PHYaa 250: Mechanics, Fluids, Waves and Light

Fall 2021

General Information

Class Schedule: M 10:30 am - 12:25 pm, T 10:30 am - 12:25 pm

Class room: MARIE S. GERMAIN

Professor: Anabela Turlione

Contact: anabela.turlione@digipen.edu - int:1029

Class web page: PHY250 at distance.digipen.edu

Office hours: by appointment

Prerequisites

PHY200: Motion dynamics and MAT200 Calculus and Analytical Geometry II.

It will be assumed that the student has knowledge in Kinematics, Newtonian Dynamics, work and the law of conservation of energy. It will also be assumed that the student has some basic knowledge in calculus of derivatives, basic trigonometrical curves and operations, common geometrical relations, integral calculus and power series. The students should revisit the above topics before entering in deeper physics.

Description

This course provides a fundamental understanding of clasical mechanics, fluid dynamics, oscillations, waves and optics. Attention will be paid to numerical applications that are relevant to simulations.

Course Objectives and Learning Outcomes

Upon a successfully completion of this course the students will gain a fundamental understanding of :

1. Main characteristic of fluids which will allow them to solve buoyancy problems and describe laminar flow with and without viscosity.
2. The causes of the oscillations and its mathematical description. The students will be able to find the frequency of simple and physical pendula as well as of an oscillating elastic body.
3. Creation and propagation of mechanical waves and its description through the wave equation.
4. Interferences between traveling waves.
5. The phenomena of standing waves and resonance. The students will learn to find the nodes and the harmonic frequencies of resonance.
6. The sound and the common effects of its propagation, Doppler effect, beats, etc.
7. Ray model of light, the foundations of ray tracers and the dual nature of the light.
8. Thermodynamics, the first and second laws, definition of entropy and the microscopic interpretation

Textbooks

- University Physics, 9th Edition, by Zears & Zemansky ISBN: 0 – 201 – 57157 – 9
- Physics for Scientists and Engineers, Prentice Hall 4th Edition, by Giancoli Chapters: 13-16, 32-34, 17-20 ISBN: 0 – 13 – 149508 – 9

Relation with other subjects

PHY250 closes PHY300.

Grading Policy

The breakdown of the weighting of the Total Score will be as follows:

1. Homework (30 %)
2. Mid term (30%)
3. Final project (40%)

The minimum grade to pass the subject is 60 %

Homework

- Problem sets are due approximately every two weeks.
- Work summited late is worth a maximum of 20 % total credit.
- Homework must be summited in Moodle.

Midterm

The midterm is a closed-book exam and consists of solving a set of exercises that cover the theory taught during the first six weeks of class.

Course Final Project

The course final project will utilize numerical methods to approximate a physical system and resolve the motion and interaction of the objects in the simulation. The project is intended as an opportunity to put into practice and further develop the techniques learned in the course.

Relevance/Statement

It is important to keep up with the material, to study regularly at home (at least 2 hours for every hour in class) and to do as many problems as you can (don't limit yourself to the assigned or recommended problems, or merely the problems that are due).

You are welcome to work with other students, so long as the aim is furthering your understanding of the concepts and problem solving techniques. I am happy to help work through problems, either in office hours or in class. Just remember, doing a problem yourself is very different from watching another person do so. If you work together on problem sets, be sure to provide your own solution to every problem proving that you understand your writing. In addition, some exam questions may be a resemblance to homework questions, so you're encouraged to fully understand what you turn in. Again, reading the relevant book sections before the material is taught is highly recommended.

Last Day to Withdraw: Tuesday 11/2/2021

Academic Integrity Policy

Academic dishonesty in any form will not be tolerated in this course. Cheating, copying from any sources (including current or past students work, online sources or books), plagiarizing, or any other form of academic dishonesty (including doing someone else's individual assignments) will result in, at the extreme minimum, a zero on the assignment

in question, and could result in a failing grade in the course or even expulsion from DigiPen. Assisting others in cheating is prohibited and will be equally punished.

Disability Support Services

If students have disabilities and will need formal accommodations in order to fully participate or effectively demonstrate learning in this class, they should contact the Administration Office at 946365163. The Administration Office welcomes the opportunity to meet with students to discuss how the accommodations will be implemented. Also, if you may need assistance in the event of an evacuation, please let the instructor know.

Outline and Tentative Dates

Timeline	Topic	HW	Approximate book Section
Week 1	Static Fluids: Density, Pressure and Pascal Principle, Buoyancy and Archimedes Principle		Ch 13
Week 2	Fluids in Motion, Equation of Continuity, Bernoulli's equation	HW 1	Ch 13
Week 3	Surface Tension, Viscosity, Poiseuille's equation, Drag forces. Generalization: Navier-Stokes equations		Ch 13
Week 4	Periodic Motion: Simple Harmonic Motion		Ch 14
Week 5	Energy of SHM, Potential Diagram. Simple Pendulum. Physical Pendulum. Oscillations in 2D, DHM, Resonance	HW 2	Ch 14
Week 6	Waves: Wave Motion, Mathematical Representation Traveling Waves, Longitudinal and Transversal Waves		Ch 15
Week 7	Energy on a Wave. Principle of Superposition. Interference, Standing Waves	HW 3	Ch 15
Week 8	**Review and Midterm**		
Week 9	Sources of sound: Resonance. Sound I: Intensity (dB), Sound Level, Ear Response. Beats. Sound II: Doppler Effect, Shocks Waves.	HW 4	Ch 16
Week 10	Thermodynamics: Temperature and Heat, Thermal Properties of Matter, The first Law of Thermodynamics		Ch 17- Ch 19
Week 11	The Second Law of Thermodynamics: The Carnot cycle, Entropy, Microscopic Interpretation	HW 5	Ch 19, Ch 20
Week 12	The Nature and propagation of light.		Ch 16, Ch 32
Week 13	Geometric Optic: Light Reflection, Light Refraction, Snell's Laws, Diffraction.	HW 6	Ch 16, Ch 32
Week 14	**Review and Final Project**		

[This entire syllabus, particularly the time line, may be adjusted or changed at any time by the instructor.]