PHYS 312: Classical Mechanics II, Spring 2024

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 9:10-10:00 (Nielsen 306) [3 Credit Hours]

Office Hours: Mon 2-3pm Nielsen 503 (or over Zoom by request) [Please contact in case you'd like to schedule a meeting at another time or if you are unable to make this time in general.]

Grader: TBD

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

Textbooks

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

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 PDF scans of any hand-written solutions. Many students use their phone's built-in scanning capabilities, apps like *CamScanner*, or *Dropbox*'s built-in feature, to produce these PDFs. *These will typically be due at 11:59pm (local Knoxville time) on Tuesdays. This may vary and will be defined on Canvas.* 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 may be on material covered in the reading assignments and not in class, or vice versa. Quizzes will be multiple choice and administered via Turning clicker. In cases where fewer than half of the class is present, the quiz is worth double.

Reading Assignments: Reading the text before lecture is a necessary part of learning the material. (Seriously! This first look 'primes' the brain into being ready to solidify understanding during lecture and while doing problem sets! This is established in the psychology of education! See [1], [2], and generally google around!) 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 Thursdays. This may vary and will be defined on Canvas.*

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 such that everyone will have the opportunity to earn extra and grow. These may be more challenging written problems, more challenging programming tasks in the problem sets, 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. No such assignments are accepted after the end of the semester.

"Three wishes": Because sometimes life just gets in the way, we will be implementing "three wishes" in this course. These will give you all three of the following:

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 problem set up to one week late, no questions asked.

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.

Computing: 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. If you are feeling symptomatic of a contagious illness, please stay home. A best effort to record all lectures will be made, to be posted on canvas in case you missed something in your notes or if you have to miss lecture due to sickness. If illness prevents you to attend lecture on a day with a quiz, please get in touch with the instructor.

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 Canvas discussion forum, not via private emails to the instructor.** Only questions particular to an individual student should be made via email. Announcements will usually be made via Canvas announcements. Ensure your Canvas notification settings are useful to you.

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 half of a letter grade (*e.g.*, a B+ becomes a B). 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, and learn how to understand the problems.

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.

Preferred Names and Pronouns: Students are welcome to inform me of preferred names and pronouns at any time. I will do my best to address and refer to all students accordingly, and I support your 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	(Starting Jan 22)	Introduction, Calculus of Variations, Action	[Syll., Taylor §6.1-6.4]
Week 2	(Jan 29)	Lagrangian Mechanics, Constraints	[§7.1-7.4]
Week 3	(Feb 5)	... (cont.), Conservation laws, Noether's Theorem	[§7.5-7.10]
Week 4	(Feb 12)	Hamiltonian Mechanics	[§13.1-13.4]
Week 5	(Feb 19)	... (cont.), Non-inertial Frames	[§13.5-13.7,9.1-9.5]
Week 6	(Feb 26)	... (cont.)	[§9.6-9.10]
Week 7	(Mar 4)	... (cont.), Review, [Midterm Mar 8]	
Week 8	(Mar 11)	Spring Break	
Week 9	(Mar 18)	Coupled Oscillators and Normal Modes	[§11.1-11.7]
Week 10	(Mar 25)	... (cont.), Chaos and Nonlinearity, [Spring Recess Mar 29]	[§12.1-12.9]
Week 11	(Apr 1)	... (cont.), Review, [Midterm Apr 5]	
Week 12	(Apr 8)	Collisions	[§14.1-14.8]
Week 13	(Apr 15)	Special Relativity	[§15.1-15.6]
Week 14	(Apr 22)	... (cont.)	[§15.7-15.13]
Week 15	(Apr 29)	... (cont.)	[§15.14-15.18]
Week 16	(May 6)	Overflow / Review, [Study Day May 8]	
Final	(May 15)	(Tentative, Set by registrar) 10:30am - 12:45pm	

Syllabus last updated January 12, 2024.