Worcester Polytechnic Institute

PH1140: Oscillations and Waves
Physics Department
E1 Term 2026

Instructor:

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Textbook and Required Materials:

Textbook: OpenStax University Physics Volume 1, Volume 2, and Volume 3 (free online).
Canvas: Be sure that you are on the Canvas site and actively engaged with any posted materials. Important announcements and assessment materials will be accessed on Canvas as well.
Zoom App: You will need Zoom installed on your electronic device to access office hours for this term. Although this is not anticipated, some classes may be conducted on Zoom.

Course Meetings

Monday, Wednesday, & Friday, Zoom, 11am-12:50pm

Please note that the designations of "Lecture" and "Discussion" are irrelevant to this course. You are expected to be at both sessions and content will carry through all meetings, which may contain problem sets and group activities.

Catalog Description:

An introduction to oscillating systems and waves. Topics include: free, damped forced, and coupled oscillations of physical systems, traveling waves and wave packets, reflection, and interference phenomena.

Recommended Background:

Working knowledge of the material covered in PH 1110 and PH 1120 (or PH 1111 and PH 1121) and completion of MA 1021, MA 1022 and MA 1023.

Overall Learning Outcomes:

- Apply concepts, principles, and fundamental laws in physics to model physical systems to solve problems and perform experiments and identify their relevance to everyday circumstances in a broad interdisciplinary context.
- Solve problems individually and as a team and demonstrate qualitative reasoning to analyze the solutions to a problem or experiment and identify the assumptions and limitations.
- Demonstrate critical thinking, analytical and quantitative reasoning by using algebra, trigonometry, and calculus to set up and solve mathematical descriptions of physical systems and to calculate measurable quantities.
- Represent and communicate physical situations in multiple representations that include diagrams, figures, written text, graphs, tables, equations, verbally, with experimental data, and other forms.
- Reduce ill-defined and complex problems and experiments to be able to obtain reasonable

solutions and recognize that science, engineering, and physics is a process.
- Gain an appreciation for how physics applies to all fields of study.

Course Inclusivity

Please join me in striving to support an environment that creates a sense of community, safety, trust, authentic engagement, where we respect each other and our diverse backgrounds and identities we bring to the classroom, WPI, and the world. Participate in discussions but recognize that listening and reflecting is a powerful skill to understand different perspectives. Value the input from others and be aware of the assumptions you are making in any situation. Help me and each other to be better human beings.

Class Environment

Education research has shown that:

- The most learning occurs in an environment characterized by high expectations and respect and care for individual students, and where the value of collaboration is stressed over competition.
- The most learning occurs in an active classroom environment where students take responsibility for learning rather than being passive receptors of the professor's knowledge.
- Students can learn as effectively or more effectively from peers than from a professor.
- Facilitating development of students' communication, teamwork, and interpersonal skills is as important as helping them learn physics, science, and engineering.
- Professors and students are equals in the learning process. I have as much to learn about teaching and people as they have to learn about physics.

I ask that you reflect on these points and join me in cultivating a class environment conducive to learning.

Online Class Expectations

This course will meet over Zoom, but I will strive towards making the experience as close to in-person as possible. You are encouraged to attend the synchronous lessons throughout the term, and to interact with myself and others as often as possible. As stated in the previous section, it is not my wish to have a group of passive receptors, but vibrant and eager individuals that strive to understand the content. You will be given problems, short activities, and asked to create your own problems so you can connect physics to your own interests. Please abide by norms and expectations as if this were an in-person class, and be mindful of your words and actions as carefully as you would during in-person sessions. Remain engaged throughout the entirety of our time together.

Laboratory

There are several purposes to the laboratory. First, it balances *theory with practice* as we get a chance to see in detail the descriptive and predictive power of physical laws. Secondly, we also discover that much of what we first present in class is *ideal* and *reality* is always more complicated, subtle, and messy. Recognizing why something does not quite work out and figuring out why is very powerful in learning and modeling systems. Finally, and *most importantly*, there is a focus are on skill development such as experimental design, data analysis, communication, evidence-based reasoning, and decision-making. The Lab Manager, Dr. Tountcheva (vtountcheva@wpi.edu) oversees and runs the labs.

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Communication:

Office hours: We will negotiate office hours together on the first day of class, and please know that I am here for your success! Office hours will be posted on Canvas. Use the following Zoom link for virtual meetings: https://wpi.zoom.us/j/4131822429

Email: The best way to contact me is via email. Please use "PH1140" in the subject line.

