Physics 314: Thermodynamics and Statistical Physics

Spring 2018

TTH 8:00 – 9:20 am

Noyce Science Center 1022

Instructor: Josh Weber

Office: Noyce Science Center 1135
Phone: x4338
E-mail: [weberjos]

Office Hours:

I encourage you to stop by during my office hours if you would like to talk about broad concepts or specific questions.

M 1-2 pm, T 10-11 am, W 1-2 pm, Th 10-11 am, Noyce 1135

Please e-mail me to set up a meeting outside of these hours.

Textbook:

An Introduction to Thermal Physics, Schroeder, D.V., Addison Wesley Longman, 2000.

In contrast to some textbooks, I find that Schroeder is good at clearly and *concisely* explaining concepts. For the most part, we will follow closely along with the text. Although the tests and the final will focus primarily on what we have discussed in class and in homework, you will be responsible for all material in the assigned textbook chapters.

A copy of the textbook is on reserve for this course in the Kistle Science Library.

Class Participation:

Active Participation:

The collaborative character of in-class activities requires that you come to class **every meeting and on time** and work well with your partners. Consistent attendance, on-time arrival, and participation in group work will earn you a good grade for participation. Class participation is an essential component of the course. If you need to miss class for a valid excuse (illness, family emergency, religious holidays, *etc.*), please email me as soon as far in advance as possible.

Content Contributions:

Although the tests and the final will focus primarily on what we have discussed in class and in homework, you will be responsible for all material in the assigned textbook chapters. We will not have time to discuss everything in class, so I want to be sure we use our class time in a way that is beneficial to you. To that end, each week you are responsible for helping me to direct class by e-mailing me three questions or comments about either the reading or what we have done in class. (This is a variation of an educational-research-based strategy that is sometimes called "just-in-time teaching".) For example, you could tell me a topic that

we covered that you would like to review, or a topic from the reading that you found confusing that you would like to be sure we cover. You also could point to something interesting that you would like to learn more about. Unfortunately, we will not be able to cover everyone's questions and concerns in class, but I am happy to continue the discussion in office hours. Contributions will be graded on effort and completion.

Questions are due by e-mail each Monday at noon. In order to make them easy for me to find and organize, please try to remember to use the subject line "THERMOQUEST".

Daily Summaries:

Instead of just cramming for the tests, I would like you to be consistently reviewing the material. To this end, I will ask you to spend the first five minutes or so of each class meeting reviewing the material from the previous meeting. **To participate and receive credit, it is necessary for you to arrive on time to class.** Along with partners, you will come up with a brief written summary of the important concepts from the previous meeting**.** I will grade these on effort and completeness, and I will return them to you so that you can use them to study.

Homework:

Homework problems allow you to further synthesize what you discover through in-class activities into a formal knowledge structure. Due to its importance, weekly homework is an important part of your overall grade. *Generally, homework will be due each Friday by 12 pm noon. Please turn in homework to my office, Noyce 1135.* **Late homework will not be accepted unless cleared with me.**

I strongly encourage you to attempt all homework on your own first. This will give you good practice for tests. After attempting a problem on your own, I encourage you to consult your fellow students and me for help in solving homework problems. You may also use outside references to aid your understanding. You may not, however, consult solution guides (from publishers, from prior semesters of this or other courses, or from online resources, *etc.*). **Even if you work with others, your homework must be in your own words and reflect your understanding of the problem.**

While I will not require formal citations, it is good practice to give credit when you receive help. (For example: "Worked with Emily" or "Estimated specific heat based on table on Hyperphysics website")

Grinnell College Policy for *Honesty in Academic Work*:

http://catalog.grinnell.edu/content.php?catoid=12&navoid=2537#Honesty_in_Academic_Work

Tests and Final Exam:

We have two tests and a cumulative final exam. The mid-term tests will be held during the regular class period. The final exam will be held at 9:00 am on Friday, May 18th. Make-ups for missed tests can only be granted under exceptional circumstances (medical emergency, official university business, *etc.*). If you know of such impending circumstances, please contact me in advance.

