Course Description (from the course catalog)
This course introduces the statistical machinery used to connect molecular behavior with thermodynamic principles. Covered topics are useful for chemists, physicists, biologists, and engineers.

Course Outcomes
By the end of this course, you will be able to:
• Understand the dominant role of microscopic fluctuations.
• Calculate the entropy of a macroscopic system from the statistics of microscopic fluctuations.
• Understand the role of the energy scale set by $k_B T$.
• Count microstates in discrete and continuous model systems.
• Determine if a system should be treated with quantum mechanics or can be understood with classical statistical mechanics.
• Write down the partition function of a simple system, and derive important properties from it.
• Explain the Second Law of Thermodynamics in terms of the likelihood of microscopic fluctuations.
• Understand the connection between entropy and thermodynamic potentials like enthalpy and Gibbs free energy.
• Understand how microscopic fluctuations dictate properties of materials.
• Predict the distribution of material from knowledge of the chemical potential.
• Use the microscopic energy landscape of a chemical reaction to calculate its macroscopic rate.
• Estimate molecular speeds of particles.

Outline of Topics
1. Microscopic foundations: microstates and probabilities
2. The Boltzmann distribution
3. The direction of spontaneous change: the Second Law
4. Elements of classical thermodynamics
5. Statistical ensembles & partition functions
7. Quantum vs. classical statistical mechanics.
8. Non-interacting molecules
9. Transition state theory

Important Dates
First day of class: Monday, August 19 2019.
Last day to drop class: Friday, August 23 2019.
Last day to withdraw from class: Friday, September 13 2019.
Midterm exam (in class): Friday, September 13 2019.
Final exam: Written part, in class: Friday, October 4 2019.
Oral part: Friday, October 4 2019, 4pm.
Required Materials
All materials will be provided. The course does not follow any textbook in particular. Here are a few books that I use for reference:
Callen, “Thermodynamics and an Introduction to Thermostatistics”.
Dill & Bromberg, “Molecular Driving Forces”.
McQuarrie & Simon, “Physical Chemistry: A Molecular Approach”.
Chandler, “Introduction to Modern Statistical Mechanics”.
Shell, “Thermodynamics and Statistical Mechanics”.

Discussion/homework
Each week I will hand out a problem set. You do not need to hand in your solutions. Instead, we will discuss them on Friday in class. Before discussion starts, there will be a sign-up sheet that you should use to indicate which problems you have worked out. For any given problem, I will select at random a student who has signed up for the problem, and he/she will present the solution on the board. The number of problems you signed up for, as well as your presentation will be an important part of the course grade. Please arrive on time, as you can only sign up for problems before discussion starts. Compared to homework that is handed in, this format is designed to make you think more deeply about the problems and the ideas involved in their solution. It is also a good opportunity to practice and get comfortable presenting your ideas in front of a critical (but friendly!) crowd, a situation you will encounter many times during your graduate studies and professional careers.
To be able to sign up for a problem with confidence, you should have arrived at a solution which appears correct to you, and you should be able to reproduce and explain the train of thought leading to its solution. Given the short duration of the discussion section (65 min), we probably will not be able to discuss all problems in detail and, depending on the number of students in the course, you will likely not be asked to present a problem every week. Nevertheless, please be honest when signing up for problems. If it becomes clear during the presentation that you have not spent enough time on the problem, this will be considered “cheating”, and all problems you have signed up for that particular week will be forfeit. Well-prepared solutions that turn out to be incorrect are certainly not considered cheating!

Exams
No make-up exams will be administered. Simply put, do not miss an exam. If you have an unavoidable academic conflict, please let me know as soon as possible, at least two weeks prior to the exam date. At During exams, you cannot use any electronic devices, including calculators, phones, laptops, tablets, etc. The midterm will be a written, in-class exam. The final has two components: A written one (in class), and an oral one. Oral exams will take the form of discussions with students in groups of two or three and will focus on conceptual questions.

Grades
30% Problems
25% Midterm
25% Final exam, written
20% Final exam, oral

Changes to the Syllabus
This syllabus is meant to serve as an outline and guide for our course. Please note that I may modify it with reasonable notice to you. I may also modify the course schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas under Announcements.

The Americans with Disabilities Act
The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you
and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services. Please notify me of any requested accommodations within the first week of class.

**Sexual Misconduct**  
Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

**Campus Safety**  
The University of Utah values the safety of all campus community members. To report suspicious activity, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

**Inclusivity**  
It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students’ learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups. In addition, if any of our class meetings conflict with your religious events, please let me know so that we can make arrangements for you.

**Names/Pronouns**  
Class rosters are provided to the instructor with the student’s legal name as well as “Preferred first name” (if previously entered by you in the Student Profile section of your CIS account, which can be managed at any time). While CIS refers to this as merely a preference, I will honor you by referring to you with the name and pronoun that feels best for you in class or on assignments. Please advise me of any name or pronoun changes so I can help create a learning environment in which you, your name, and your pronoun are respected. If you need any assistance or support, please reach out to the LGBT Resource Center. https://lgbt.utah.edu/campus/faculty_resources.php

**Academic Honesty**  
Any form of cheating on exams will not be tolerated. Please refer to the University regulations for more information. (http://www.regulations.utah.edu/academics/6-400.html)