PHYS 911 – Classical Mechanics

Fall Semester 2024

August 26, 2024

Instructor

Robert Streubel | Office: Jorgensen Hall 310C | Email: streubel@unl.edu

Office Hours: Mondays, Wednesdays, and Fridays 10:45 – 11:45

Grader: Thomas Clement (tclement4)

Lectures: Mondays and Wednesdays, 9:00 thru 10:30, JH 151

Recitation: Fridays, 9:00 thru 10:30, JH 151

Textbooks

Primary: Classical Mechanics, H. Goldstein, C. Poole, and J. Safko, Addison Wesley/Pearson

Secondary: Classical Dynamics, J.V. Jose, E.J. Saletan, Cambridge

Reference: Mechanics, L. D. Landau and E. M. Lifshitz, Butterworth-Heinemann

Course Overview

This course focuses on non-relativistic and relativistic classical mechanics with emphasis on Lagrange's and Hamilton's formulation and coding applications. These formulations are applicable to virtually all fields in physics, including relativistic mechanics, quantum mechanics, particle physics, electrodynamics, and quantum electrodynamics. Hence, understanding the concepts, mathematical and computational tricks, and physical background are of utmost importance.

A time investment of **at least 10 hours per week** is needed in addition to lectures.

Course Activities

Lecture. Comprehensive lecture notes with > 75 examples will be provided to digest the primary textbook and shift the focus during class to active problem solving and discussing challenging aspects. It is highly recommended to thoroughly prepare for class.

Homework. There will be homework every week assigned at the first class of the week and due the following Monday in class, independent of whether an exam is scheduled or not. While collaborative problem solving is encouraged, the submitted homework must be yours, i.e., not copied.

Exams. There will be two two-hour midterm exams and a four-hour comprehensive final exam. They will be closed book. You can prepare and use a US letter-sized formula sheet with relevant equations to prevent memorization of mathematical equations.

Quizzes. There will be three 20-min closed-book quizzes leading up to the second midterm.

Final project. The week before the final exams will be dedicated to students presenting a mechanics problem of their choice that can only be solved by computing/numerical means. Presentation, difficulty, and originality of the problem will be considered for evaluation. Please consult with the

Instructor before starting to work on your project. You may form groups of two students or work individually on your project.

Late Work. A 10% penalty per workday (up to 50%) is taken from work that is turned in late.

Canvas. Class information, including syllabus, announcements, materials etc. will be posted and updated on the UNL Canvas page.

Instructional Continuity Guidance. If in-person classes are canceled, you will be notified of the instructional continuity plan for this class by Canvas.

UNL Course Policies and Resources, including use of A.I. Students are responsible for knowing the university policies and resources found at `https://go.unl.edu/coursepolicies`. Intellectual honesty is vital to an academic community and for my fair evaluation of your work. All work submitted in this course must be your own, completed in accordance with the University's academic regulations. Use of A.I. tools, including ChatGPT, is permitted in this course, but only to help brainstorm assignments, revise existing work you have written or digest course material (private tutor, e.g., `https://tll.mit.edu/chatgpt-4-questions-from-a-materials-thermodynamics-course`). Using A.I. to complete assignments on your behalf is considered plagiarism. Also, be aware that the accuracy or quality of A.I. generated content may not meet the standards of this course, even if you only incorporate such content partially and after substantial paraphrasing, modification and/or editing. Consider A.I. a tool whose proficient handling may boost your knowledge gain, productivity, and career.

Course Content

Set 1

1. Survey of elementary physics
2. Variational principles and Lagrange's equations
3. The Hamilton equation of motion

Set 2

4. The central force problem
5. Oscillations

Set 3

6. The classical mechanics of the special theory of relativity
7. Hamilton-Jacobi theory and action-angle variables
8. Canonical perturbation theory (if time allows)

Exams and Grading

Mid-term Exams (JH 251): 8:30 thru 10:30 on Wednesday, 9/25/24 and Wednesday, 11/6/24

Final Project Presentation: 9:00 thru 10:30 on Monday, 12/9/24 and Wednesday, 12/11/24

Final Exam: 10:00 thru 14:00 on Wednesday, 12/18/24

Grading Scale

Score	≥ 95	≥ 90	≥ 85	≥ 80	≥ 75	≥ 70	≥ 65	≥ 60	≥ 57	≥ 53	≥ 50
Grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D

Homework	20%
Quizzes	15%
Two mid-term exams (15% each)	30%
Final project	10%
Final exam	25%

A single instance of academic dishonesty may result in a failing grade for the course. Academic dishonesty includes copying solutions for homework, recitations, or exams either from another student or from existing solutions, whether published or not. Students are allowed to discuss homework with each other, but copying is considered cheating. For more examples of what is considered academic dishonesty, see the Student Code of Conduct (`http://stuafs.unl.edu/ja/code/three.shtml`).

Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. It is the policy of the University of Nebraska-Lincoln to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to fully participate in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.