PHYS 462/662   Thermal and Statistical Physics   Fall 2019

Course #5043-5044 (3 credits)

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Classes: Tuesday & Thursday, 3:30-4:45 p.m., SE 221

Office Hours (SE 214B):   Drop in any time or email me to arrange a time.

Bulletin Description:

Classical postulates and laws of thermodynamics; cyclic processes and entropy; thermodynamic potentials, equilibrium, stability, and phase transitions; Maxwell-Boltzmann distribution, applications to classical gases and magnets; quantum statistics, Bose-Einstein and Fermi-Dirac distributions, applications to quantum gases.

Objectives: The objectives are to master the foundations of thermodynamics and statistical mechanics and to apply theoretical and computational methods to model physical systems ranging from fluids (gases, liquids) to solids and magnets. *Graduate students will complete a research project on a topic of relevance to the course and their own interests.*

Preparation: Basic knowledge of mechanics, quantum physics, mathematical methods.

Student Responsibilities: Attend all classes. Read assigned material in advance. Come prepared for discussion. Be curious! Ask questions. Complete assignments on time.

Textbooks: D. Schroeder, *An Introduction to Thermal Physics* (Addison-Wesley, 2000)
          F. Reif, *Fundamentals of Statistical and Thermal Physics* (Waveland, 2008)
          For further reading, see also the separate list of Supplemental References.

Evaluation:	Homework	100 pts	
	Exams (3)	150 pts	(50+50+50)
	Reading quizzes	20 pts	
	Project (graduate students only)	50 pts	
	Total	270/320 pts	

Requirements and assessment of the project are described in a separate document.

The optional makeup exam during finals week will replace your lowest midterm score.

According to NDSU Policy 333 (`www.ndsu.edu/fileadmin/policy/333.pdf`), attendance in classes is expected. *More than three unexcused absences may result in failure.*

Homework: Assignments will be posted on Blackboard (`https://bb.ndsu.nodak.edu`). While discussion of homework with classmates is encouraged, submitted work must be your own. Similarity to work of other students or to internet solutions will yield no points. Since solutions will be discussed on the due date, *late assignments cannot be accepted.* However, partial credit may be given for incomplete work, so be sure to submit whatever you can finish by the due date.

Note: Three missed homework assignments will result in automatic failure of the course.

Grading: A: $\geq 90\%$, B: 80 to $< 90\%$, C: 70 to $< 80\%$, D: 60 to $< 70\%$, F: $< 60\%$

I reserve the right to shift grade boundaries, but any shift will work only in your favor.

Preliminary Schedule

Week	Topics	Reading*
1	Thermodynamic systems and postulates	S1, R2
2	Energy, work, heat and the First Law of Thermodynamics	S1, R4
3	Cyclic processes and thermal engines	S4
4	States, entropy, and the Second Law of Thermodynamics	S2
5	Ideal and interacting systems, thermodynamic equilibrium	S3
6	**Midterm Exam: Oct. 3**	S5, R3, R8
7	Free energy and thermodynamic phase stability	S1-S4
8	Equations of state, phase transitions, and critical phenomena	S5
9	Thermodynamic potentials (Legendre transformations)	S5
10	Microstates, macrostates, phase space, ensembles, Second Law	R2-R5
11	**Midterm Exam: Nov. 5**	S6, R7
12	Classical statistics: Maxwell-Boltzmann distribution	S6, R7
13	Applications: ideal gases, paramagnets, and ferromagnets	S1-S6
14	Quantum statistics: Bose-Einstein and Fermi-Dirac distributions	S7, R9
15	Systems of interacting particles, computer simulation methods	S7, S8, R9
16	**Midterm Exam: Dec. 5**	
17	**Makeup Exam (Optional): Dec. 17, 10:30 AM**	S1-S8

∗ S=Schroeder (strongly recommended), R=Reif (optional)

The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at `www.ndsu.edu/academichonesty`*.*

All access to NDSU computers must respect NDSU Senate Policy, section 158:
Acceptable use of Electronic Communication Devices
`https://www.ndsu.edu/fileadmin/policy/158.pdf`

Any students with disabilities or other special needs, who need special accommodations in this course are invited to share concerns or requests with the instructor and to contact the Disability Services Office (`www.ndsu.edu/disabilityservices`*) as soon as possible.*