PHYSICS 4110
Statistical and Thermal Physics
Spring 2022
Lecture Section 001, Physics Room 115, MWF 9:00–9:50 am
Recitation Section 201, Lang Room 313, W 2:00–2:50 pm

Professor: Yuanxi Wang
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Office Hours: MF 10–11 am, and by appointment

Required Text:
An Introduction to Thermal Physics, by David V. Schroeder, Oxford University Press (OUP)
The OUP reissue is identical in content to the earlier Addison Wesley Longman version.

Additional suggested references:
Fundamentals of Statistical and Thermal Physics, by F. Reif, Waveland Press
Lectures on Statistical Physics, by David Tong, http://www.damtp.cam.ac.uk/user/tong/statphys.html

Topics and General Information: This course covers basic probability concepts, statistical description of systems of particles, statistical thermodynamics and thermodynamic laws, macroscopic and microscopic descriptions of systems, and phase transitions. By the end of the course, you should be able to answer questions like:

- What is temperature? Why does energy always flow from a hot system to a cold one?
- What is the difference between heat and work?
- Why is the air thinner at high altitudes? Why is there air at all at high altitudes?
- Why is carbon monoxide poisonous? How does osmosis work?
- Under what conditions do quantum effects start to emerge in modeling ideal gas?
- What keeps a metal from collapsing? What keeps white dwarf star from collapsing?
- What do ferromagnets and interacting classical gas have in common?

Attendance: Attendance of all lectures and recitations is strongly encouraged.

Exams: There will be three in-class hourly exams during the semester and a comprehensive final exam. Exam questions will be based on material covered in the lecture, contained in the text, and in the homework assignments. There will be no makeup exams, but if your homework score is higher than your lowest hourly exam score, these two will be swapped.

Homework: Homework sets will be assigned each week in lecture, and generally will be due Monday the week after assigned. Work must be legible and complete to receive full credit.

Grade: The grading in the course will be based on the total points earned from exams and homework as follows:

Exams	20 points for each hourly exams
	30 points for the final
Homework	10 points
Total	**100 points**

Note: This document is for informational purposes only and is subject to change upon notification in writing. Rev. 01/09/2022

Tentative Lecture Schedule

Session	**Date**	**Day**	**Chapter.Section, Lecture Topic**	
1	Jan 19	W	Ch. 1.1 Thermal equilibrium and temperature; 1.2 Ideal gas	
2	Jan 21	F	Ch. 1.3 Equipartition Theorem; 1.4 1st Law of Thermodynamics	
3	Jan 24	M	Ch. 1.5 Compression work	
4	Jan 26	W	Ch. 1.6 Heat capacity, enthalpy	
5	Jan 28	F	Ch. 2.1 Two-state systems and combinatorics; 2.2 Einstein solid	
6	Jan 31	M	Ch. 2.3 Coupled small systems; 2.4 Large systems	
7	Feb 2	W	Ch. 2.5 Multiplicity of ideal gas	Fundamentals
8	Feb 4	F	Ch. 2.6 Entropy	
9	Feb 7	M	Ch. 3.1 Temperature defined from statistical mechanics	
10	Feb 9	W	Ch. 3.2 Entropy and Heat	
11	Feb 11	F	Ch. 3.3 Paramagnetism	
12	Feb 14	M	Ch. 3.4 Pressure defined from statistical mechanics	
13	Feb 16	W	**Exam Chs. 1–2**	
14	Feb 18	F	Ch. 3.5 Diffusive equilibrium and chemical potential	
15	Feb 21	M	Ch. 3.5 Cont'd	
16	Feb 23	W	Ch. 4.1 Heat engines	
17	Feb 25	F	Ch. 4.1 Cont'd	
18	Feb 28	M	Ch. 4.2 Refrigerators	Classical thermodynamics
19	Mar 2	W	Ch 5.2 Free energy and thermodynamic potentials	
20	Mar 4	F	Ch. 5.2 Free energy and equilibrium	
21	Mar 7	M	Ch. 6.1 Boltzmann factor, partition function	
22	Mar 9	W	Ch. 6.2 Canonical ensemble, average values	
23	Mar 11	F	Ch. 6.2 Cont'd	
24	Mar 21	M	Ch. 6.3 Equipartition theorem revisited; 6.4 Maxwell speed distribution	Classical statistical mechanics
25	Mar 23	W	**Exam Chs. 3–5**	
26	Mar 25	F	Ch. 6.5 Partition fn. Z and free energy; 6.6 Z for composite systems	
27	Mar 28	M	Ch. 6.7 Ideal gas revisited	
28	Mar 30	W	Ch. 7.1 Gibbs factor, grand partition function	
29	Apr 1	F	Ch. 7.1 Grand canonical ensemble	
30	Apr 4	M	Ch. 7.2 Statistics of bosons and fermions	
31	Apr 6	W	Ch. 7.3 Degenerate Fermi gases	
32	Apr 8	F	Ch. 7.3 Cont'd	
33	Apr 11	M	Ch. 7.3 White dwarfs	
34	Apr 13	W	Ch. 7.4 Blackbody radiation	Quantum statistical mechanics
35	Apr 15	F	Ch. 7.4 Cont'd.	
36	Apr 18	M	Ch. 7.5 Debye Theory	
37	Apr 20	W	**Exam Chs. 6–7.3**	
38	Apr 22	F	Ch. 7.6 Bose-Einstein condensation	
39	Apr 25	M	Ch. 5.3 Van der Waals gas	
40	Apr 27	W	Ch. 5.3 Phase transitions	
41	Apr 29	F	Ch. 8.2 Ferromagnet Ising model	Phase transitions
42	May 2	M	Landau Theory	
43	May 4	W	Last day of class—Review	

Comprehensive Final Exam, Wednesday, May 11, 8:00–10:00 am

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Other Information

Canvas. The Canvas module section will be used to post course materials, lecture notes, announcements, grades, and the most up-to-date version of this syllabus (https://unt.instructure.com/). You may use your UNT EUID and password to log on and select this course.

Course Evaluation – Student Perceptions of Teaching (SPOT). Student feedback is an essential part of participation in this course. Providing the student evaluation of instruction instrument is a requirement for all organized classes at UNT.

A short SPOT survey will be made available **April 18 – May 5** to provide you with an opportunity to evaluate how this course is taught. You will receive an email from "UNT SPOT Course Evaluations via IASystem Notification" (no-reply@iasystem.org) with the survey link. Simply click on the link and complete your survey.

Once you complete the survey you will receive a confirmation email. For additional information, please email spot@unt.edu.

Office hours: Connect with me through attending office hours on Monday and Friday 10–11 am right after class! During busy times my inbox may be rather full - if you contact me and don't receive a response within two business days, please send a follow-up email. A gentle nudge is always appreciated.

ADA Policy: The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access(ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time, however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the studentFor additional information, refer to the Office of Disability Access website at https://studentaffairs.unt.edu/office-disability-access. You may also contact ODA by phone at (940) 565-4323.

Academic Integrity: UNT policy on Academic Dishonesty can be found at: https://vpaa.unt.edu/ss/integrity

COVID Impact: Please inform me if you are unable to attend class meetings because you are ill, in mindfulness of the health and safety of everyone in our community. If you are experiencing any symptoms of COVID (https://www.cdc.gov/coronavirus/2019-ncov/symptoms testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider prior to coming to campus. UNT also requires you to contact the UNT COVID Team at COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure.