PHYSICS 1341
(An Introduction to) Thermodynamics and Statistical Mechanics

Term 2174 (Spring 2017), class# 10160

- Instructor: Dr.S. (Prof. Vladimir Savinov, a.k.a. dr.s.)

- Office: Allen Hall, 402 (note that office hours are normally conducted elsewhere).

- Office hours: time and location will be announced in class, on CourseWeb and via e-mail. Also, I am usually available right after class in Thaw 102 or in the hallway outside. I am rarely, if ever, available right before class, even for quick questions. Office hours are conducted in group environment (unless you are the only student who came to office hours). I do not do individual tutoring. 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 (possibly, related to your question(s)!).

- Phone#: (412) 624-9042 (NOT a good way to get in touch with me, but leaving a msg (if you really have to) should be OK).

- 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 CourseWeb.

- Lectures: Tu,Th 9:00am-10:45am, Thaw 102.

- Textbook: *An Introduction to Thermal Physics* by Daniel V. Schroeder, Addison-Wesley, 1999.

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 stressed. 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 requested a copy of the textbook to be placed on reserve at Bevier Engineering Library in Benedum Hall. You can buy a copy of the textbook from Pitt's bookstore. Textbook information can be found at publisher's web site or/and at amazon.com and many other sources (google is your friend, hopefully). Textbook's ISBN-13: 978-0201380279, ISBN-10: 0201380277. 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. 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).

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 in the day / 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 and almost never use slides. 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.

Courseweb

Up to date information about class, including assignments and complementary materials, will be regularly posted on Courseweb (a.k.a. Blackboard). You can access Courseweb at http://courseweb.pitt.edu (use your Pitt network computer account and password to log in). I will be updating class information on CourseWeb every few days.

Homework Assignments – IMPORTANT – PLEASE READ!

Homework will be assigned (announced electronically on Courseweb) 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). When you turn in your assignment (do so in class or leave it under my office door on the day when it's due, but please NEVER leave it for me on the 1st floor of Allen Hall / in my mailbox!), show all your work. Do not skip intermediate steps. Do not try to save paper/trees. Your pictures/plots/sketches

should be large size. Do not turn in your scratch paper. Be neat. Do not e-mail your work to me (unless I request you to do so). 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 will have most severe consequences associated with this.

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 will hurt you in more than one way.

In recent years some students were expelled for such violations of academic integrity. Attend office hours. Take notes in class. Solutions to homework problems will be posted on CourseWeb. Before you ask questions of the type "what's wrong with (this or/and that step(s)) of my solution?", please 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 http://www.registrar.pitt.edu/assets/pdf/2174_EXAMS.pdf), and it is currently scheduled on Tuesday, Apr. 25, between noon and 1:50pm. 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 ($\sim$10%), evaluation tools such as, *e.g.*, (unannounced) pop quizzes (or similar) ($\sim$5%), mid-term exams ($\sim$25% each), and final exam ($\sim$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 you may need a student license for **Mathematica** software (don't use Wolfram Alpha, as, in my experience, it's buggy). More information can be found on Pitt's web. Note that **Mathematica** is also available at Pitt's computer labs. If you want to use some other software / tools, it's OK with me, but it's 100% your responsibility and liability to get everything done as requested in a project / problem.

Supplementary References

I requested to place a copy of the main textbook on reserve at Bevier Engineering Library in Benedum Hall. The following two books (not required for this class, but may come in handy) are also placed on reserve for you:

- *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).

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 an e-mail to your teacher outlining your circumstances and the nature of your emergency. All such events will be handled on case by case basis. Generally, do not rely on oral communications with your teacher, 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 your teacher 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 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. Disability Resources and Services is located in the William Pitt Union, Room 140. If needed, please call (412) 648-7890 (voice) or (412) 383-7355 (TTY) to schedule an appointment with them. A comprehensive description of the services provided by DRS can be obtained at their web site.

Academic Integrity: All students (and the instructor) 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, a failing grade for the entire course, suspension or/and expulsion.