

PHYS 213: Fluids & Thermal Physics, General Syllabus

Instructor	Please contact Dr. Costantino for questions djc321@psu.edu
Times	See your course schedule for times & locations
Course Credits	2

Course Description

Calculus-based study of the basic concepts of fluids and sound, heat, kinetic theory, and entropy.

Required Text

The text for this course is *Physics for Scientists and Engineers: A Strategic Approach* by Knight, 4th edition. This course will cover Chapters 14, 16-21. The soft-cover PSU custom “split” with these sections, available at the bookstore, also contains access to the MasteringPhysics homework system we will be using in the course.

In addition, you are also required to have an i>clicker. These are available from the bookstore and elsewhere. Using your i>clicker in lecture is part of your grade. You can find out about obtaining and registering i>clickers on the ITS Clicker website. There is a link in the Lessons folder to directly register your clicker. If you do not register your clicker, then you cannot earn a lecture participation grade (3% of the total course grade).

Course Prerequisites

- Prerequisite: PHYS 211, MATH 140
- Concurrent: MATH 141

Course Content Objectives

PHYS 213 students are expected to be proficient in all PHYS 211 core objectives. Upon completion of PHYS 213, students should be able to demonstrate a mastery of:

1. Fluids and elasticity by
 - 1.1. Interpreting correctly densities and pressure
 - 1.2. Relating buoyant force to the volume of fluid displaced and its density.
 - 1.3. Calculating the hydrostatic pressure as a function of depth in a fluid.
 - 1.4. Calculating the fractional change in an object's length, volume, or shape when it is subjected to a given tensile, bulk, or shear stress.
 - 1.5. Using the equation of continuity for fluid motion.
 - 1.6. Using Bernoulli's equation (conservation of energy) for fluid motion.
2. Waves including
 - 2.1. Employing the mathematical description of traveling plane waves to describe the longitudinal sound wave and transverse waves on a string.

- 2.2. Predicting the waveform due to the superposition of two overlapping waves and identifying cases of constructive and destructive interference.
- 2.3. Relating the fundamental frequency to the harmonics of standing waves in confined media.
- 2.4. Relating the speed of sound to the properties of the medium.
- 2.5. Relating the beat frequency of two interacting waves to the frequencies of the individual waves.
3. Macroscopic description of matter including
 - 3.1. Identifying macroscopic state variables such as pressure, volume, temperature, and mass or number of moles of a system.
 - 3.2. Applying the ideal gas equation to an ideal gas problem.
 - 3.3. Identifying a pV diagram as depicting an isothermal, isochoric, isobaric, or adiabatic process.
4. Thermodynamics such as
 - 4.1. Identifying heat as a transfer of energy and relating heat transfer between objects to specific heats and temperature changes.
 - 4.2. Calculating heat transfer in a phase transition.
 - 4.3. Contrasting specific heat of gases at constant pressure and constant volume.
 - 4.4. Relating the work done by (or on) a system to the initial and final states of the system and to the path taken on the pV diagram.
 - 4.5. Applying the first law of thermodynamics and relating changes in thermal energy to changes in temperature.
 - 4.6. Qualitative application of the second law of thermodynamics to understand equilibration of temperatures.
 - 4.7. Relating the physical dimensions of an object to the coefficients of expansion and the temperature changes during thermal expansion.
5. Kinetic theory (micro/macro connection) by
 - 5.1. Relating the pressure of a gas to the number of atomic collisions per unit time and/or the properties of the particles.
 - 5.2. Relating the thermal energy of a gas to the kinetic energy of the molecules.
 - 5.3. Identifying the relation between the heat capacity of a gas and the number of degrees of freedom.
 - 5.4. Relating the density of a gas to the mean free time and mean free path of a gas molecule.
 - 5.5. Applying the equipartition theorem to a gas problem.
6. Heat engines and refrigerators by
 - 6.1. Interpreting the cycle of a heat engine from a pV diagram.
 - 6.2. Relating the thermal efficiency/coefficient of performance of a heat engine/refrigerator to the work output/input and heat exhausted/extracted.
 - 6.3. Identifying the steps of the Carnot cycle and relating its efficiency in term of temperature of the hot and cold reservoir.
 - 6.4. Identifying and contrasting reversible and irreversible processes.
 - 6.5. Identifying equivalent statements of the second law of thermodynamics and its relation to heat engines and cycles.

