

PHYSICS 2110A OSCILLATIONS AND WAVES

Course Outline: Fall 2023

Version 1.0

Important Notice:

This course outline is a living document that may be updated throughout the course. Such updates will be announced in class, and the latest version will be posted on <http://owl.uwo.ca>.

1 General Course Information

Course Information A unified treatment of oscillatory and wave motion, with examples from mechanics, electromagnetism, optics and materials science. Topics include simple harmonic motion, forced oscillations and resonance, coupled oscillations, transverse waves on strings and in crystals, longitudinal waves in gases and solids, electromagnetic waves, Fourier methods, nonlinear oscillations and chaos.

0.5 course: 3 lecture hours per week, 2 tutorial hours per week.

Prerequisite(s): Physics 1201A/B or Physics 1401A/B or Physics 1501A/B or the former Physics 1301A/B, each with a minimum mark of 60%, or the former Physics 1028A/B with a minimum mark of 80%; Physics 1202A/B or Physics 1402A/B or Physics 1502A/B or the former Physics 1302A/B, each with a minimum mark of 60%, or the former Physics 1029A/B with a minimum mark of 80%; a minimum mark of 60% in each of (Calculus 1000A/B or Calculus 1500A/B or Numerical and Mathematical Methods 1412A/B or the former Applied Mathematics 1412A/B) and (Calculus 1301A/B or Calculus 1501A/B or Numerical and Mathematical Methods 1414A/B or the former Applied Mathematics 1414A/B), or in the former Applied Mathematics 1413. Integrated Science 1001X with a minimum mark of 60% can be used in place of Physics 1202A/B and Calculus 1301A/B. **Pre-or Corequisite(s):** Mathematics 1600A/B or Numerical and Mathematical Methods 1411A/B or the former Applied Mathematics 1411A/B.

Note: Unless you have either the requisites for this course or written special permission from your Dean's Designate (Department/Program Counsellors and

Science Academic Counselling) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

2 Instructor Information

Instructor: Prof. Trichtchenko

email: otrichtc@uwo.ca

The simplest way to reach me outside of normal class hours is by email. Please allow me at least 24 hours to respond during regular week and 48 hours during the weekends. Students must use their Western (@uwo.ca) email addresses when contacting their instructors.

3 Course Syllabus, Schedule, Delivery Mode

Course Content Here are some of the topics we will cover in this class (not necessarily in this order). Whenever the topics are not covered in the course text, supplementary readings will be provided as required.

- Review of simple harmonic motion
- Damped oscillations
- Forced oscillations and resonance
- Coupled oscillations

- Travelling waves
- Standing waves
- Dispersion

Whenever possible, we will relate the topics to mechanical waves, electromagnetic waves, waves in quantum mechanics and finally waves in fluids. In addition to learning about oscillations and waves, part of the aim of this course is that you become familiar with some important mathematical tools that are important in all areas of physics. You will thus encounter complex numbers, matrices, integrals, and Fourier transforms, to name a few.

Learning Outcomes By the end of the course, the students will be able to

1. Understand the difference between free, damped and forced motion.
2. Understand the difference between oscillations and waves.
3. Understand the differences and similarities between standing and travelling waves.
4. Relate physical concepts to mathematical descriptions using concepts from linear algebra, complex analysis and differential equations.
5. Solve the relevant equations of motion for simple, damped and forced oscillators and interpret their physical meaning.
6. Perform simple calculations using Python and Jupyter notebooks.
7. Represent solutions to equations of motion both numerically and graphically in Python.

Labs The weekly lab period is an essential part of the course. Note that part of your course grade will be based on your attendance, your active participation and completion of the labs. As part of the lab you will learn how to use Python to do calculations and plot solutions graphically. Some of the homework assignments will also require the use of Python. The lab periods will also provide you with an opportunity to discuss homework assignments with the course instructor and teaching assistant.

Key Dates

Classes begin: September 7, 2023

National Day for Truth and Reconciliation (no classes): September 29, 2023

Thanksgiving Weekend: October 7-9, 2023

Fall Reading Week: October 30 – November 5, 2023

Last Day of Class: December 8, 2023

Exam period: December 10 – 22, 2023

Contingency plan

Although the intent is for this course to be delivered in person, should any university-declared emergency require some or all of the course to be delivered online, either synchronously or asynchronously, the course will adapt accordingly. The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

4 Course Materials

Owl: <https://owl.uwo.ca/portal> (log in with your UWO username and password) Owl will be used to post course materials, assignments, and grades.

Note: Students are responsible for checking the course OWL site (<http://owl.uwo.ca>) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class.

All course material will be posted to OWL: <http://owl.uwo.ca>.

