Physics 305

Statistical Mechanics and Thermodynamics

Francesco Becattini

Spring 2017 - Florence

Meeting Time: to be determined
Office: to be determined
Phone Number: to be determined
Email Address: becattini@fi.infn.it
Office Hours: to be determined
Credits: 4
Prerequisites:

Course ID  Title

Statistical Mechanics and Thermodynamics

This course counts toward the following NYUAD degree requirements:

• Majors > Physics

Course Description: Understanding the behavior of macroscopic systems composed of many particles requires a statistical approach. Phenomena like the behavior of polyatomic gases, magnetism, thermal radiation, phase changes and many others can be understood through Statistical Mechanics. Topics include relation of entropy to probability and energy to temperature, the laws of thermodynamics, Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics, equations of state for simple gases and chemical and magnetic systems, and elementary theory of phase transitions.

Learning Outcomes:

• We will start with a general summary of the theory of probability which will also include topics not strictly related to Statistical Mechanics, but anyway useful for a physics or more in general a scientist. We will then move to the classical description of Statistical Mechanics with particular interest in the definition of Entropy (or more in general information). We will then explore the consequences of the quantum mechanical nature of particles and how they manifest in microscopic systems. Finally we will talk about phase transitions and simple models to describe them. During classes several applications of Stat. Mech. in chemistry, solid state physics and astrophysics will be presented.

Teaching Methodologies:
• The class will be taught in a tutorial style. It is my experience that abstract concepts can be more easily assimilated if used to solve practical problems. Several example and exercises will be discussed and assigned in each class. They will require a fair amount of independent thinking and will cover your entire range of comprehension, from very basic knowledge to just beyond your current understanding.

**Graded Activities:**

Class problems 20%  
Homeworks 40%  
Exams 40%

**Required Bookstore Texts:**

• Greiner: Thermodynamics and Statistical Mechanics (9780387942995)

**Other Required Readings:**

• Reif: Fundamentals of Statistical and Thermal Physics (978-1577666127)

**Other Optional Texts:**

• Fitzpatrick Notes: Thermodynamics and Statistical Mechanics

**Attendance:** A consistent amount of time will be devoted to work on problems as a class. It is therefore critical to attend class.

**Academic Integrity:** As set forth in NYU Academic Integrity Policy, the relationship between students and faculty at NYU is defined by a shared commitment to academic excellence and is grounded in an expectation of fairness, honesty, and respect, which are essential to maintaining the integrity of the community. Every student who enrolls and everyone who accepts an appointment as a member of the faculty or staff at NYU agrees to abide by the expectation of academic honesty.

The full policies and procedures relating to Academic Integrity may be found on the NYUAD Student Portal: https://students.nyuad.nyu.edu/campus-life/student-policies/community-standards-policies/academic-integrity/

**Day-by-Day Schedule:**

<table>
<thead>
<tr>
<th>Dates TBD</th>
<th>Topic</th>
<th>Reading</th>
<th>Other</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Probability theory</td>
<td>1.1-1.4 Reif</td>
<td></td>
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<tr>
<td></td>
<td>Bayesian approach</td>
<td>1.1-1.4 Reif</td>
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Phase Transitions p. 417-430 Greiner
Application: Ising Model p. 436-443 Greiner