

Course # 16473 (3 credits)

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http://www.ndsu.edu/pubweb/~denton/

**Classes:** TTh, 3:30-4:45 PM    **Office hours:** MW, 4:15-5:30 PM (Zoom) or drop in

**Bulletin Description:** Review of thermodynamics and statistical mechanics; Monte Carlo and molecular dynamics simulation; applications to phase transitions.

**Prerequisite:** PHYS 462/662 Thermal and Statistical Physics (or equivalent)

**Objectives:** Develop conceptual and technical mastery of theoretical and computational methods of statistical physics and applications to a variety of many-particle systems.

**Preparation:** Basic knowledge of mechanics, thermodynamics, statistics, and mathematical methods. Some familiarity with numerical methods and programming.

**Format:** Review assigned resources in advance and attend class prepared to discuss and work through guided exercises. You are not expected to fully understand the material before class, but be familiar with terminology and definitions. In this way, we can use class time most effectively to deepen conceptual understanding, strengthen problem-solving skills, and discuss practical relevance and applications.

**Textbooks:** R. K. Pathria & P. D. Beale, *Statistical Mechanics*, 3rd ed. (Elsevier, 2011); D. Chandler, *Introduction to Modern Statistical Mechanics* (Oxford, 1987).

**Evaluation:**

Homework	100 pts
Exams	200 pts
Quizzes	50 pts

**Homework:** Assignments will be posted on Blackboard (<https://blackboard.ndsu.edu>). Discussion of homework with classmates is encouraged, but submitted work must be your own. Similarity to work of other students or to internet solutions will yield no points.

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

Grades will not be curved and any shift in grade boundaries will be only in your favor.

Attendance is expected (NDSU Policy 333, [www.ndsu.edu/fileadmin/policy/333.pdf](http://www.ndsu.edu/fileadmin/policy/333.pdf)), but face masks and physical distancing (2 m separation) are required in the classroom. Active engagement in class discussions is strongly correlated with success in this course! *More than three unexcused absences may result in failure.*

### Contingency Plan for Remote Instruction and Learning

Requests for remote participation due to COVID-19 concerns will be accommodated. See attached COVID-19 Related Information. Should circumstances necessitate online instruction, all course resources will remain accessible through Blackboard and communications and interactive discussions will continue via email and video conference.

# Preliminary Schedule

(PB=Pathria & Beale; C=Chandler)

Dates	Topic(s)	Reading
Weeks 1-3	Statistical Thermodynamics, Ensembles	PB 1-4; C 1-3
Week 4	Quantum Statistics: Bosons and Fermions	PB 5; C 4
Week 5	Theory of Simple Gases	PB 6; C 4
<b>Feb. 24</b>	<b>Midterm Exam 1</b>	PB 1-6; C 1-4
Weeks 6-7	Ideal Bose and Fermi Systems	PB 7-8; C 4
Weeks 8-9	Statistical Mechanics of Interacting Systems	PB 10-11; C 5, 7
March 14-18	Spring Break (no classes)	
Weeks 10-11	Phase Transitions, Critical Phenomena, Scaling	PB 12; C 5
<b>March 29</b>	<b>Midterm Exam 2</b>	PB 6-9; C 3-4
Week 12	Phase Transitions: Exact Solutions of Various Models	PB 13; C 5
Week 13	Phase Transitions: Renormalization Group Theory	PB 14; C 5
Week 14	Statistical Mechanics of Nonequilibrium Systems	PB 15; C 8
<b>April 26</b>	<b>Midterm Exam 3</b>	PB 10-14; C 5-7
Weeks 15-16	Computer Simulation Methods	PB 16; C 6
<b>May 10, 10:30 AM</b>	<b>Final Exam</b>	PB 1-16; C 1-8

*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](http://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](http://www.ndsu.edu/disabilityservices)) as soon as possible.*

Homework	Date Assigned/Date Due	Recommended Reading
1	Jan. 11/25	PB 1-3; C 1-3
2	Jan. 25/Feb. 3	PB 4; C 3
3	Feb. 3/15	PB 5-6; C 4
4	Feb. 15/March 3	PB 6-8; C 4-5
5	March 3/22	PB 8; C 4
6	March 22/31	PB 10-11; C 5, 7
7	March 31/April 12	PB 12; C 5
8	April 12/21	PB 13-14; C 5
9	April 21/May 3	PB 14-15; C 5, 8

# COVID-19 Related Information

## Communication

Course-related information will be communicated primarily during our class meetings. Reminders and notifications of any schedule changes will be communicated through NDSU email and posted on the Blackboard announcements page.

