

## CHM 6461: Introduction to Statistical Thermodynamics, Spring 2019

**Instructor:** Prof. Russ Bowers

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**Office Hours:** Physics Building, Rm. 2360.

Mon. 1-3 pm

Other times by appointment

**Meeting Place and Time:** Matherly Hall, Rm 0112, MWF 8<sup>th</sup> Period (3:00 - 3:50)

**Classes begin/end:** January 7 - May 3

**Final Exam:** May 1, 2019 @ 3:00-5:00 pm

**Holidays:** Jan.21; March 2-9 (Spring Break)

**Course Objectives and Goals:** This course gives a self-contained exposition of topics that are generally considered fundamental in a modern introductory equilibrium statistical thermodynamics. After a brief review of the role of entropy in the macroscopic (thermodynamic) description, the bridge to the microscopic (statistical) point of view is established. Students will learn about the formulation of the canonical and grand canonical ensembles, partition functions, and quantum statistics, followed by key applications in chemical physics.

### Grading Rubric

Midterm Exam	30%
Final Exam	30%
Quizzes (2)	30%
Homework	10%

### Required Text

- Terrell L. Hill, An Introduction to Statistical Thermodynamics (Also available as an e-book), Dover Publications (January 1, 1987) ISBN-10: 0486652424, ISBN-13: 978-0486652429

### Supplemental Texts

- Donald A. McQuarrie, Statistical Mechanics (Hardcover), Publisher: University Science Books; 2nd Ed. (May 2000), ISBN-10: 1891389157, ISBN-13: 978-1891389153.
- Terrell L. Hill, An Introduction to Statistical Thermodynamics (Also available as an e-book), Dover Publications (January 1, 1987) ISBN-10: 0486652424, ISBN-13: 978-0486652429
- Roger Bowley and Mariana Sanchez, Introductory Statistical Mechanics, Second Edition, 2011, Oxford Science Publications, Clarendon Press, Oxford ISBN 978-0-19-850576-1.

**Required Software:** Wolfram's Mathematica. (Available on UFApps)

**Attendance:** 100% attendance is expected. Make-up exams must be arranged in advance and will be granted only in emergency situations, consistent with the university policies that can be found at:

<https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx>".

**Students with disabilities:** Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

**Grading:** <https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx>

**Course Evaluation:** Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

**Honesty Pledge:** UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

### **Health and Wellness**

U Matter, We Care:

If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center:

<https://counseling.ufl.edu/>, 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)  
Student Health Care Center, 392-1161.

University Police Department, 392-1111 (or 9-1-1 for emergencies).  
<http://www.police.ufl.edu/>

### **Academic Resources**

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. <https://lss.at.ufl.edu/help.shtml>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling. <https://career.ufl.edu/>

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

**Tentative Schedule**

<b>Week</b>	<b>TOPIC</b>
<b>1</b>	Microscopic and macroscopic variables Postulate of maximum entropy Internal constraints and entropy Quasi-static, reversible, and irreversible processes Stability criteria
<b>2</b>	Probability and statistics
<b>3</b>	Concepts in statistical mechanics Microcanonical ensemble Applications
<b>4-5</b>	Time evolution in quantum mechanics Density operator and time evolution Boltzmann distribution Statistical entropy Time evolution of statistical entropy Equilibrium distributions
<b>6-7</b>	Canonical and grand canonical ensembles Partition functions Relationship to thermodynamic potentials
<b>EXAM 1</b>	
<b>8-10</b>	Applications I <ul style="list-style-type: none"> <li>• Monatomic ideal gas</li> <li>• Quantum phase space</li> <li>• Diatomic and polyatomic molecules</li> <li>• Vibrations in solids - phonons</li> <li>• Paramagnetism and Ferromagnetism</li> <li>• Spin waves</li> </ul>
<b>11-12</b>	Applications II <ul style="list-style-type: none"> <li>• Identical particles, quantum statistics</li> <li>• Bose-Einstein and Fermi-Dirac distributions</li> <li>• Maxwell-Boltzmann limit</li> <li>• Ideal Fermi gas</li> </ul>
<b>13-15</b>	Applications III <ul style="list-style-type: none"> <li>• Chemical equilibrium</li> <li>• Rates of chemical reactions</li> <li>• Absolute rate theory</li> </ul>
<b>FINAL EXAM</b>	