PHYS 3010: Classical Mechanics (Winter 2022)

(This is a tentative version (updated on Jan 6, 2022). The final version will become available soon.)

Course Director:	Tom Kirchner, Department of Physics and Astronomy, York University, Petrie 228, (416) 736-2100 x33695, tomk@yorku.ca
WWW:	**eClass** (York's Learning Management System)
Class Times:	MWF 9:30 – 10:30, ACW 003 and/or via Zoom
Office Hours:	MW 10:30 – 11:30 (or by appointment)
Recommended Texts:	**S. T. Thornton and J. B. Marion**, *Classical Dynamics of Particles and Systems*, Thomson 2004 J. R. Taylor, *Classical Mechanics*, University Science Books 2005
Lecture Notes:	posted on eClass and www.yorku.ca/tomk/phys3010.html

Content

Intermediate classical mechanics, including dynamics of particles and systems of particles, Lagrange's equations and Hamilton's equations

Topics:

1 Introduction: Recap of Newtonian Mechanics

2 **Hamilton's Principle — Lagrangian and Hamiltonian Dynamics**

Calculus of variations, constrained systems and generalized coordinates, general formulation of Hamilton's principle and Lagrange's equations of motion, conservation theorems, Hamiltonian dynamics, extensions

3 Applications

3.1 Central-force problem

3.2 Dynamics of rigid bodies

3.3 Coupled oscillations

Learning Outcomes

- Demonstrate a systematic understanding of the framework and the principles of (nonrelativistic) Classical Mechanics and its mathematical representation.
- Apply the principles of Lagrangian and Hamiltonian mechanics to analyze and solve problems in the field and describe applications in new settings; in particular
  - Apply Lagrangian and Hamiltonian mechanics to analyze two-body central-force problems.
  - Explain the intricacies of (three-dimensional) rigid-body dynamics.
  - Describe the physics of (linear) coupled systems and apply the Lagrangian formalism to analyze their motion.
- Appreciate the complexity, broader implications, and limitations of (nonrelativistic) Classical Mechanics in the description of physical phenomena.
- Gather, organize, synthesize, and critically evaluate information from lecture notes and textbooks.
- Demonstrate the intellectual independence, professional integrity and interpersonal skills required for successful mastery of your degree.

Prerequisites

PHYS 2010, MATH 2015, MATH 2271

Marking scheme

- assignments (six in total, pro-rated, best five out of six will count): 20 % of final grade
- tests (two in total): 40 % of final grade
  test formats and dates: tbd
- comprehensive (in-person) final exam: 40 % of final grade

Other considerations

- As per York's announcements from December 14 and January 6, courses will be delivered online until January 31. Accordingly, we will **meet on Zoom in the first three weeks of the term**.
- **Class attendance is highly recommended.** The material covered in class is the material that will be relevant for the midterm tests and the final exam.
- **The course eClass site** (to which all registered students will have access before classes begin) **will host all course materials (lecture notes, recordings, assignments, solutions, etc.)** It is imperative to consult it regularly.
- **It is VERY important that you do the assignments**, which will be posted on eClass and will have (firm) due dates. You can submit your assignments in person (once we are back on campus) or in digital format (pdf files are strongly preferred) through the eClass site. In addition to the graded homework problems you will be provided with a few ungraded practice problems and/or quizzes during the term. My advice: Do them all. There are many more problems available in the recommended texts and you are encouraged to try at least a few of those as well. It is a good idea to work together with your peers, but it is a bad idea to copy solutions from others or from the internet. **I expect everybody to hand in their own, original solutions.**
- A minimal formula sheet will be provided for the (closed-book) final exam and will be posted on eClass a few days before the exam date.
- If you miss a test the weight of that test will be pushed to the final exam.
- Cheating and plagiarism—the attempt to gain unfair academic advantage—will not be tolerated. Note that this includes allowing another student to submit original work—whole or in part—that you yourself have done. Note also that exams, tests, and other assignments are the copyrighted works of the professor assigning them, whether copyright is overtly claimed or not. Scanning or sharing these documents constitutes copying, which is a breach of Canadian copyright law, and the breach is aggravated when scans are shared or uploaded to third party repository sites.
- Any offence against the standards of academic honesty is a serious matter. It is expected that you are familiar with York's academic honesty policy to be found at: `https://www.yorku.ca/secretariat/policies/` and the academic integrity module in the Student Papers & Academic Research Kit (SPARK) that can be accessed via eClass.
- Other relevant York University policy statements deal, e.g., with the student code of rights and responsibilities, with academic accommodation, and accessibility for persons with disabilities. They can be found at:
`https://www.yorku.ca/secretariat/policies/` or via eClass.

- Please be aware of University-wide "Important Dates" to be found at `https://registrar.yorku.ca/enrol/dates/2021-2022/fall-winter`
- We all have to follow York's guidance on COVID-19, which may change during the term, e.g., we may have to change plans and dates of tests and exams or oscillate between in-person and online delivery. Any such changes will be communicated promptly (via eClass). Meanwhile, visiting `https://www.yorku.ca/bettertogether/` regularly will help everybody to stay updated on the latest York COVID-19 information and guidance.
- If you are in doubt about any of the above or require access to other resources, please ask. Any other questions, suggestions, criticisms are welcome as well. Just use one of the communication channels mentioned on the first page and get in touch. It is understood that we will all adhere to "common sense" guidelines to communicate effectively and courteously.