

Oscillations & Waves Syllabus

Department of Physics and Atmospheric Science

PHYC2060 Fall 2023

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Course Instructor(s)

Name	Email	Office Hours
Laurent Kreplak	kreplak@dal.ca	Fridays, 2:30, Dunn 225
Glen Pridham	glen.pridham@dal.ca	TBD

Course Description

Oscillations and waves occur in a wide range of physical, chemical and biological systems. The objective of this course is to quantitatively explore the physics of oscillation and waves in a variety of classical systems such as mechanical and electrical oscillators, sound, and electromagnetic waves.

Course Prerequisites

PHYC 1190/1290 or PHYC 1310/1320, and MATH 1000/1010 or MATH 1280/1290

Course Exclusions

PHYC2140

Student Resources

Every week you will have access to corrected problems and curated web resources on the course brightspace page. The proposed activities are not marked and provide enrichment related to mathematical concepts presented in class. You will also have access to scanned notes and slides after each lecture, also on the brightspace page.

Course Structure

Course Delivery

This is an in-person course. During lectures you can expect a combination of writing on the board, slides and most importantly demonstrations. Note that demonstrations are not recorded and are a key component of the lectures.

Lectures

MWF 13:35-14:25 in Dunn 304

Laboratories

Not applicable

Tutorials

F 11:35-12:25 in Dunn 135

Course Materials

- *Waves and Oscillations, A prelude to Quantum Mechanics (Walter Fox Smith)*
- [https://bookstore.dal.ca/CourseSearch/?course\[\]=SUB,FALL23,PHYC,PHYC2060,01&](https://bookstore.dal.ca/CourseSearch/?course[]=SUB,FALL23,PHYC,PHYC2060,01&)
- *Kit for at home experiments will be provided in class*
- [Course Brightspace page](#)

Assessment

Assignments

4 assignments (one every 3 weeks), each 15%

Assignment 2 includes experiments to be done at home and will require a cell phone camera or a webcam.

Tests/quizzes

Mid-Term (50 min in class), 0 or 15%, Monday October 16th.

Final exam

Final Exam (3 hours, during exam period), 40 or 25%

Conversion of numerical grades to final letter grades follows the

<u>Dalhousie Grade Scale</u>			
A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (0-49)
A- (80-84)	B- (70-72)	C- (55-59)	

Course Policies on Missed or Late Academic Requirements

Assignment solutions are posted on Brightspace 1 week after the Assignment is due. There is no penalty for late assignments, but assignments received after the solution is posted will not be graded.

I do not offer make-ups for the assignments. For each assignment missed, the assignment weight (15%) will be shared equally between the students Mid-term and Final grades. The option of reducing the Mid-term weight by 15% to the benefice of the Final will remain, whichever scheme works best for the student.

*The Mid-term is set in class for **Monday October 16th**. Students should contact me as soon as possible if they are not able to attend that day.*

Course Policies related to Academic Integrity

*Students are encouraged to work together as a group on all 4 assignments. They can share tips and tricks, explain answers to each other. Trying to explain a concept to someone else is an excellent way to judge whether you fully understand that concept. **However full solutions of questions can't be copied verbatim within a group.***

For Assignment 2 that requires students to perform experiments at home and use their findings to answer a set of questions, students are encouraged to perform experiments together and to

share the raw data. **Each student must perform its own analysis and write their own answers to the questions.**

If you are using a generative AI and large language models (like chatGPT) to answer assignment questions, you must provide a screenshot of the question you asked and the answer you obtained. You are encouraged to think critically about the answer you have obtained by this method and modify it further to reflect your own understanding.

Learning Objectives

- *Underdamped and overdamped free oscillations in mechanical and electrical systems.*
- *Quality factor and driven response of a damped oscillator*
- *Analyse the behaviour of coupled oscillators (2 and 3 degrees of freedom) in term of normal modes*
- *Normal modes of a continuous string*
- *Fourier series and Fourier transform*
- *1D wave equation*
- *Complex number notation for oscillations, complex impedance*
- *Solving 2nd order linear Differential equations in various regimes and for different initial conditions*

Course Content

Week 1: Introduction (review of Newton 2nd law using projectile motion and review of key concepts of first year Calculus)

Week 2: Simple harmonic motion

Week 3: Using complex numbers to study harmonic motion

Week 4: Damped harmonic motion

Week 5&6: Driven oscillations

Week 7&8: Coupled oscillators

Week 9&10: Standing waves and Fourier analysis

Week 11&12: Travelling waves on a string, sound waves

University Policies and Statements

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

Conduct in the Classroom – Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at:

https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at:

https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.