

# PHYSICS 1341

## (An Introduction to) Thermodynamics and Statistical Mechanics

Term 2214 (Spring 2021)

- Instructor: dr.s. (Prof. Vladimir Savinov).
- Office: It's all virtual now. I will be seeing you on ZOOM.
- Office hours: (possibly floating, as needed) time for office hours and ZOOM info will be announced in class, on CANVAS and via e-mail. Also, I am usually available right after class on ZOOM. Office hours will be conducted in group environment (unless you are the only student who came) and are more like recitations (than office hours). Please show up at the time when office hours start. If you come late, most likely you will miss some important discussion. If you can't attend, please send me your questions ahead of time, I will answer your questions at office hours anyway. You are also welcome to post your questions on CANVAS or send them to me via CANVAS messages. If you want me to discuss some particular topics or non-HW problems with you, it would be best to let me know ahead of time, so I can prepare and be more efficient for you. Office hours will be recorded via ZOOM/Panopto. Just in case, so you know and don't ask, I do NOT do tutoring.
- e-mail (the best way to contact me): [vps3@pitt.edu](mailto:vps3@pitt.edu)  
In order for your e-mail to be delivered to me you are **most strongly advised** to use Pitt's e-mail system. Note that I will be communicating with the class using students' e-mail addresses in **pitt.edu** domain. It is your responsibility to make sure you read e-mails sent to you at **pitt.edu** regularly and do not miss any important information. All e-mails sent to class will also be posted/archived on CANVAS. Please make sure to set up your CANVAS account to send you emails when new announcements are posted. You can also interact with me via CANVAS messaging.
- Lectures: Tu and Th, 9:25am – 10:40am, 152 Chevron Science Center (also via ZOOM).
- Textbook: *An Introduction to Thermal Physics* by Daniel V. Schroeder, originally published by Addison-Wesley, 1999, rebranded as Pearson in 2011. Textbook's ISBN-13: 978-0201380279, ISBN-10: 0201380277. Since last year this textbook is out of print at Pearson, but will soon be reissued (same edition, new publisher) by Oxford University Press. At this time this textbook is available for rent electronically at [RedShelf](#) for \$20/180 days. You can also get a used copy online. Note that Schroeder himself advises against "international editions" ([scroll down to "Editorial Reviews" section at amazon](#)). Note that you can rent a printed copy from amazon for \$35.49 per term. In the end of the term you can buy your rented copy (the buyout price is currently \$73.32). Amazon says (as of Jan. 14, 2021): "**ANY RENTAL AND EXTENSION FEES PAID WILL BE APPLIED TOWARDS THE BUYOUT PRICE OF THE BOOK**". Currently, Amazon also offers a Kindle edition (just a print replica, NOT a navigatable edition) for \$38.99. Pitt bookstore will likely be another option at a later time.

## Course Description

In this class I will be focusing on the basic concepts of equilibrium thermodynamics and statistical mechanics. The main goal will be to provide an understanding of thermal properties of macroscopic systems (in case of statistical mechanics, through microscopic description). Connections between the atomic scale statistical description and the large scale macroscopic properties of bulk matter will be emphasized. Specific topics covered in this class will include: (1) The first and second (and the other two) laws of thermodynamics, (2) Equilibrium thermodynamics and the meanings and relationships among heat, work, entropy, energy and other thermodynamic potentials, (3) The microscopic, statistical interpretation of entropy connecting microscopic and macroscopic descriptions, and (4) Statistical ensembles and related partition functions. I will discuss using thermodynamics and statistical physics to describe (1) thermal properties of molecular gases, solids and liquids, (2) thermal properties of simple magnetic systems, (3) quantum (Fermi-Dirac and Bose-Einstein) statistics with applications to electrons and phonons in solids, special types of stars, photons and quantum liquids, and, if time allows, (4) engines and refrigerators.

The lectures will generally follow the main textbook (Schroeder, see p. 1 of this Syllabus), with additional material introduced in class, as needed, and most, but not necessarily all homework problems will be from the text or based on it. In addition, there may also be assignments on relevant material from outside the textbook(s). It would be a very good idea to have regular access to the main textbook. I will cover most of material from chapters 1 through 7 (except, may be, for (in spring 2021) Ch.4 (Engines and Refrigerators)). Knowledge of introductory physics (at PHYS174/175 or 475/476 level), thermodynamics (at PHYS477 (Modern Physics) level), calculus, vector algebra and differential equations is assumed, expected and required. Please keep in mind that these are prerequisites for this class. You will have to read the textbook before class and after class and do a sizeable body of independent work outside class. You will be responsible for all material from chapters (partially or fully) discussed in class (unless I tell you otherwise).

## Supplementary References

The following two books (not required for this class, but may come in handy):

- *Thermal Physics* by Charles Kittel and Herbert Kroemer, [a more advanced undergraduate-level textbook with a heavier focus on statistical mechanics](#).
- *Statistical Physics* by Franz Mandl, [another excellent intermediate-level textbook \(though rarely used as the main source\)](#).

## Attendance

Attendance is not mandatory but will be monitored. I expect every student to attend every single class. **In case your circumstances make it impossible or difficult for you to attend class regularly during scheduled time, please contact me, so we discuss this matter and work out the best learning strategy and a study plan for you.** Students are most strongly advised to take lecture notes during class and to study their notes later in the week. If you can't reproduce the calculations presented in class or/and in the textbook, this would be a clear sign of having trouble with class material. If you miss a class, don't worry: real-time lectures will be recorded and posted on CANVAS via Panopto. Also, I usually package the snapshots of my whiteboard as a single PDF file for the students to use after class.