6.6. Applying Clausius' relation between entropy and heat transfer in thermal cycles.

Grading Policy

Your grade in the course will be based on your performance in the labs, on the homework assignments, on lecture participation, on a concept survey, and on the exams with the following weights:

- Homework on MasteringPhysics: 15%
- Laboratories: 17%
- Lecture Participation (via iClicker): 3%
- Pre-Lecture Questions (on Canvas): 2%
- Concept Quizzes at Testing Center: 3% (pre-quiz is 1%; post-quiz is 2%)
- PreMidterm Quiz: 3%
- Midterm: 27% (PreMidterm Quiz + Midterm add up to 30%)
- Final Exam: 30%

Final letter grades for the course will be based on an absolute scale. The course score will be rounded to the nearest integer (69.49 becomes a 69; 69.5 becomes a 70). No curving of any kind will be employed unless the combined average exam score (computed as the combined average of all midterm and final exams taken to date) is less than 70%. In such cases, the grades on the most recent exam will be adjusted by additively raising the exam scores to allow the combined exam average to meet the target minimum of 70%.

The break points for the various grade levels are:

- $93\% \leq A \leq 100\%$
- $90\% \leq A- < 93\%$
- $87\% \leq B+ < 90\%$
- $83\% \leq B < 87\%$
- $80\% \leq B- < 83\%$
- $77\% \leq C+ < 80\%$
- $70\% \leq C < 77\%$
- $60\% \leq D < 70\%$
- $F < 60\%$

You are responsible for verifying all of your scores (with the exception of the final exam score) before the final exam.

Exams

There will be one midterm exam and a cumulative final exam.

Exams will be closed book. Relevant physical constants and formulae will be provided. The exam questions will not require extensive calculations, but you may bring a standard non-programmable and non-wireless scientific calculator (for example, a TI 30X is allowed, but not a TI-83+). Cellular phones and other communication devices are not allowed. The exams will be

based on the assigned reading in the textbook, the material covered in lecture, the homework assignments and the laboratories.

No curving of any kind will be employed on exams unless the combined average exam score (computed as the combined average of all midterm and final exams taken to date) is less than 70%. In such cases, the grades on the most recent exam will be adjusted by additively raising the exam scores to allow the combined exam average to meet the target minimum of 70%.

If you have SDR accommodations for exams, you need to present your paperwork to the Course Administrator, Dr. Van Hook, at least one week before the exam.

Before the midterm, you will have a chance to test your understanding of the course material with a PreMidterm quiz at the Testing Center. This quiz is worth 10% of your Midterm grade. However, if you do better on the midterm than on the quiz, then your midterm will overwrite the quiz score. If you do better on the quiz than on the midterm, you have "banked" that 10% and the quiz score will remain. Because the midterm score overwrites the quiz score if better, there will be no opportunities to make up the PreMidterm quiz for any reason. About a week before the quiz, you will receive an email from the Testing Center with a link to follow to register for the quiz.

Laboratories

Laboratory sections meet for about 2 hours once a week in 306 Osmond. Your meeting time is determined by your 213L section number. You must attend the laboratory section in which you are scheduled — **no switching is permitted**. After add/drop period, no section changes will be approved.

The laboratories are designed to provide you with hands-on experience with the material being investigated in class. During the lab session, your group will prepare a single write-up, addressing specific points of the experiments. This is graded and this write-up must be submitted by your group before the end of the laboratory session and all group members must be present when the report is submitted in person to the laboratory instructor.

If a student is more than ten minutes late to a lab, they cannot receive any credit for that period so be on time!

