the material possible. Every student is still expected to complete the assignments in their own voice, implementation, and instance. Purely copied work, plagiarism, or joint solutions will be considered a violation of the academic integrity policy. If I judge that you have copied other sources (from the internet, classmates, or otherwise) or that you have aided others in plagiarizing your work, you will receive zero credit for the assignment or test and your final course grade will be reduced by a full letter grade. A second offense will lead to automatic failure for the course and a report to the Dean of Students. Work with your peers to increase your own understanding of the material.

Campus Syllabus: The University's *Campus Syllabus* applies at all times.

Students w/ Disabilities: Any student who may need an accommodation based on the impact of a disability should contact Student Disability Services in Dunford Hall at 865-974-6087 to coordinate reasonable academic accommodations.

Personal Pronouns: Students are welcome to inform me preferred names and pronouns at any time. I will do my best to address and refer to all students accordingly and support classmates in doing so as well.

Tentative Schedule

n.b. Class will meet on all days in parentheses below unless otherwise announced. Reading assignments are listed in square brackets.

Week 1	(Aug 24)	Introduction, essential math, Newton's laws	[Syll.]
Week 2	(Aug 29, 31)	Technical setup, applications of Newton's laws, ODEs	[Taylor §1.1-1.7, §2.6]
Week 3	(Sep 7)	[No Monday Meeting, Labor Day] Projectiles and drag	[§2.1-2.7]
Week 4	(Sep 12, 14)	Momentum and angular momentum	[§3.1-3.5]
Week 5	(Sep 19, 21)	Work, potential, energy	[§4.1-4.2]
Week 6	(Sep 26, 28)	Forces, vector analysis	[§4.3-4.7]
Week 7	(Oct 3, 5)	Review	
Week 8	(Oct 10, 12)	[Midterm Oct 10] Central forces, gravity	[§4.8-4.10]
Week 9	(Oct 17, 19)	Two-body problems	[§8.1-8.3]
Week 10	(Oct 24, 26)	Kepler orbits	[§8.4-8.8]
Week 11	(Oct 31, Nov 2)	Simple harmonic motion	[§5.1-5.3]
Week 12	(Nov 7, 9)	More complex oscillations	[§5.4-5.8]
Week 13	(Nov 14, 16)	Rigid bodies, Center of mass	[§10.1-10.2]
Week 14	(Nov 21)	[No Class Day Nov 23]	
Week 15	(Nov 28, 30)	Rotations, Inertia	[§10.3]
Week 17	(Dec 5, 7)	Using the inertia tensor	[§10.4-10.6]

COVID-19 Policies

CDC guidance recognizes the changing dynamics of living in a world with COVID-19. It rates COVID-19 community levels as low, medium, and high, with recommendations at each level about the use of masks and other precautions. At all levels of community spread, staying up-to-date with vaccination is the best way to protect yourself from serious illness and to limit the spread of COVID-19. Wearing a mask is always an option for any individual who chooses to do so, and the CDC recommends that those with high risk of severe illness talk with their health care providers. If you are sick, please stay in, avoid being around others as much as possible, and contact your health care provider for any symptoms that are worsening, moderate to severe, or concerning to you. For more information about vaccination or to self-report an illness and receive support, visit https://studenthealth.utk.edu/CommunityHealth. For more information about COVID-19, visit https://studenthealth.utk.edu/covid-19.

Syllabus last updated August 23, 2022.