Syllabus – PHYS 343 – Fall 2025

Course Information:

PHYS 343:	Classical Physics III: Vibration and Waves, 4 credits, Fall 2025
Meeting Times:	MWF, 11:45 am-12:45 am; Thurs, 11:30 am-12:30 pm
Meeting Location:	Reichardt 203

Instructor Information:

Instructor:	Peter Delamere, Professor of Space Physics
Office:	708E Elvey (Geophysical Institute)
Email:	padelamere@alaska.edu
Phone:	(907) 474-6442
Office Hours:	Tues: 1:30 pm to 4:30 pm (Reichardt) or By appointment (Elvey)

Prerequisites: Physics 342

Scope: This final course in the Classical Physics sequence addresses normal modes and small vibrations, continuum systems, wave mechanics, electromagnetic waves and radiation, relativistic mechanics and electromagnetism.

Approach: The course is intended to address all aspects of wave phenomena in Classical Physics. We will start with simple coupled oscillations and normal mode analysis. The secret of normal mode analysis is to identify a coordinate system where each component oscillates with a single, well-defined frequency. That is, no coupling occurs among the normal coordinates. And at the root of the normal mode problem is eigenmode analysis. Students will become quite familiar with eigenfrequencies, eigenvectors and orthogonality. The second topic addresses vibrating strings, or continuous systems from which we will derive the wave equation. Wave mode analysis is at the core of many branches of physics. We will address solutions to the wave equation and such fundamental wave concepts as phase and group velocity, dispersion, attenuation, wave packets, spectral distribution, beats, modulation, reflection, transmission, and polarization. The third topic will be involve electromagnetic waves and radiation (basically a continuation of PHYS 342). Finally, the course will culminate with the special theory of relativity, relativistic mechanics, and relativistic electrodynamics.

Topics:

- Coupled oscillations and normal mode analysis (eigenmode analysis)
- Continuous systems and the wave equation
- Basic wave concepts
- Electromagnetic waves and radiation
- Special theory of relativity
- Relativistic mechanics
- Relativistic electrodynamics

Student learning outcomes: Upon completion of this course, students should be able to:

- Conduct normal mode analysis and feel very comfortable with the eigenmode problem.
- Systematically develop properties of continuous systems (e.g., vibrating strings) and derive the wave equation.
- Solve the wave equation.

- Connect wave concepts to the broad range of topics in physics that involve waves, e.g., water, sound, electromagnetic, seismic, and plasma waves.
- Derive the wave equation for electric and magnetic fields.
- Utilize Liénard-Wiechert potentials.
- Understand the origin of electromagnetic radiation.
- Appreciate the origins and development of the special theory of relativity.

Textbook:
Griffiths, D. J., Introduction to Electrodynamics, Third Edition.
Taylor, John R., Classical Mechanics.
[optional: Marion and Thornton, Classical Dynamics, Third Edition.]

Programming languages: Should numerical solutions be requested, students are welcome to submit programming solutions in the language of their choice. Recommended languages for this course are Matlab, IDL, and Python.

Grading:

Homework/Quizzes	30%
Midterm #1	20%
Midterm #2	20%
Final Exam	30%

Course Policies:

(a) Attendance and participation in class is expected of all students.
(b) Assignments are due at the beginning of class on the due date.
(c) Students are encouraged to work together on homework problems, but the final written solutions must be individual work.
(d) Students must acknowledge all sources of information – included fellow students – used in homework solutions and final projects. The UAF catalog states: "The university may initiate disciplinary action and impose disciplinary sanctions against any student or student organization found responsible for committing, attempting to commit or intentionally assisting in the commission of . . . cheating, plagiarism, or other forms of academic dishonesty. . . "
(e) All UA student academics and regulations are adhered to in this course. You may find these in the UAF catalog (section "Academics and Regulations").
(f) A large component of the assessments in this course requires critical thinking and synthesis of ideas in writing. Artificial Intelligence (AI) platforms such as ChatGPT could easily be used as a "student proxy" for this work. The danger in letting an AI platform do the synthesis and writing is that the student will not develop these important skills as part of the course learning objectives. Additionally, AI platforms such as ChatGPT are notorious for making things up, and it is difficult to ascertain if the information is correct or not. Therefore, the course policy is for students not to use AI platforms at all in this course (unless explicitly encouraged by the instructor). It is critical for students to develop core research and writing skills first before adding AI and other technological tools to their research toolbox.

Student protections statement: The university respects and upholds the principles of due process and a fair and equitable process as specified in the Board of Regents' Policy 09.02 Student Rights and Responsibilities. For more information regarding the rights and responsibilities of students, refer to the Office of Rights, Compliance and Accountability website. You are encouraged to read the Board of Regents' policy carefully to fully understand your responsibilities to our community.