If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Textbook: Vibrations and Waves by George C. King (Wylie, Chichester, 2009) This textbook can be purchased at the UWO Bookstore. Additional course materials will be distributed in class or made available on Owl as needed.

Homework: To be posted and submitted on Gradescope approximately every other week. **tentative due dates** are shown below

Homework Assignments (Total of 5)	Tentative Due Date
Homework 1	Sept 22
Homework 2	Oct. 6
Homework 3	Oct. 27
Homework 4	Nov. 17
Homework 5	Dec. 6

Note: Due dates may be pushed to later (but not earlier) depending on how the class is progressing.

Labs: Completed labs to be submitted weekly on Gradescope (linked through the course OWL site). Will use Jupyter notebooks and Python 3.8 freely available from <https://www.anaconda.com/products/individual>.

Dates of labs are below

Lab	Date
Lab 1	[*]
Lab 2	[*]
Lab 3	[*]
Lab 4	[*]
Lab 5	[*]
Lab 6	[*]
Lab 7	[*]
Lab 8	[*]

Technical Requirements:

- a laptop computer running any of Windows, Linux or MacOS and with an Anaconda Python installation (see link above)
- a non-programmable calculator

5 Methods of Evaluation

Your final grade in this course will be computed using the following scheme:

Homework Assignments (best 4 of 5)	20%
Labs (best 6 of 8)	10%
Test 1	18%
Test 2	17%
Final Exam (cumulative)	35%

Assignments: will be posted online approximately every other week, for a total of 5 assignments. Best 4 of 5 assignments count. Late penalties are automatically waived for the first 48 hours after a due date after which late assignments without academic accommodation will be penalized 10% per day for up to five days; assignments more than five days late will not be accepted. Weekends count: an assignment due on Friday but submitted on Monday is three days late. You may work on the homework together, but please submit individual answers and do not plagiarise from each other or internet sources (including ChatGPT). You may include the names of the people you worked with.

Assignments are to be submitted through Gradescope: if the uploaded answers cannot be read or the right answer is not indicated and easily found, these answers will not be assigned points. Please make sure your assignment is complete and legible before finishing your upload to Gradescope.

Labs/Tutorials: Students are expected to attend labs/tutorials and upload their completed Jupyter notebooks on Gradescope to be marked for effort and completion. These must be in a format that is recognised by Gradescope. No late submissions will be accepted as students can miss up to two labs without penalty.

Tests: There will be two tests that will take place during the lab times of two hours duration each.

Note: If a student misses test 1 or test 2 with valid documentation sent to Academic Counselling Office, the makeup exam will be the following [*]. If the student cannot attend the makeup test with valid documentation sent to Academic Counselling, the weight will be transferred to the one test that was written (if both tests were missed, the weight will be transferred to the final exam).

Final exam will be a three-hour exam held during the December exam period. It will cover the entire course. The format of the exam will be discussed in class.

To pass the course, students must achieve a minimum weighted average of 40% on the tests and final exams. A student who does not meet this criterion will receive a maximum grade of 45, regardless of marks in the other components of the course.¹

6 Student Absences

For missed work totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. For further information, please consult the University's medical illness policy at https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

The Student Medical Certificate is available at https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

Absences from Final Examinations If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam). You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (e.g., more than 2 exams in 23-hour period, more than 3 exams

¹The Department of Physics and Astronomy may, in exceptional cases, adjust the final course marks in order to conform to Departmental policy. Final grades will be rounded to the nearest integer, and grades ending in 9 (eg. 69) are not automatically "bumped up" by 1 mark.

in a 47-hour period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

7 Accommodation and Accessibility

Religious Accommodation: When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at <https://multiculturalcalendar.com/ecal/index.php?s=c-univwo>

Accommodation Policies: Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/AcademicAccommodation_disabilities.pdf

8 Academic Policies

The website for Registrarial Services is <http://www.registrar.uwo.ca>. In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner. Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Please note, academic integrity involves claiming credit only for work that you performed; the use of AI tools without acknowledgment violates this integrity. If you are found to have used AI tools inappropriately, this will be considered a violation of Western's academic integrity and scholastic offence policies. Please ask if you have questions about this topic or this policy.

9 Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling web-page for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: <https://www.uwo.ca/sci/counselling/>.

Students who are in emotional/mental distress should refer to Mental Health@Western (<https://uwo.ca/health/>) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at https://www.uwo.ca/health/student_support/survivor_support/get-help.html. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at http://academicsupport.uwo.ca/accessible_education/index.html if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (<https://learning.uwo.ca>) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Western University is committed to a thriving campus as we deliver our courses in the mixed model of both virtual and face-to-face formats. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: <https://www.uwo.ca/se/digital/>.

Additional student-run support services are offered by the USC, <https://westernusc.ca/services/>