Contact Information

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Course Description

This course covers reformulations and extensions of classical mechanics beyond the Newtonian formulation of the mechanics of discrete rigid bodies. We will introduce the Lagrangian and Hamiltonian formulations of classical mechanics and discuss how they elucidate symmetries and the origins of conservation laws. Additionally we will study coupled oscillations leading up to the mechanics of waves in continuous media.

Topics covered:
- variational principles & the calculus of variations
- Lagrangian dynamics
- symmetries & conservation laws
- Hamiltonian dynamics
- coupled oscillators
- waves in continuous media
- non-inertial frames of reference

Prerequisites:
- One of PHYS 263, AMATH 261, 271
- One of MATH 227, 237, 247
- One of MATH 228, AMATH 250, AMATH 251

Learning objectives

A primary conceptual objective of this course is to understand how the Newtonian laws of physics can originate from a variational principle. Another major goal is to better appreciate the origin of conservation laws and their relationship to symmetries.
Additionally, we will seek to understand the origin of wave dynamics in continuous media. Beyond the conceptual objectives, we will develop the calculational techniques required to solve problems using the Lagrangian and Hamiltonian formalisms, as well as those involving wave dynamics in continuum media.

Resources

**Lectures:** Tues. & Thurs. 8:30AM-9:50AM  
room: DWE 3522

**Required textbook:** *Classical Dynamics of Particles and Systems*  
Authors: Stephen T. Thornton & Jerry B. Marion  
ISBN: 0534408966

**Other course materials:**  
Problem sets, reading assignments, and other course information will be posted on the Waterloo LEARN course website.

Assignments

**Reading assignments:**  
- Reading assignments from the textbooks will be posted on LEARN a weekly basis.  
- Weekly reading assignments should be completed prior to the first lecture of each week.

**Problem sets:**  
- Problem sets will be assigned on a roughly weekly basis.  
- Problem sets will generally be due at 2pm on Fridays in the PHYS 363 assignment box on the 2nd floor of the PHY building and the due date/time for each assignment will be posted on the problem set.  
- All assignments will be posted on the LEARN course website.  
- While working with other students on the problem sets is encouraged, the final problem set that is turned in for credit must be your own writeup and version of the solutions (that is at most based on an approach that was developed in collaboration with other students).  
- Solutions to problem sets will generally be posted on the LEARN page by the end of the week following the due date.

Assessments

**Problem sets:**  
- A selection of problems (possibly including all problems) will be graded on any given problem set.
• The lowest grade on a problem set will be dropped and the total problem set score will be the mean of the remaining problem sets.
• Late problem sets will generally be accepted for up to 50% credit up to 5 days following the due date (usually 2pm on Wednesdays). However, when it may be necessary to post solutions earlier than one week after the due date (e.g. due to an upcoming midterm exam), no late problem sets will be accepted and this will be indicated on the problem set when it is assigned.

Exams: There will be **TWO evening midterms** as well as a final exam

• Midterm schedule:
  
  - Midterm 1: Wednesday June 10th, 7-9PM MC 4020
  - Midterm 2: Wednesday July 8th, 7-9PM MC 4020

• If a student has an academic or religious conflict with the above scheduled midterm times they must inform the instructor by the end of the first week of lectures.
• Missed midterm or final exams will result in a an exam grade of 0%.
• Final Exam: TBA by The Registrar’s Office approximately five weeks prior to the final exam period.

Marking scheme: The course grade will be the greater of these two schemes

• 25% Problem sets, 20% Midterm 1, 15% Midterm 2, 40% Final exam
• 25% Problem sets, 15% Midterm 1, 20% Midterm 2, 40% Final exam

Special cases: Accommodations for missed exams or assignments will be considered only with verified Verification of Illness Forms (VIF).

Course expectations

• Lectures: Students are expected to attend and participate in all lectures and are responsible for all material covered in lecture. Students are responsible for taking their own lecture notes.

• Reading assignment: Students are expected to complete all reading assignments prior to the first lecture of the week, and are responsible for all material assigned in readings, even if it is not covered explicitly in lecture.

• Problem sets: Students are expected to complete and turn in all problem sets on time. Collaboration with other students is encouraged, but the final problem set that is turned in for credit must be your own, independent version of the solutions. Therefore your writeup may be based on an approach to the problem that was developed in collaboration with others, but you must generate and write up your own independent solution to submit the problem set for credit.

• Assignments and course announcements: Students are expected to regularly check for any new assignments or course announcements on the course UW LEARN website.
University Required Fine Print

- **Illness**: If you are ill and are unable to complete one or more course elements you must obtain a Verification of Illness form from this URL [http://www.healthservices.uwaterloo.ca/Health_Services/verification.html](http://www.healthservices.uwaterloo.ca/Health_Services/verification.html), have it signed by your doctor and bring it to the Science Undergraduate Office (Earth Sciences and Chemistry Building Room 253).

- **Academic Integrity**: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility.

- **Grievances**: Students, who believe that a decision affecting some aspect of their university life has been unfair or unreasonable, may have grounds for initiating a grievance. Students should read Policy #70, Student Petitions and Grievances, Section 4. When in doubt, students must contact the departments/schools administrative assistant who will provide further assistance.

- **Discipline**: Students are expected to know what constitutes academic integrity, to avoid committing academic offenses, and to take responsibility for their actions. Students who are unsure whether an action constitutes an offense, or who need help in learning how to avoid offenses (e.g., plagiarism, cheating) or about rules for group work/collaboration should seek guidance from the course instructor, academic advisor, or the Associate Dean of Science for Undergraduate Studies. For information on categories of offenses and types of penalties, students should refer to Policy #71, Student Discipline. For information on typical penalties, students should check Guidelines for the Assessment of Penalties.

- **Appeals**: A decision or penalty imposed under Policy 33 (Ethical Behavior), Policy #70 (Student Petitions and Grievances) or Policy #71 (Student Discipline) may be appealed, if there is a ground. Students, who believe they have a ground for an appeal, should refer to Policy #72 (Student Appeals).

- **Exam Period Travel**: Students should start checking for posted exam dates in the middle of June. Student travel plans are not considered acceptable grounds for granting an alternative examination time.

- **Students with Disabilities**: AccessAbility Services, located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If students require academic accommodations to lessen the impact of their disability, they should register with AccessAbility Services at the beginning of each academic term.

- **Revisions to Course Outline**: Some course details may be revised as necessary. Any revisions will be announced on the LEARN website and a revised outline will be posted with revisions highlighted in red.