Course Approach:

Week	Date Range	Topics and Assignments
1	5/21 – 5/22	**Topics:** Circular motion, Hooke's Law & simple harmonic motion of springs, **Readings:** Volume 1: 4.4, 15.1, 15.2, 15.3 **Homework:** In-class problems and SMART goals
2	5/25 – 5/29 *No class 5/25*	**Topics:** Pendulum simple harmonic motion (simple and physical), energy conservation **Readings:** Volume 1: 15.5, 15.6 **Homework:** Problem Set #1 (5/29), in-class problems, weekly reflection
3	6/1 – 6/5	**Topics:** Damped oscillations, energy in damped motion, damped driven mechanical systems, Circuitry & SHM **Readings:** Volume 2: 15.1 – 15.5 **Homework:** Problem Set #2 (6/5), in-class problems, weekly reflection
4	6/8 – 6/12	**Topics:** Completion of circuitry; mechanical waves & mathematics of waves, power, intensity, and waves at interfaces; principle of superposition, standing waves, sound waves, interference, Doppler Effect **Readings:** Volume 1: 16.4 – 16.6, 17.1 – 17.7 **Homework:** Problem Set #3 (6/12), in-class problems, weekly reflection
5	6/15 – 6/19 *No class 6/19*	**Topics:** Behavior of light, Young's double-slit, diffraction grating, single-slit diffraction, thin film interference, interferometers, EM waves **Readings:** Volume III: 1.1 – 1.7 **Homework:** Problem Set #4 (6/20), content problems, weekly reflection
6	6/22 – 6/26	**Topics:** Matter waves & intro to quantum mechanics **Readings:** Volume III: 6.5, 6.6, 7.1, 7.3 **Homework:** Problem Set #5 (6/27), content problems. final self-reflection

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Course Requirements:

1. **Grade Determination Breakdown:**

   a. Goal settings, reflections, and inquiry (150 points). An important element of success in any workplace is the writing of *SMART goals* (Specific, Measurable, Achievable, Relevant, and Timely). Setting goals helps to maintain focus and serve as a reminder of why we are learning. Your goals will serve as a guide to ensure you are focused on learning the content along with connecting the content to your own studies and interests. *Reflections* are an opportunity to consider progress towards meeting goals and to determine what needs to be done to bring them into realization. This is an opportunity to keep yourself honest and monitor your learning of content. *Asking questions* is vital to understanding material – it is expected to join office hours or ask questions whenever needed. If you are unsure of how to carry out any of these processes, be sure to ask me for assistance as soon as possible.

   b. Content problems & explorations (300 points). Every class will consist of problem sets and explorations that will be graded based upon your effort and diligence towards understanding the presented material. Some may be collected and correctness will be considered. Explorations may be simply practicing the methods learned in class, simulations, or short activities. Watching all classes is therefore expected so you can properly complete these explorations and earn the points associated with each assignment. These assignments should be submitted by the end of each week. Extra problems will also be provided to be solved for your own benefit and towards your growth plan.

   c. Homework assignments (300 points). There will be five problem sets throughout the term, each worth 60 points. Solutions to the problem set will be posted at least one day prior to the due date. You are expected to submit your original solutions, corrections to your own solutions, and a reflection that documents your strengths and areas of growth. In your reflection, construct an action plan on how you intend to turn areas of growth into strengths. *All corrections and reflections must be clearly shown*, *and if corrections are not present no points will be awarded on the assignment*. You are encouraged to solve problems through keeping your course goals in mind. For example, you might have a goal where you would like to become more proficient in Python. In that case, try and solve problems using Python – creating graphs and other visuals would be an excellent way to achieve such a goal. You could also write small simulations to visualize solutions to problems. There are many ways to accomplish your goals!

   d. Lab (250 points). There is lab component integrated with the class. *You are required to complete all labs and submit a lab report for each to pass this course*. The lab grade will be the average of the scores over all the lab reports.

Your course grade will be a percentage of the total amount of points earned divided by the total possible points (1000 points). Please make every effort to keep track of your grade throughout the term to monitor your progress.

2. **Assignments**

   a. In-class problems will be assigned within each class. Students are expected to work as a group or individually, but it is encouraged to work together and aide one another in the problem-solving process. This portion of the course emphasizes the importance of your participation.

   b. Homework can be found on Canvas. The due date for each assignment is provided in this document, on the homework folder itself, and within the "Assignment" area of Canvas (see the

Course Approach). You will submit a document with each homework assignment that contains your *original* solutions, your *corrected* solutions, and a short reflection. Solutions will be provided at least one day *before* the due date. Homework is meant to be a self-reflective practice and to gauge where you stand in your understanding. These problems are meant to be challenging and to stimulate thought as you will have one week to bring them to completion.

c. Content problems will be provided each week. These are open response questions meant to gauge your understanding the material that was presented in-class. You will be expected to solve these problems to the best of your ability. While you might not solve every problem, they were created to scaffold your understanding of the material. These problems build up in their complexity, so if you feel you have mastered the basics, move onwards to the later problems for a greater challenge. Again, keep your goals in mind throughout the process!

