

PHYS 312: Classical Mechanics II, Spring 2022

University of Tennessee, Knoxville
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Welcome to PHYS 312! 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: MWF 9:15-10:05 (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: TBA. Office Hours TBA

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 presence 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 311; (Corequisite) MATH 241. Familiarity with calculus and basic linear algebra. Familiarity with introductory programming.

Textbooks

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

Useful supplement: Anders Møller-Sørensen, *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. Scans must be legible, in order, and rotated correctly for grading. *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 two midterm exams, and a final exam at the end of the semester. There will be unannounced quizzes most weeks. Quizzes will be multiple choice and administered via clicker.

Reading Assignments: Reading the text 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:

40%	Problem Sets
15%	Midterm Exam I
15%	Midterm Exam II
20%	Final Exam
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, contributing significantly to discussions, 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: Students are expected to have read the reading assignment and taken notes as described above prior to lecture. 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 312]**. 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 half letter grade (*e.g.* from a B- to a C+). 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. Tentative reading assignments are listed in square brackets.

Week 1	(Starting Jan 24)	Introduction, Calculus of Variations, Action	[Syll., Taylor §6.1-6.4]
Week 2	(Jan 31)	Lagrangian Mechanics, Constraints	[§7.1-7.4]
Week 3	(Feb 7)	... (cont.), Conservation laws, Noether's Theorem	[§7.5-7.10]
Week 4	(Feb 14)	Hamiltonian Mechanics	[§13.1-13.7]
Week 5	(Feb 21)	... (cont.), Non-inertial Frames	[§9.1-9.5]
Week 6	(Feb 28)	... (cont.)	[§9.6-9.10]
Week 7	(Mar 7)	[MIDTERM MAR 7], Intro to Coupled Oscillators	
Week 8	(Mar 14)	SPRING BREAK	
Week 9	(Mar 21)	Coupled Oscillators and Normal Modes	[§11.1-11.7]
Week 10	(Mar 28)	... (cont.), Chaos and Nonlinearity	[§12.1-12.9]
Week 11	(Apr 4)	Collisions	[§14.1-14.8]
Week 12	(Apr 11)	[MIDTERM APR 11], [SPRING RECESS APR 15]	
Week 13	(Apr 18)	Special Relativity	[§15.1-15.6]
Week 14	(Apr 25)	... (cont.)	[§15.7-15.13]
Week 15	(May 2)	... (cont.)	[§15.14-15.18]
Week 16	(May 9)	Overflow / Review, [STUDY DAY MAY 11]	[§10.4-10.6]

COVID-19 Policies

As of Spring 2022, we remain in an unprecedented pandemic that requires careful and strict policies in the classroom environment. The health of the community is of paramount importance. In the event that the local situation requires a change of teaching environment, this will be clearly communicated and will follow the guidelines of the university.

Masks: Everyone is strongly encouraged to wear a high-quality masks at all times in the classroom regardless of vaccination status. Current CDC guidelines recommend using N95, KN95 or KF94 masks, which are the most effective in preventing infection from the current Omicron variant. A reasonable alternative is double masking. The university expects everyone to protect others from the spread of COVID-19 and strongly recommends wearing masks in academic and administrative spaces.

Vaccination: The university strongly recommends that all members of the campus community be vaccinated for their own protection, to prevent disruption to the semester, and to prevent the spread of COVID-19. Vaccination information and appointment signups are available at tiny.utk.edu/vaccine. The Student Health Center medical staff is available to students to answer questions or discuss concerns about vaccines, and the center provides vaccines free of charge for anyone 18 years or older who would like one.

Reporting: If you begin to feel sick or you have been in contact with someone who has COVID-19, the first step is to begin self-isolating immediately and fill out the university's self-isolation form. You should contact the Student Health Center or your preferred health care provider. You can also contact the university's COVID-19 support team for guidance by filling out the COVID-19 self-isolation form at covidform.utk.edu.

Attendance You must not attend class if you have tested positive for COVID-19 and are in the isolation period, if you have COVID-19 symptoms and have not been cleared by a medical provider, or if you are an unvaccinated close contact in the quarantine period. If you need to miss class for illness, please contact the instructor as soon as possible via Email.

Make Up/Late Work If you are feeling well enough, you should keep up with the course readings and assignment due dates. Contact me in order to ensure all material is made available to you. If you are too ill to complete daily tasks, we will discuss accommodations individually. It is your responsibility to reach out to me before returning to class to set up a time to discuss these accommodations.

You can find more information and updates at utk.edu/coronavirus.

Syllabus last updated February 4, 2022.