004:231:001 Statistical Thermodynamics I

LECTURES: 11:00A - 12:15P TTh C10 PC. Attendance is expected.

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Office Hours: Th 2pm-5pm in 118 IATL. All other meetings by appointment only.

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COURSE DESCRIPTION: This course will cover the subject of quantum and classical statistical thermodynamics. The course will mainly focus on systems in equilibrium but some limited non-equilibrium topics such as time correlation functions will be introduced.

1) To prepare and be successful for the close book tests, you must become proficient in solving problems and understanding the underlying theory behind them.

2) Some times a particular topic is more clearly explained in one book than in some other. Several textbooks on this topic are available. We will not follow one particular book in this course; however, an abbreviated list of text books that I have used to prepare lectures appears later on this syllabus with their corresponding ISBN #.

3) This course is demanding; we will cover a large amount of material this semester. You must spend enough time to keep up with the lectures. If you fall behind it will be very hard to catch up because topics are interconnected.

TEXTBOOKS: (recommended but not required)

Thermodynamics and an Introduction to Thermostatistics, 2nd Edition by Herbert B. Callen
Publisher: Wiley; 2 edition (August 29, 1985)
ISBN: 0471862568
(This book is used only during the first few weeks as a refresher on classical thermodynamics)

Introduction to Modern Statistical Mechanics by David Chandler
Publisher: Oxford University Press (September 1, 1987)
ISBN: 0195042778
(Much of the first part of this course is based on this book, however not all topics that will be discussed in class are covered)
Statistical Mechanics by Donald A. McQuarrie  
Publisher: University Science Books; 2nd Ed edition (February 1, 2000)  
ISBN: 1891389157  
(This book covers nearly all the topics in this course and will be used extensively throughout the semester)

Statistical Mechanics: Principles and Selected Applications by Terrell L. Hill  
Publisher: Dover Publications (August 1, 1987)  
ISBN: 0486653900  
(A classic, and still and excellent source for the equilibrium topics covered in this course)

I have a copy of all of the above books. If you plan on purchasing a book it may be advantageous to borrow these from me first to see which one you like best. These books will be available for checkout from my office for a maximum period of 2 hours at a time.

GRADING: The final course grade will be based on the following components:

Problem sets  20 %

2 Exams  20 % each (total 40%)

Final Project  40%

EXAMINATIONS: There will be 2 in-class exams and a final project. Exams are closed-book. Exams will be held on March 12 and April 30. The final project is also due on April 30 but can be submitted any time before this deadline. The May lecture hours are reserved for students to present their projects to the rest of the class. For each exam, emphasis will be placed on material covered since the preceding exam, however it is very important to understand that the material covered later in the course requires the application of concepts learned earlier. Announcements will be made in class regarding the material to be covered on each exam. All exams must be written in ink if you want them to be regraded. Exams will be returned in class as soon as possible.

Make-up exams must be arranged with the instructor and are only available in the event of a university recognized excuse (e.g. a documented medical emergency). Under no circumstances will a make-up exam be given to take the place of a regular exam taken earlier.

If you feel that an error was made in the grading of an exam, you may request a re-grade by notifying the instructor within one week of receiving the graded material. The request should be in writing and indicate the section of the exam that is in question. Please note that the entire examination will be subject to a regrade.

FINAL PROJECT: As part of this course you need to complete a final project. The final project which will most likely be relevant to your research must be agreed upon you and the instructor (me). By February 26 you must come up with one or more ideas that are
related to the material in this class and that can be achieved computationally or analytically (i.e. with pencil and paper). During office hours we will outline a plan of action so that these can be completed by the project deadline. Hopefully this will provide you with skills that you can continue using for your research in the future.

HOMEWORK: Unless otherwise announced in class, a problem set will be due exactly one week after it was assigned (for example if the homework is assigned on Tuesday it will be due the following Tuesday at the beginning of class). The problem sets should represent the students own work. (Please see the section in the Student Academic Handbook on Rights and Responsibilities for University policy on academic misconduct). Late assignments and assignments submitted by email will not be accepted. Exceptions to the late assignment rule will only be made in the case of a valid excuse as described in the examinations section above. The homework assignments must be securely fastened with a staple. The problem sets are subject to the same regrade policy as for examinations, as described above.

Teaching Policies & Resources — Syllabus Insert
From (http://clas.uiowa.edu/faculty/teaching-policies-resources-syllabus-insert)

Administrative Home

The College of Liberal Arts and Sciences is the administrative home of this course and governs matters such as the add/drop deadlines, the second-grade-only option, and other related issues. Different colleges may have different policies. Questions may be addressed to 120 Schaeffer Hall, or see the CLAS Academic Policies Handbook at http://clas.uiowa.edu/students/handbook.

Electronic Communication

University policy specifies that students are responsible for all official correspondences sent to their University of Iowa e-mail address (@uiowa.edu). Faculty and students should use this account for correspondences (Operations Manual, III.15.2, k.11).

Accommodations for Disabilities

A student seeking academic accommodations should first register with Student Disability Services and then meet privately with the course instructor to make particular arrangements. See www.uiowa.edu/~sds/ for more information.

Academic Honesty

All CLAS students have, in essence, agreed to the College's Code of Academic Honesty: "I pledge to do my own academic work and to excel to the best of my abilities, upholding the IOWA Challenge. I promise not to lie about my academic work, to cheat, or to steal the words or ideas of others; nor will I help fellow students to violate the Code of Academic Honesty." Any student committing academic misconduct is reported to the
College and placed on disciplinary probation or may be suspended or expelled (CLAS Academic Policies Handbook).

CLAS Final Examination Policies

The final examination schedule for each class is announced around the fifth week of the semester by the Registrar. Final exams are offered only during the official final examination period. No exams of any kind are allowed during the last week of classes. All students should plan on being at the UI through the final examination period. Once the Registrar has announced the dates and times of each final exam, the complete schedule will be published on the Registrar's web site.

Making a Suggestion or a Complaint

Students with a suggestion or complaint should first visit with the instructor (and the course supervisor), and then with the departmental DEO. Complaints must be made within six months of the incident (CLAS Academic Policies Handbook).

Understanding Sexual Harassment

Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community have a responsibility to uphold this mission and to contribute to a safe environment that enhances learning. Incidents of sexual harassment should be reported immediately. See the UI Comprehensive Guide on Sexual Harassment for assistance, definitions, and the full University policy.

Reacting Safely to Severe Weather

In severe weather, class members should seek appropriate shelter immediately, leaving the classroom if necessary. The class will continue if possible when the event is over. For more information on Hawk Alert and the siren warning system, visit the Department of Public Safety website.

TENTATIVE OUTLINE OF THE COURSE

1) Review of macroscopic thermodynamics. Fundamental laws, maximum and minimum principles for the entropy and different free energies, the Gibbs-Duhem equation, Legendre transformations.

2) Introduction to equilibrium statistical mechanics. Ensembles, partition functions and the connection with thermodynamics.

3) Bose-Einstein, Fermi-Dirac and Boltzmann statistics.
4) Classical statistical mechanics. Reduced distribution functions. Thermodynamics from g(r).

5) Perturbation theory and the Van der Waals equation.

6) Time correlation functions.

7) Some other more advanced selected topics that will be cover if we have time. (Monte Carlo sampling, path integral formulations)