You are NOT allowed to collaborate on the tests or final exam.

Test 1:	**Thursday, Feb. 22nd**
Test 2:	**Tuesday, Apr. 17th**
Final:	***9 am, Friday, May 18th***

Grading:

In calculating your final grade, the different components of the course will be weighted as follows:

Participation:		(15% total)
Active Participation:	*5%*	
Content Contributions:	*5%*	
Daily Summaries:	*5%*	
Homework:	**30%**	
Tests:	15% each	(30% total)
Final Exam:	**25%**	

Work Expectations:

According to Grinnell College, the expectation for a four-credit course is, at minimum, three hours of class meetings and nine hours work outside of class. I expect a majority of your outside time, perhaps seven hours a week, will be spent on homework. The rest of your time will be spent on reading, reviewing, and composing your content contributions. The amount of time you spend on each of these activities will vary by week.

Disability Accommodations:

I strive to create a fully inclusive classroom; thus, I welcome individual students to approach me about distinctive learning needs. In particular, I encourage students with disabilities to have a conversation with me and disclose how our classroom or course activities could impact the disability and what accommodations would be essential. If you have a documented disability needing academic adjustments or accommodations, please speak with me during the first two weeks of class. All discussions will remain confidential. Students with disabilities are also encouraged to contact John Hirschman, Coordinator of Student Disability Resources [hirschma].

Feedback:

Feedback on my teaching or on any aspects of the course is welcome at any time. I would like to make the course beneficial for you, so please let me know what is working and what is not working. There is a formal course evaluation at the end of the semester, but I would appreciate hearing from you along the way. Your negative or positive feedback will help to improve the course, but *it will <u>not</u> affect your grade.*

Learning Goals:

The Physics Department at Grinnell College has proposed desired learning outcomes for students in its courses. The aims most relevant to you as a Physics 314 student are listed below.

We hope that by completing the course, you will gain:

- An appreciation for physics as a predictive, quantitative science governing the physical aspects of the world around us
- Familiarity with basic techniques of analyzing classical physical systems
- A basic facility with the craft of physics
- Adequate preparation for further study in physics or engineering or for meaningful careers utilizing their study of physics
- The ability to:
    - Work collaboratively to produce written solutions to physics problems
    - Correctly and effectively use tools such as graphs, tables, images, and equations to communicate ideas and results

For a full list of the Physics Department's Learning Outcomes, see:
https://www.grinnell.edu/academics/centers/ctla/departmental/physics

Major learning objectives in Physics 314 include the abilities to:

- Define heat and work, and describe how they are related through the First Law of Thermodynamics
- Apply principles of combinatorics and classical probability to explore entropy in many body systems
- Use the concept of entropy to explain macroscopic properties such as temperature and pressure
- Explain the concepts of engines and refrigerators using the principles of thermodynamics
- Describe chemical reactions and changes in matter using the laws of thermodynamics
- Utilize Boltzmann and quantum statistics to develop sophisticated models of physical systems
- Identify and concisely summarize main ideas from class meetings and homework

Anticipated Schedule

Week Beginning	Topic	Textbook Chapter
Jan. 22	The First Law and Energy in Thermal Physics	1
Jan. 29	The First Law and Energy in Thermal Physics	1
Feb. 5	The Second Law	2
Feb. 12	The Second Law	2
Feb. 19	Interactions and Implications **TEST 1 – Thursday, Feb. 22nd**	3
Feb. 26	Interactions and Implications	3
Mar. 5	Engines and Refrigerators	4
Mar. 12	Engines and Refrigerators	4
Spring Break, No Class Weeks of March 19th and 26th		
Apr. 2	Free Energy and Chemical Thermodynamics	5
Apr. 9	Free Energy and Chemical Thermodynamics	5
Apr. 16	Boltmann Statistics **TEST 2 – Tuesday, Apr. 17th**	6
Apr. 23	Boltmann Statistics	6
Apr. 30	Quantum Statistics	7
May 7	Quantum Statistics	7
Final **9 am, Friday, May 18th**		