Homework (MasteringPhysics)

In general, there is one main homework per week. The due date and time for each assignment appears on MasteringPhysics. We will be using an online computer grading system called MasteringPhysics to give you immediate feedback on your work & to grade the homework. Access to MasteringPhysics is provided in the PSU custom book in the bookstore. This system allows you to submit your homework at any time up until the time it is due. Your grade on each assignment will be available immediately and, in most cases, you will have multiple tries to arrive at the correct answer. Any work done after the due date will not receive credit and no extensions will be given. Because homework answers will appear immediately after the due date, and assignments are available at least a week before the due date and can

be done in advance, **NO late homework submissions are allowed (see bottom of page for more info on excuse policy).**

Most main homework assignments will also include an "Adaptive Follow-Up" assignment containing 1-2 sets of questions (about 15-30 minutes of content). Mastering Physics automatically determines the content of the Adaptive Follow-up based on concepts and problems that gave you the most difficulty. Students with a raw score of less than 85% on the main assignment will be required to complete the Adaptive Follow-up questions to earn all the points allocated to that particular assignment. Typically, Adaptive Follow-Up questions will be due several days after the main assignment due date. Students with a raw score of 85% or higher on the main assignment and who *complete the entire main assignment* will test out of the Adaptive Follow-up and will automatically receive full credit for the Adaptive Follow-Up portion of the homework.

Students are encouraged to work together and collaborate on assignments. Work submitted for individual assessment must be the work of the individual student. Please refer to the Academic Integrity Policy below.

The homework score is calculated as the average of the scores of each homework assignment; all assignments are weighted equally (unless stated otherwise) and the score includes points from any possible Adaptive Follow-Up questions. Each assignment's score is calculated as $100 \times (\text{points earned on assignment} / \text{total points possible on assignment})$. The number of points earned on a problem decreases on each submission after the first. On multiple choice questions, on each submission after the first, credit will decrease by $100\% / (\# \text{ of answer options} - 1)$. On all other questions, on each submission after the first, credit will decrease by 3%. You are strongly encouraged to complete the entire homework since any of the problems are fair game for the exams. To account for small mistakes due to the nature of the online system (such as incorrectly typing an answer) and to reduce the stress of entering an answer you are not sure is correct, **we will have a 90% threshold** so that 90% is equivalent to 100%. All scores will be boosted by a factor of $1/0.9$, but capped at 100%.

Pre-Lecture Questions (on Canvas)

To help you assess your preparation for lecture and to give us information about what material needs emphasis in class, there is a brief Canvas quiz due before each class (the night before at 10 pm). These Pre-Lecture Questions (PLQs) are graded for correctness, but we excuse one for each block of lectures (one before the midterm and one after the midterm). Because of this cushion of one lecture per half of the class, we never excuse PLQ scores or give extensions on them for any reason. The individual PLQs will not be part of your final grade calculation, just the "PLQ Block" scores, consisting of your best (N-1) of N scores for each N-lecture block.

Lecture Participation

Your Lecture Participation score is based on your participation through responding to conceptual questions via iClicker in lecture. We will post temporary clicker scores (that will not be part of your final grade) so that you can know that your clicker is registered correctly. If this score is 0%, then you need to act immediately to get your clicker properly registered since we

will not retroactively award clicker points when a clicker is registered late). We will post clicker scores (that will be part of your final grade) after lectures 05, 10 and 15. There will be a cushion of one lecture per 5-lecture block - i.e., you can miss one out of the lectures in each block and still get a full grade in case you need to miss lectures due to illness or other excused absences. Because of this cushion, *we never excuse clicker scores* since this cushion is already built in; similarly, there will be no adjustments for forgetting to bring your clicker to lecture or adding the course after the first lecture, and no extra-credit or make-up work for absences. You need to respond to at least 50% of the clicker questions to earn lecture participation points for a given lecture.

Concept Survey

There will be a concept survey for you to take in the Testing Center (in the Pollock Building) at the beginning and the end of the course. The pre-survey is worth 1% of your grade and is based on participation. The post-survey is worth 2% of your grade, with half of this score for participation and half based on your score on the post-survey.