Your NDSU email address is the official route for course-related information.

Office hours will be conducted in person and via Zoom (at times to be announced).

If you have any technology concerns, please contact the IT Help Desk:

[ndsuhelpdesk@ndsu.edu](mailto:ndsuhelpdesk@ndsu.edu) 701-231-8685 (option 1)

## Submission of Homework and Posting of Grades

Homework assignments will be submitted through our Blackboard course homepage, where all grades will be posted.

## Copyright of Course Materials

Recording any class meetings with your own personal devices is strictly prohibited. See NDSU [Policy 190](#) on Intellectual Property.

## Health and Safety Expectations

Information on COVID-19 and NDSU's response:

[https://www.ndsu.edu/police\\_safety/covid\\_19\\_preparedness\\_and\\_response/](https://www.ndsu.edu/police_safety/covid_19_preparedness_and_response/)

I encourage all students to attend class meetings in person. According to NDSU policy and CDC guidelines, when in the classroom, you must properly wear a face covering (covering both the mouth and nose) for the entire class. Wearing a face covering helps reduce the risk to others in case you are infected but do not have symptoms, and also may protect you from infection. *Research studies show that even if vaccinated you can become infected and transmit the virus to others.*

If you fail to properly wear a face covering, you will not be admitted to the classroom.

However, you may choose to participate remotely and synchronously via Zoom (see HyFlex options below).

Students who cannot wear a face covering due to a medical condition or disability may seek accommodation through Disability Services:

701-231-8463 <https://www.ndsu.edu/disabilityservices/>

Disinfecting supplies are provided for you to disinfect your learning space. You may also use your own disinfecting supplies.

Whenever possible, observe physical distancing guidelines, maintaining 2 m separation from others. Avoid congregating around the classroom entrance before or after class.

In accordance with NDSU [Policy 601](#), failure to comply with instructions, including this syllabus, may be handled according to the Code of Student Conduct resolution process and may result in disciplinary sanctions.

Food and drink are not allowed in class except with a documented accommodation through Disability Services.

*Do not come to class if you are sick.* Please protect your health and the health of others by staying home, where you may participate remotely. For information on COVID-19, symptoms, testing, and steps to stay healthy see

[https://www.ndsu.edu/studenthealthservice/patient\\_resources/covid\\_19\\_information/](https://www.ndsu.edu/studenthealthservice/patient_resources/covid_19_information/)

*Do not come to class if you have been exposed to individuals who tested positive for COVID-19 and/or you have been notified to self-quarantine due to exposure.*

If you are unable to attend class at the scheduled time due to illness or exposure, email me promptly for alternate arrangements, including accommodations and extensions.

If you are absent from class as a result of a COVID-19 diagnosis or quarantine, you will be able to participate in class remotely (see HyFlex Options below).

### **HyFlex Options**

If you have an underlying medical condition putting you at high risk for severe COVID-19 (or of infecting someone at high risk), you have the option of attending classes remotely via Zoom. You may opt to do so at the beginning of the semester or as the need arises during the semester.

To participate in HyFlex instruction remotely, you must have access to the requisite technology, including a laptop or computer with a functioning microphone, speakers (or headphones) and webcam, as well as reliable internet access.

### **Additional Resources for Students**

As a valued member of the NDSU community, you have access to resources should you need help in dealing with adverse reactions to things happening in the world today:

Counseling Services: 701-231-7671; <https://www.ndsu.edu/counseling/>

Disability Services: 701-231-8463; <https://www.ndsu.edu/disabilityservices/>

Student Health Service: 701-231-7331; <https://www.ndsu.edu/studenthealthservice/>

Dean of Students Office: 701-231-7701; <https://www.ndsu.edu/deanofstudents/>

**In a Crisis or Emergency Situation:**

Call University Police: 701-231-8998

Call 9-1-1

For physical health crises: Go to a Hospital Emergency Room

For mental health crises: Go to Prairie St. John's for a Needs Assessment

510 4th St. S, Fargo (701-476-7216)

Call the FirstLink Help Line: 1-800-273-TALK (8255) or 2-1-1

Call the Rape and Abuse Crisis Center: 701-293-7273