We strive to create a safe and respectful environment for all members of our community. If you have questions about expectations of you as a student or believe your rights are being violated, we encourage you to reach out to the Office of Rights, Compliance and Accountability for help. UAF reserves the right to suspend, expel or take other necessary and appropriate action in cases where a student is unable or unwilling to uphold community standards and campus safety.

For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: https://catalog.uaf.edu/academics-regulations/students-rights-responsibilities/.

Disability services statement: I will work with the Office of Disability Services to provide reasonable accommodation to students with disabilities.

ASUAF advocacy statement: The Associated Students of the University of Alaska Fairbanks, the student government of UAF, offers advocacy services to students who feel they are facing issues with staff, faculty, and/or other students specifically if these issues are hindering the ability of the student to succeed in their academics or go about their lives at the university. Students who wish to utilize these services can contact the Student Advocacy Director by visiting the ASUAF office or emailing asuaf.office@alaska.edu.

Student Academic Support:

- Communication Center (907-474-7007, uaf-commcenter@alaska.edu, Student Success Center, 6th Floor Room 677 Rasmuson Library)
- Writing Center (907-474-5314, uaf-writing-center@alaska.edu, Student Success Center, 6th Floor Room 677 Rasmuson Library)
- UAF Math Services (907-474-7332, uaf-traccloud@alaska.edu)

Drop-in tutoring, Student Success Center, 6th Floor Room 672 Rasmuson Library)
1:1 tutoring (by appointment only), 6th Floor Room 677 Rasmuson Library
Online tutoring (by appointment only) available
https://www.uaf.edu/dms/mathlab/, available at the Student Success Center

- Developmental Math Lab (Gruening 406, https://www.uaf.edu/deved/math/)
- The Debbie Moses Learning Center at CTC (907-455-2860, 604 Barnette St, Room 102, https://www.ctc.uaf.edu/student-services/student-success-center/)
- For more information and resources, please see the Academic Advising Resource List https://www.uaf.edu/advising/students/index.php

Student Resources:

- Disability Services (907-474-5655, uaf-disability-services@alaska.edu, 110 Eielson Building)
- Student Health & Counseling [free counseling sessions available] (907-474-7043, https://www.uaf.edu/chc/appointments.php, Whitaker Building, Room 206, Health, Safety & Security Bldg - same building as Fire and Police)
- Office of Rights, Compliance and Accountability (907-474-7300, uaf-orca@alaska.edu, 3rd Floor, Constitution Hall)
- Associated Students of the University of Alaska Fairbanks (ASUAF) or ASUAF Student Government (907-474-7355, asuaf.office@alaska.edu, Wood Center 119)

Nondiscrimination statement: The University of Alaska is an equal opportunity/equal access employer, educational institution and provider. The University of Alaska does not discriminate on the basis of race, religion, color, national origin, citizenship, age, sex, physical or mental disability, status as a protected veteran, marital status, changes in marital status, pregnancy, childbirth or related medical conditions, parenthood, sexual orientation, gender identity, political affiliation or belief, genetic information, or other legally protected status. The University's commitment to nondiscrimination, including against sex discrimination, applies to students, employees, and applicants for

admission and employment. Contact information, applicable laws, and complaint procedures are included on UA's statement of nondiscrimination available at www.alaska.edu/nondiscrimination.

UAF Department of Equity and Compliance
1692 Tok Lane, 3rd floor, Constitution Hall, Fairbanks, AK 99775
907-474-7300
uaf-deo@alaska.edu

University Sponsored Off-Campus Programs and Research Activities:
We want you to know that:

- UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: https://www.alaska.edu/nondiscrimination/.
- Incidents can be reported to your university's Equity and Compliance office (listed below) or online reporting portal. University of Alaska takes immediate, effective, and appropriate action to respond to reported acts of discrimination and harassment.
- There are supportive measures available to individuals that may have experienced discrimination.
- University of Alaska's Board of Regents' Policy & University Regulations (UA BoR P&R) 01.02.020 Nondiscrimination and 01.04 Sex and Gender-Based Discrimination Under Title IX, go to: http://alaska.edu/bor/policy-regulations/.
- UA BoR P&R apply at all university owned or operated sites, university sanctioned events, clinical sites and during all academic or research related travel that are university sponsored.

For further information on your rights and resources go to https://www.alaska.edu/accountability.

Schedule:

Topic	Week	Dates
Coupled oscillations and continuous systems	1-4	
E&M conservation laws	5	
Midterm #1	6	Wednesday, September 24
General wave properties and electromagnetic waves	6-10	
Midterm #2	11	Wednesday, October 29
Electromagnetic radiation and relativity	11-15	
Final exam	16	1:00 - 3:00 p.m., Mon, Dec. 8