Excuses

Since University regulations require course instructors to make conflict exams available to students, missing a laboratory due to an examination in another course is not considered a valid excuse request or reason to attend a different section.

Labs: The laboratory components of this course are structured around collaborative learning. You must be present in laboratory to do these assignments. If you are absent from a laboratory section with a valid excuse, as described under "Valid Excuse Policy", fill out the excuse form. You will NOT be required to make up the missed activity.

Only one laboratory activity may be excused for a student throughout the entire course for University- approved reasons. More than one absence from activities at their regular times will interfere excessively with student learning. In extreme circumstances in which a student has more than 1 absence, he or she must contact the instructor or course coordinator directly to discuss the situation as soon as possible. Requests to be excused from a missed evaluative event due to reasons that are based on false claims is cheating and will be treated as an academic integrity violation.

Your score for the missed activity will be recorded as a zero until the excuse is accepted and recorded. If you are absent without a valid excuse, a score of zero will be recorded for that assignment.

Valid excuses are

- Family emergencies include a death in the immediate family, death of a close friend, sudden hospitalization of a close family member, and events of similar gravity. Students should inform the course administrator about the family emergency as soon as possible.
- Student illness and injuries

- University-approved curricular and extra-curricular activities. A student needs to obtain a letter (or a class absence form) from the unit or department sponsoring the activity. The letter must indicate the anticipated absence dates, and it must be submitted by email (or in person) to the course coordinator *before* the absence. The student must also fill out the makeup request form (for labs) before the date of the absence.
- Religious Holidays. Students must submit the excuse request *before* the date of the absence.

Homework and PLQs: You must complete the homework and PLQs as scheduled. The homeworks and PLQs are available early so no excuses are accepted. Even technical glitches are not valid excuses.

Examinations: All students should plan to take their exams at the scheduled times. Students can request makeup exams only by filling the conflict exam signup form under lessons. In the case of sudden or unexpected events that will cause them to miss an exam, students are required to notify the course coordinator prior to the exam or as soon as is reasonably possible.

Academic Integrity

Pretty simple really, don't cheat and don't plagiarize. If you think you are doing something wrong, you probably are. We take academic integrity very seriously. There are many ways to get help in this course and we hope you do contact any member of the instructional team if you feel unsure about the material and worry about your grade. Our goal is for you to learn the material and succeed in the course. Everyone can get an A and we are ready to help any students that struggle.

In exchange for your hard work, participation and academic integrity we promise to create the best learning environments that we can and to help you as much as we can. There will be many opportunities for help and we are fair to all students. Collaborations and discussions among the students are strongly encouraged (they help learning) but we expect your best efforts to individually learn the material and we expect honesty and academic integrity in all aspects of the course.

As described in **The Penn State Principles**, academic integrity is the basic guiding principle for all academic activity at Penn State University, allowing the pursuit of scholarly activity in an open, honest, and responsible manner. We expect that each student will practice integrity in regard to all academic assignments and will not tolerate or engage in acts of falsification, misrepresentation, or deception. To protect the fundamental ethical principles of the University community and the worth of work completed by others, we will record and report to the office of Judicial Affairs all instances of academic dishonesty.

Disability Policy

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. [Student Disability Resources](#). (SDR) provides contact information for every Penn State campus. In order to receive consideration for reasonable accommodations, you must contact the appropriate disability

services office at the campus where you are officially enrolled, participate in an intake interview, and provide [documentation](#). If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Counseling Services

The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

- [Counseling and Psychological Services at University Park \(CAPS\)](#): 814-863-0395
- Penn State Crisis Line (24 hours/7 days/week): 877-229-6400
- Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

Educational Equity/Report Bias

Consistent with University Policy AD29, students who believe they have experienced or observed a hate crime, an act of intolerance, discrimination, or harassment that occurs at Penn State are urged to report these incidents as outlined at <http://equity.psu.edu/reportbias>.