Syllabus { PHYS 343 { Fall 2020

Course Information:

PHYS 343:	Classical Physics III: Vibration and Waves, 4 credits, Fall 2020
Meeting Times:	MWF, 11:45-12:45; Thurs, 9:30-10:30
Meeting Location:	Reichardt 204

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: 1:00 to 4:00 (Reichardt) or By appointment (Elvey)
	https://alaska.zoom.us/j/92046037194?pwd=VHFPVmN2LzN2VmhYY2hzR1krdnNMdz09

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 elds.
- Utilize Lienard-Wiechert potentials.
- Understand the origin of electromagnetic radiation.
- Appreciate the origins and development of the special theory of relativity.

Textbook:
Gri ths, 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 to

beyond the student's control, such as sickness, has not been able to complete the course during the regular semester. Negligence or indi erence are not acceptable reasons for an \I" grade."

(e) E ective communication: Students who have di culties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication's Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English Department's Writing Center (907-474-5314, Gruening 8th oor), and/or CTC's LearningCenter(604 BarnetteStreet,907-455-2860).

Schedule:

Topic	Week	Dates
Coupled oscillations and continuous systems	1-4	
E&M conservation laws	5	
Midterm #1	6	Wednesday, September 30
General wave properties and electromagnetic waves	6-10	
Midterm #2	11	Wednesday, November 4
Electromagnetic radiation and relativity	11-15	
Final exam	16	