

PHYSICS 1341

(An Introduction to) Thermodynamics and Statistical Mechanics

- Instructor: Prof. V. Savinov, a.k.a. dr.s.
- Office: N/A, if and when necessary, you will be told where, when and why to report.
- Office hours: time and location will be announced in class, on Canvas and via e-mail. Also, I am usually available right after class in the hallway outside of Thaw 11. I am not available right before class, even for quick questions. Office hours are conducted in a group environment. Please make an effort to be there at the time when office hours start. If you show up late, you could miss an important discussion (likely related to your question(s)!). I do not do tutoring (individual or otherwise).
- e-mail (THE best way to contact me): vps3@pitt.edu
Note that I will be communicating with class using students' e-mail addresses in **pitt.edu** domain. It is your responsibility to make sure you read e-mail sent to you at **pitt.edu** regularly and none of the information is missed. All e-mails sent to class will also be posted/archived on Canvas.
- Lectures: Tu,Th 9:30am-10:45am, Thaw 11.
- Textbook: *An Introduction to Thermal Physics* by Daniel V. Schroeder
- **Absolutely no audio and/or video recordings of the lectures and office hours are allowed. Any such recording will be treated as a violation of academic integrity.**

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 laws of thermodynamics, (2) Equilibrium thermodynamics and the meanings and relationships among heat, work, energy, entropy and free energy, (3) The microscopic, statistical interpretation of entropy connecting microscopic and macroscopic descriptions, and (4) Statistical ensembles and related partition functions. There will be numerous examples of the application of thermodynamics and of statistical physics, including: (1) heat engines, (2) thermal

properties of molecular gases, solids and liquids, (3) thermal properties of simple magnetic systems, (4) quantum (Fermi-Dirac and Bose) statistics with applications to electrons and phonons in solids, special types of stars, photons and quantum liquids.

The lectures will generally follow the textbook (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 from outside the book on relevant material. It would be a very good idea to have regular access to the textbook. I will cover most of material from chapters 1 through 7. Knowledge of introductory physics (at PHYS174/175 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. I recommend to read the textbook before and after class, and do a sizeable body of independent work outside class time. You will be responsible for all material from chapters (partially or fully) discussed in class (unless I tell you otherwise).

Attendance

Attendance is not mandatory, though I do expect students to attend lectures. Students are most strongly advised to take lecture notes during class and to study their notes later same week. If you can't reproduce calculations performed in class or/and in the book, this would be a clear sign of having trouble with class material. If you miss a class, it is your responsibility to catch up by studying the textbook, by asking other students to share their notes with you and by attending office hours to ask questions about assigned problems and to clarify material in the textbook and/or presented in class. I do not make my notes available, however, as I use whiteboard, I plan to post snapshots of my whiteboard on Canvas later in the day after class. I will not be holding individual meetings with students who missed a class – if you couldn't make it, please read the book and ask me questions.

Canvas

Up to date information about class, including assignments and complementary materials, will be regularly posted on Canvas. I will be updating class information on Canvas every few days.

Homework Assignments – IMPORTANT – PLEASE READ!

Homework will be assigned (announced electronically on Canvas) regularly. You are strongly encouraged to discuss homework problems with other students (though copying other people's work and/or from online sources is, of course, strictly forbidden). You will be turning in your homeworks via Gradescope. Never e-mail your work to me or the grader (unless the grader requests you to e-mail your work to them). Make it easy for whoever grades your work to figure out what you have done. Show ALL steps, do NOT assume that some of the steps are “obvious” or “trivial”. When working on problems together with other students I advise you to show the names of your group's members on the first page. Copying from any solution manual may have most severe consequences associated with such popular approach to learning class material. Paying Chegg or such to “help you learn” would, most likely, hurt your learning.

Do not contact dr.s. concerning HW extensions and other such matters. Contact the grader.

Note that working out homework problems is an integral part of learning the material. Homework problems will often introduce new ideas and methods of how to solve such problems and are tightly integrated with the material in the textbook. Homework is NOT an evaluation tool. Copying solutions from elsewhere would very likely hurt you in more than one way.

Attend office hours. Take notes in class. Solutions to homework problems will be posted on Canvas. Before you ask questions of the type “what’s wrong with (this or/and that step(s)) of my solution?”, study posted solutions, try to solve the problem(s) from scratch and, if you are unable to solve the problem after that, come to see me during office hours / ask me to help, so I can explain the (posted) solution to you. I do not normally explain well what’s wrong with individual wrong solutions (though I usually try my best), rather, I explain how the problem should (or could) be solved.

Grading Scheme and Other Details

There will be two midterm exams and one comprehensive (*i.e.*, cumulative) final exam. Midterms dates will be announced at a later time, but no later than two weeks before the actual exam. The final exam date is set by the university (see https://www.registrar.pitt.edu/sites/default/files/pdf/2254%20Web%20Examination%20Schedules%20Information_Updated.pdf), and it is currently scheduled on Monday, Apr. 28, between 4:00pm and 5:50pm. The location of final exam will be announced at a later time. You should be aware of the [University Final Exam Conflict Accommodation Procedure](#) outlined in [this document](#) (you may also need [this form](#)). The final grade will be determined by your homework (~15%), mid-term exams (~25% each), and final exam (~35%). If you have any questions / need anything clarified, please contact me at vps3@pitt.edu.

Note that to solve some of the problems / work on projects (if and when applicable) you may need to use **Mathematica** (don’t use Wolfram Alpha, as, in my experience, it is still buggy). More information can be found [here](#). If you want to use some other software / tools, it is OK with me, but it would be 100% your responsibility and liability to get everything done as requested in a project / problem.

Supplementary References

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

- *Thermal Physics* by Charles Kittel and Herbert Kroemer, Pitt library call number **QC311.5 K52 1980**, [a more advanced undergraduate-level textbook with a heavier focus on statistical mechanics](#).
- *Statistical Physics* by Franz Mandl, Pitt library call number **QC174.8 M27 1988**, [another excellent intermediate-level textbook \(though rarely used as the main source\)](#).

There exist many other high-quality textbooks available. From time to time I am going to give you some references and pointers in class.

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 email 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 semester.

Religious Observances and Class Activities

In case your religious observances conflict with class activities / tests / homework assignments due dates and such, please alert me and the grader 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 semester. 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 etc or/and a failing grade for the entire course.

Other University Policies

Over the past many years Pitt developed a large number of important policies. This syllabus is assumed to be in implicit 100% compliance with all these policies and regulations.