3. Late Work

Late work is not encouraged in this course. However, if a difficult situation arises that will result in an assignment being turned in after its due date, please communicate this with me so that I am aware.

4. Class Participation Expectations and Criteria

You are required to watch each class and participate in the provided in-class problem sets and explorations. Classwork assignments are expected to be completed within the allotted time.

Academic Integrity:

You are expected to be familiar with the policies surrounding academic integrity, which can be found here. Consequences for violating the Academic Honest Policy range from earning a zero on the assignment, failing the course, or being suspended or expelled from WPI.

Common examples of violations include:

- Copying and pasting text directly from a source without providing appropriately cited credit.
- Paraphrasing, summarizing, or rephrasing from a source without providing appropriate citations.
- While working in groups for the labs and solving the homework problems is strongly encouraged in this class, collaborating on exams is considered cheating.
- Turning in work where a good portion of the work is someone else's, even if properly cited.

Academic Accommodations:

Students with approved academic accommodations should plan to submit their accommodation letters through the Office of Accessibility Services Student Portal. Should you have any questions about how accommodations can be implemented in this particular course, please contact me as soon as possible. Students who are not currently registered with the Office of Accessibility Services (OAS) but who would like to find out more information about requesting accommodations, documentation guidelines, and what the accommodated interactive process entails should plan to contact OAS either by email (AccessibilityServices@wpi.edu), by phone (508) 831-4908, or by stopping by the office on the 5th floor of Unity Hall.

In addition to the services offered by WPI, I want to be sure all students understand that they are supported in my class. If you require extra time to complete any task, please do not hesitate to contact me directly and let me know. It is not necessary to let me know why you need extra time – I will trust your own judgment, dedication, and desire to learn the content being delivered.

Support Information:
Support is always available to students in this course. Along with office hours provided by the instructor and negotiated by the students, Peer Learning Assistants and/or Teaching Assistants will also offer office hours at locations specified on our Canvas landing page. In your endeavors to master course content, it is also highly suggested to do the following:

- Properly utilize the textbooks. This means *not* reading the textbook like a novel, but using it as a reference guide to support any misunderstandings or difficulties you are having. For example, skip to a particular section, try the text's practice problem(s), and then go to the end of the chapter to try to solve end of chapter problems.
- Form study groups. Research has shown the benefits of working in groups and collaboration, especially when all members of a group work towards avoiding distractions. It is recommended that you find individuals that you work well with and sit with them in class and continue working together outside of class. Negotiate a regular space and meeting time ahead of time to avoid potential conflicts.
- Use study patterns shown to provide the best results. Start assignments ahead of time and do not cram for quizzes. Study and work in reasonable time intervals, and provide room for breaks.

Gordon Library:
Gordon Library offers research support to all WPI students, at any stage of your academic career. For any research-related questions, general or specific, please feel free to contact the Library. Research librarians provide individual and group research consultations, and are happy to work with students in-person or online. Reach out to Gordon Library research librarians by doing one of the following:

- Make an appointment to set up a meeting with a librarian for research help one-on-one or in a small group.
- Email research librarians at reslib@wpi.edu and a librarian will get back to you within one business day.
- Use our chat service to get a quick response from someone who can help you or refer you to the right person.

Grading Policy:
Final course grades are based on a student's performance. This course has 1000 possible points, and your grade can be tabulated simply by taking the earned points and dividing that by the possible points. Please be advised that there are no assignments for extra credit – all assignments are meant to be exercises of self-reflection and monitoring of progress. If you do not actually complete the assignments as intended, then there exists no evidence of learning. The grading scale is as seen below:

Letter Grade	Percentage
A	90 - 100
B	80 - 89
C	70 - 79
NR	< 70

A course incomplete may be granted if the student demonstrates progress towards content mastery and maintains communication with me. The conversation around being granted an incomplete should begin one

week prior to the end of the term. If an incomplete is granted, a timeline to submit assignments will be built and agreed upon by the student and myself.

Changes to the Syllabus:

This syllabus is a guide, and every attempt is made to provide an accurate overview of the course. However, circumstances and events may make it necessary for the instructor to modify the syllabus during the term and may depend, in part, on the progress, needs, and experiences of the students. Changes to the syllabus will be made in writing and in advance.