Physics 551: Statistical Physics
Department of Physics & Astronomy, University of Tennessee
Fall 2010

Hours: Tuesdays and Thursdays, 3:40-4:55 pm
Classroom: Physics 306
Instructor: Prof. Zhenyu Zhang
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Prerequisites: A solid mastery of thermodynamics and quantum mechanics.

**Brief course description:**
This course introduces the statistical foundation of thermodynamics. Statistical mechanics is relevant whenever the number of particles in a system is large; therefore, it plays an important role from the beginning of the history of the universe to the most recent developments in physics and beyond. This is a core course intended for all physics graduate students at The University of Tennessee. The material covered is at a more advanced level than the typical undergraduate course on the same subject. Particular emphasis will be made to connect the textbook-level concepts learned in this course with some of the current topics in frontier research within the department and elsewhere.

Specific topics and tentative lecture schedule (Note: Each chapter of Pathria will be enriched by materials from the key reference books listed above or other references):

1. Basic concepts and statistical basis of thermodynamics (Pathria Ch. 1) (8/19, 8/24, 8/26)
2. Elements of ensemble theory and microcanonical ensemble (Ch. 2) (8/31,9/2)
3. The canonical ensemble (Ch. 3) (9/7, 9/9, 9/14)
Special Lecture: Louiville’s Theorem in Spin-Dependent Phase Space  
(Dr. Di Xiao, ORNL) (9/16)
4. Grand canonical ensemble (Ch. 4) (9/21, 9/23)  
Review (9/28)  
Midterm Exam (in class, open book, 2 hours) (9/30)  
Special Lecture: Nonequilibrium Green’s Function Method for Quantum Transport  
(Dr. Kirk Bevan, McGill University, Canada & ORNL) (10/5)  
No Class on Thursday, 10/7 (fall break)
5. Formulation of Quantum statistics (Ch. 5) (10/12, 10/14)  
6. Simple gases (Ch. 6) (10/19, 10/21)  
7. Ideal Bose systems (Ch. 7) (10/26, 10/28)  
8. Ideal Fermi gas (ch.8) (11/2, 11/4, 11/9)  
Student Presentations I (11/11)  
Student Presentations II (11/16)  
Special Lecture: “Electronic growth” of metallic nanostructures (11/18)
9. A brief view on interacting systems (Ch. 9) (11/23)  
No Class on Thursday, 11/25 (Thanksgiving break)  
Reviews (11/30)  
Final Exam (close book, 5:00-7:00pm, date to be confirmed)

**Grading Scheme:**

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<thead>
<tr>
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<th>Points</th>
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<tbody>
<tr>
<td>Homework</td>
<td>30</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>30</td>
</tr>
<tr>
<td>Final Exam</td>
<td>40</td>
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<tr>
<td>Maximum score</td>
<td>100</td>
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Past experience with this course strongly suggests that those students who managed to attend all or most of the classes would typically score substantially better than those who missed too many classes. In the current year we might see increased statistics to test the validity of this correlation.

Homework is also an **extremely** important part of the course. Statistical mechanics is abstract, mathematical, challenging, and fun (once you dive in). Only by solving problems and thinking about the concepts of the course will you arrive at a solid understanding of the subject. Unless otherwise specified, homework assignments will be handed out every Thursday and should be turned in one week later. The homework will be graded, each set contributing towards the final grade for the course.

The midterm exam will be open book, for two hours, on materials up to Chapter 4.

The comprehensive final exam will be closed book, for two hours, covering all the materials of Chapters 1-9.

You are strongly encouraged to see the instructor and/or the TA regularly to discuss your progress. You are also welcome to send your questions and comments by email, which will be responded promptly or as soon as possible.