## CANVAS and ZOOM

Up to date information about class, including assignments and complementary material, will be regularly posted on CANVAS. You can access CANVAS at <http://canvas.pitt.edu> (use your Pitt network computing account and password to log in). CANVAS information will be updated regularly (almost daily). Make sure you check CANVAS for this class often.

I will teach over ZOOM, you are welcome to attend class in Chevron Science Center. I plan to have the AV system microphone muted, so please have some personal device with you to type in your questions, to connect to class in case of technical issues in Chevron, AND, most importantly, **to make sure that I record your attendance (see my comments concerning attendance on page 2). In other words, you must be connected to class via ZOOM no matter how you attend.** I do not use PowerPoint slides. Everything will be happening in real time. To connect to class via ZOOM you will have to authenticate using your Pitt network computing account. Anonymous, unauthenticated access to class and office hours via ZOOM will not be allowed. You are very welcome to turn on your camera if you like, but you will never be required to do so. I will try my best to be maximally interactive, these are difficult times, you have my full understanding. We will get through this together with a little help from everyone.

## Homework Assignments

Homework will be assigned (announced via email and on CANVAS) regularly. You will be turning in your work as snapshots via GradeScope. Make sure to show all your work. Do not skip intermediate steps. Do not try to save paper. Do not turn in your scratch paper. Please try to be neat. Do not e-mail your work to me (unless I request this) – use GradeScope. Make it easy for the grader to figure out what you have done. Show ALL steps, do NOT assume that some of the steps are “obvious” or “trivial”. Points will be taken off for incomplete explanations and/or difficult-to-follow work. This applies even more so to the exams. I will continue to be absolutely unforgiving for not showing all your work. One more time: your work must be exceptionally well-documented, with the explanations of what you do and why you do that. Attend office hours. Take notes in class. The solutions to the homework problems will be posted on CANVAS.

## Grading Scheme and Other Important Details

There will be two remote midterm exams and one remote comprehensive (*i.e.*, cumulative) final exam (though it will emphasize more recent material more than previously-tested material). Midterm dates will be announced at a later time, but no later than two weeks before the actual exam time. The final exam date will be set by the university. The date and time of final exam will be announced later. Your work will be score-graded. Each homework will be 10 pts max. Scoring (*i.e.* points) will be used also for midterms and final exam. Your letter grade will be determined using your total score with contributions from your homework (~10%), class attendance (~5%, see my comments concerning attendance on page 2), mid-term exams (~25% each), and final exam (~35%). Correspondence of scores to letter grades will be announced in May after the grades are posted. There will be no for-credit quizzes. There will normally be no extra-credit opportunities, unless I decide to make these available to the entire class. **Some aspects of your remote midterms and final exam may resemble and mimic various aspects of oral exams. I reserve the right, without providing any explanation, randomly or otherwise, to require individual students to take remote oral exams with me (in addition**

to in-class exams). If you are selected for an oral exam, please don't worry about this, you may be able to perform even better (and get some extra credit) when asked questions about class material and requested (in real time) to solve relatively simple problems in a non-stressful environment. Any student, regardless of their performance in this class, may be required to take an oral exam. You are not allowed to request oral examinations. Your oral exam grade would unconditionally replace your in-class exam grade. If you have any questions / need anything clarified, please contact me at [vps3@pitt.edu](mailto:vps3@pitt.edu), ask in class, on CANVAS, or/and on ZOOM.

**Special and/or Unexpected Circumstances and Emergencies:** Should such arise, please follow the following protocol: first take care of your emergency and/or unexpected circumstances and then, when you have time, send me an e-mail outlining your circumstances and the nature of your emergency. All such events will be handled on case by case basis. Generally, please do not rely on oral communications with me – any request / explanation of some situation / any commitment must be communicated electronically. Generally, no “I” or “G” grades will be assigned in this class. All work for this course should be completed before the end of this term.

**Religious Observances and Class Activities:** In case your religious observances conflict with class activities / tests / homework assignments due dates and such, please alert me to such possible conflicts as soon as possible and in advance.

**Special Accommodations for Disability:** If you have a disability that requires special testing or other accommodations, you should notify both the instructor and the Office of Disability Resources and Services (DRS) as early as possible in the term. You may be asked to provide documentation of your disability to determine the appropriateness of accommodations. The Office of Disability Resources and Services is located in the William Pitt Union, Room 140. If needed, please call (412) 648-7890 (voice) to schedule an appointment with them. A comprehensive description of the services provided by DRS office can be obtained on [their web site](#).

**Academic Integrity:** All students in this course are expected to follow the University of Pittsburgh academic integrity guidelines. If you are not aware of the specifics, you should obtain a copy of these guidelines from the Dietrich School of Arts and Sciences Dean's Office, 140 Thackeray Hall, or look them up online at [their web site](#). Violations of these guidelines by a student may result in a zero score for an examination/homework/other or/and a failing grade for the entire course.

**Other University Policies:** Over the past many years our very bestest institution of highestest education developed a large number of important policies. This syllabus and class policies are in implicit 100% compliance with all these policies and regulations.