PHYS 3331 Thermal Physics (CRN 22339)

This document last updated: January 25th, 2021

Changes:
Corrected some dates in the schedule (Jan 25)

Term:	Spring 2021
Lecture:	MW 9:00 am – 10:20 am on class team in Microsoft Teams In person TBD
Prerequisites:	PHYS 2421, MATH 2313, MATH 2326. One year of calculus-based physics, multivariate calculus, differential equations. In this course we will also learn some probability, discrete math, and quantum mechanics.

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Grading Policy

In-class exams	40 points (3 exams, 20 points each, worst score is dropped)
Homework	14 points (14 problem sets, 1 point each)
Literature discussion	14 points (14 reading assignment, 1 point per 'meaningful' contribution)
Final	40 points
Participation	Limited to 12 additional points (5 points for leading a study session, 2 for attending)
Total	120 points (so there will be no curve)

A: 90+ points B: 80-89 points C: 70-79 points D: 60-69 points F: 0-59 points

Alternative1	If you get 90%+ on the final you get an A in the class.
Alternative2	If you get an average of 90%+ on the 3 in class exams you get an A in the class.
Alternative3	If you get at least 12 points from the homework and at least 12 points from the literature discussion, you get an A in the class.

In Spring 2020, the distribution of grades was: A – 68% B – 20% S – 8% F – 4%

Textbooks
Required: Thermal Physics by Kittel and Kroemer, 2nd Edition. (KK)
This is one of my favorite textbooks and I will follow it closely for this class. It has many insights and it is really good preparation for the Physics GRE, but I am aware that it might feel disparate the first time you read it. I will do my best to keep you focused on what is really important. If you are a physics major, it is a good book to have.

Required: Statistical and Thermal Physics: With Computer Applications by Gould and Tobochnik. (GT)
No need to buy the textbook, we will be using the notes which are available for free here: http://stp.clarku.edu/notes/. *This reads almost as a tutorial, it is focused, with explanations based on molecular dynamics simulations and bits of code, and has many exercises.*

Optional: Statistical Physics by Reif, volume 5 of the Berkeley Physics Course.
Unfortunately, this book is out of print, but if you can find it, it is more verbose than KK and mathematically a little simpler, so it is a nice bridge between your sophomore thermal physics and KK.

Lectures and lecture notes
My lectures notes will follow KK, but with a decent number of (hopefully interesting) diversions. I will upload my lecture notes to Bb in case you find them useful. Recorded lectures will also be uploaded to Bb.

Homework
There will be 14 problem sets during the semester which will be posted on Wednesday and are due the following Wednesday before the end of the day. There are 120 possible points in this class, so late homework is not accepted. About two thirds of the problems will come from KK and the rest from GT. Some problems might be of my own inspiration. Solutions will be posted after each problem set is due.

Take-home exams
There will be 3 take-home exams with a 2-hour time limit, although the time limit is negotiable. The exams will be posted on Bb and will be available for 1 week, you are free to take the exam at any time during that week.

I will request input from students regarding which problems should be on the exams with the proviso that problems will not be identical to those suggested and I reserve the right to include any problems I want.

Everybody has a bad day, sometimes even a bad year, so the worst score will be dropped. Although the material tested on the exams is not rigorously cumulative, new concepts in physics are built on previous ones.

Literature discussion
Every week starting on Week 2, I will upload a technical or (occasionally) pop science article about thermodynamics and some of its many roles in science and technology with a list of questions for you to pick to answer. Technically, this will be a Bb forum discussion.

The preferred way to do this is to read the paper, answer as many questions as possible on your own and maybe come up with some of your own questions. Then create a meeting on Teams, meet with friends (minimum of 3 and maximum of 5 people), discuss the questions and your answers for 0.5 to 1 hour, and at the end record your conclusions (using Teams). The discussion should be from 10 to 20 minutes, talk about conclusions, disagreements, etc.

Sometimes synchronous collaboration is not an option. If you can't meet with peers, read the paper and post written answers to 3 of the questions.

You get 1 point in for each discussion as long as it is 'meaningful.' By this I mean that you did participate in the discussion, meaning that you had read the paper and had opinions or answers. If you go the written way, this means that your answer were not copy-pasted and are not trivial, meaning that you had read the paper and had opinions or answers.

Participation
Before each exam, I will request volunteers to hold student-lead review sessions (5 participation points), and if you attend a student-led review session, you get 2 participation points. These can be online or perhaps in person if things improve during the semester.

Collaboration
Discussing the problems with peers, tutors, etc. after attempting to solve them on your own is encouraged, but the work you turn in has to be your own.

Final
The final will be available on Bb during finals week. It will have a 4-hour time limit and will be cumulative. It is due on May 17th end-of-day, but you are encouraged to submit it earlier than that.

Schedule (essentially the first 10 chapters of KK)

Week	Lecture Dates	Notes	Topics
1	Jan. 20		Counting states
2	Jan. 25, 27	HW1 due Jan. 27	Probability, entropy and temp
3	Feb. 1, 3	F1 due Feb. 1, HW2 due Feb. 4	Boltzmann distribution
4	Feb. 8, 10	F2 due Feb. 8, HW3 due Feb. 11	Helmholtz Free Energy
5	Feb. 15, 17	F3 due Feb. 15, HW4 due Feb. 17	Planck distribution
		1st exam due Feb. 21 end-of-day	
6	Feb. 22, 24	F4 due Feb. 22, HW5 due Feb. 24	Debye theory of phonons
7	March 1, 3	F5 due March 1, HW6 due March 3	Chemical potential
8	March 8, 10	F6 due March 8, HW7 due March 10	Gibbs distribution
	March 15 – 19	Spring Break	
9	March 22, 24	F7 due March 22, HW8 due March 24	Ideal gas
		2nd exam due March 28 end-of-day	
10	March 29, 31	F8 due March 29, HW9 due March 31	Fermi gas
		Withdrawal deadline April 1	
11	April 5, 7	F9 due April 5, HW10 due April 7	Heat and work
12	April 12, 14	F10 due April 12, HW11 due April 14	Gibbs Free Energy
13	April 19, 21	F11 due April 19, HW12 due April 21	Binary mixtures
14	April 26, 28	F12 due April 26, HW13 due April 28	Buffer
		3rd exam due May 2 end-of-day	
15	May 3, 5	F13 due May 3, HW14 due May 5	Buffer
16	N/A	F14 due May 10	
16		Final exam due May 17 end-of-day	

Missed exams and other eventualities
Since the worse score is dropped, there are no make ups for exams. If you experience a situation that affects your long-term performance in the class, let me know and show appropriate documentation.

Mentoring
Feel free to approach me for mentoring about your career, research ideas or opportunities, letters of recommendation, etc. I work for you and I like to do a good job, take advantage of that.

Students with Disabilities
If you have a disability and need classroom accommodations, please contact The Center for Accommodations and Support Services (CASS) at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at https://www.utep.edu/student-affairs/cass/. Accommodations might include but are not limited to note takers, readers, or extended time on exams and assignments. Please take care of this as soon as possible and before the first exam.

Useful links
Caltech Ph 12c Statistical Mechanics taught by John Preskill (YouTube playlist)
Microsoft Teams meeting