



PHYS 250: Classical Mechanics II: Fluids, Waves, & Thermodynamics

Course Syllabus
Summer Session II – 2026

Instructor:

Credits: 3

Contact Hours: 45

Class Meeting Days & Time:

Office Hours: By appointment after class or via Zoom (see Moodle)

Email:

Course Type: Standard Course

Course Fee:

Course Description

This course introduces the following concepts: Physics of fluids: statics and an introduction to dynamics. Ideal and real fluids. Periodic motion, simple harmonic motion, damped and forced oscillations. Waves in elastic media. Interference. Thermodynamics: temperature and heat. First law, transformations. Heat transfer. Second law. Thermodynamic functions: entropy and enthalpy. Microscopic interpretation. Entropy and disorder. The course is organized into frontal lectures, exercises, and small laboratory experiments.

Learning Outcomes and Assessment Measures

By the end of this course, students will be able to:

- describe the basic elements of fluid statics and dynamics;
- illustrate through problems the nature of wave propagation in elastic media;
- test the thermodynamics of equilibrium states using laboratory experiments.

Course Materials

Walker, J. (2018). *Fundamentals of Physics* (Halliday & Resnick) (11th ed.). Wiley.

Additional Resources

- Supplementary notes and practice problems will be provided on Moodle.
- Software (optional): MATLAB, Python (NumPy), or SolidWorks for computational labs, accessible via institutional licenses or free downloads.

Grading

Students are reminded that it is their responsibility to note the dates of exams and other assignments. No alternative exam dates will be offered and professors are not required to give partial credit for any late work (they do so at their discretion: the Institute's default policy is no extensions and a zero for any work turned in late). Students who book travel when they have an exam or other assessment will have to change

their plans or accept a zero. Letter grades for student work are based on the following percentage scale:

Letter Grade Range	Numerical Score Equivalent	Student Performance
A	93% - 100%	Exceptional Excellent
A-	90% - 92%	
B+	87% - 89%	Superior
B	83% - 86%	
B-	80% - 82%	
C+	77% - 79%	Satisfactory
C	73% - 76%	
C-	70% - 72%	
D+	67% - 69%	Low Pass
D	63% - 66%	
D-	60% - 62%	
F	59% or less	Fail (no credit)

Please note: decimal numerals between 1-4 are rounded down while 5-9 are rounded up: e.g., expect 89.4 to be 89.0 while 89.5 to round up to 90.

Course Requirements

Attendance: 10%

Quizzes: 5% (weekly, in-class, testing core skills)

Problem Sets: 25%

Labs: 10%

Midterm Exam: 25% (Week 2, covering Weeks 1–2)

Final Exam: 25% (Week 4, comprehensive)

Extension & Submitting Late Work

Umbra Academic Policies apply

Attendance Policy

Umbra Academic Policies apply

Tardiness Policy

Umbra Academic Policies apply

Academic Integrity

Umbra Academic Policies apply

Classroom Policy

Umbra Academic Policies apply

Moodle

Please note that Moodle, not this syllabus, is the ultimate reference for due dates, assignment prompts, and course announcements. It is *the student's responsibility* to check the site regularly to be aware of announcements as well as to see and record all due dates for assignments.

Schedule of Topics, Readings, and Assignments

Week 1: Fluid Physics

Pressure and density. Fluid statics, Stevino's and Pascal's laws. Archimedes' principle. Fluid dynamics. Continuity equation. Bernoulli's theorem and applications. Viscous fluids. Surface and capillary phenomena. Turbulence

- **Meeting 1:** Fluids (Walker 386-401)
- **Meeting 2:** Oscillations (Walker 413-442)
- **Meeting 3:** Waves (444-472)
- **Meeting 4:** Problem Sets & Lab at the University of Perugia

Week 2: Oscillations and Waves

Periodic motions: sinusoidal vibrations, simple harmonic motion. Superposition of periodic motions. Damped and forced harmonic oscillator; resonance. Waves in elastic media. Transverse and longitudinal elastic waves. Waves in gases.

Interference phenomena. Standing waves. Doppler effect..

- **Meeting 1:** Waves II (Walker 479-503)
- **Meeting 2:** Temperature, Heat, and the First Law of Thermodynamics (Walker 514-548)
- **Meeting 3:** The Kinetic Theory of Gases (Walker 549-571)
- **Meeting 4:** Problem Sets & Lab at the University of Perugia

Week 3: Thermodynamics I

Thermodynamic systems and states. Thermodynamic equilibrium. Temperature, thermometers. Work and heat. First law of thermodynamics. Internal energy. Thermodynamic transformations. Calorimetry. Specific heats. Ideal and real gases.

Ideal gas law. Internal energy of an ideal gas.

- **Meeting 1:** Mid-Term Exam
- **Meeting 2:** Entropy and the Second Law of Thermodynamics (Walker 583-598)
- **Meeting 3:** Energy in Complex Systems: Computational Systems (AI)
- **Meeting 4:** Energy in Complex Systems: Biological Systems

Week 4: Thermodynamics II

Adiabatic, isothermal, isochoric, and isobaric transformations. Cyclic transformations. Second law of thermodynamics.

Carnot cycle. Entropy. Thermodynamic potentials. Enthalpy and Free energy. Kinetic theory of gases. Entropy and disorder.

- **Meeting 1:** Problem Sets & Discussion
- **Meeting 2:** Problem Sets & Discussion
- **Meeting 3:** Lab at the University of Perugia
- **Meeting 4:** Final Exam