

# Ch En 593R: Statistical Thermodynamics

## Fall 2024, 3 Cr.

<b>Location</b>	W142 BNSN
<b>Time</b>	10:00 am – 10:50 am MWF
<b>Prerequisites</b>	Ch En, Me En, Physics, or Chemistry Graduate Student OR Undergraduate Thermodynamics: CH EN 373, ME EN 321, PHSCS 360, or CHEM 463.
<b>Instructor</b>	Douglas R. Tree, 330I Engineering Building Phone: (801) 422-5162 Email: <a href="mailto:tree.doug@byu.edu">tree.doug@byu.edu</a> Zoom: <a href="https://byu.zoom.us/my/treedoug">https://byu.zoom.us/my/treedoug</a>
<b>TAs</b>	None
<b>Office Hours</b>	See website for times and locations: <a href="http://www.et.byu.edu/~treedoug/teaching/">http://www.et.byu.edu/~treedoug/teaching/</a>
<b>Course Website</b>	Content: <a href="http://www.et.byu.edu/~treedoug/teaching/">http://www.et.byu.edu/~treedoug/teaching/</a> Learning Suite for Grades, Keys, Copyrighted Material, Assignment Submission
<b>Textbook</b>	Statistical Thermodynamics and Stochastic Kinetics: An Introduction for Engineers Yiannis Kaznessis, 1 <sup>st</sup> Edition, Cambridge Univ. Press, 2011 <a href="https://www.amazon.com/Statistical-Thermodynamics-Stochastic-Kinetics-Introduction/dp/0521765617">https://www.amazon.com/Statistical-Thermodynamics-Stochastic-Kinetics-Introduction/dp/0521765617</a> ; <a href="https://doi.org/10.1017/CBO9781139015554">https://doi.org/10.1017/CBO9781139015554</a>
<b>Course Description</b>	<p>This course is an introduction to Statistical Thermodynamics (i.e., Statistical Mechanics) for Engineers. This course should be accessible to 1<sup>st</sup> year graduate students and advanced undergraduate students in engineering, physics, or chemistry who have completed a course in thermodynamics. We will cover topics including:</p> <ul style="list-style-type: none"><li>• Probability theory and stochastic processes: multivariate distributions, correlation functions, characteristic functions, Markov processes</li><li>• Phase space and ensemble theory: classical/quantum, microcanonical/canonical/grand canonical ensembles, fluctuations, partition functions</li><li>• Pure component systems: ideal and non-ideal gases, liquids, crystals</li><li>• Polymers, colloids, and electrolytes</li><li>• Non-equilibrium systems (transport) and reaction kinetics</li></ul> <p><i>This class will not focus on molecular simulation techniques (i.e., Molecular Dynamics or Monte Carlo). See instead CH EN 513 Molecular Modeling.</i></p>

<b>Lectures</b>	Most days of class will consist of interactive lectures. I will provide occasional handouts or supplemental notes, but in general, <i>I will not provide you with a copy of my lecture notes</i> . This policy is for pedagogical reasons; taking notes help you pay attention in class.
<b>Reading</b>	There are reading assignments that correspond to each lecture in the course (see the course schedule). You are strongly encouraged to read these sections in the textbook as a supplement to the lecture and homework in a manner that most enhances your learning. Unless I say otherwise, I do not expect that you will have read the outlined sections before you come to class, but I will hold you responsible to know the material for the exam.
<b>Homework</b>	<p>Homework assignments will be due at the beginning of class on the days noted in the schedule.</p> <p><i>Getting help:</i> I will be available to help you for homework during office hours. However, you should respect my time and strive solve the problems on your own. I will only provide help for problems that you have already attempted. Additionally, please do not come to me to simply to “check your answer.” I am not a human answer key.</p> <p><i>Group Work:</i> Working in groups to solve homework is encouraged, but you must turn in your own assignment. Since learning is an individual activity, I strongly recommend you try the homework on your own before seeking help from a group or from me. Copying the work of someone else, including students from previous years, is academic dishonesty. Using the solutions manual of this or any other textbook or a key from a previous version of this course is also academic dishonesty.</p> <p><i>Electronic Submission:</i> I will only accept homework that is submitted electronically via Learning Suite. To do so, please generate a single pdf file from your electronically or handwritten work, and then submit it to Learning Suite.</p> <p><i>Late HW:</i> Late homework will be accepted for 50% credit. Exceptions for illness or personal circumstances will be considered upon request.</p>
<b>Exams</b>	<p>There will be one midterm and a final exam (see the schedule for dates). The format of the exam will be disclosed at a later date.</p> <p>I will not accept makeup exams under normal circumstances. <i>Please contact me as soon as possible if you have an extenuating circumstance.</i></p>
<b>Re-grade Policy</b>	<p>Occasionally, students find mistakes in grading or summing the scores on an exam or homework. If you find yourself in this situation, I request that within one week you send me (Dr. Tree) an email that:</p> <ol style="list-style-type: none"> <li>1. Identifies the assignment or exam and includes it as an attachment, and</li> <li>2. Describes the mistake and your request.</li> </ol> <p>You are of course also welcome to talk to me about these issues during my office hours or after class, but I request that you still send me this email. The email process provides a convenient way to keep a record of such requests (otherwise, they are easily lost).</p> <p>Additionally, please be considerate and do not abuse the re-grading privilege. As mature students, I have great confidence that you will do so.</p>

## Grading

Grades for the course will be based on the following point distribution.

- Homework – 40%
- Exams and Final (100 pts ea.) – 60%

I will determine the grade scale at the end of the semester. However, I will guarantee that it will be no harder than:

		B+	87%	C+	77%	D+	67%
A	93%	B	83%	C	73%	D	63%
A-	90%	B-	80%	C-	70%	D-	60%

## Teaching Philosophy

I view my role as a teacher as being analogous to a coach. Like a coach, it is my job to help you know what your goal is (i.e. set an expectation of excellence), provide structure to reach that goal, help motivate you to achieve it, provide critical feedback and cheer you on when the pressure is on. However, just like a coach, I can't do the work for you or perform when it is "game-time." I am trying to use the best pedagogy that I know to help you succeed, but no pedagogy can succeed without your best effort.

This philosophy colors my view of the activities we do in class. I view lectures as a time where I outline the concepts and try and provide motivation to learn. However, once you leave class it is up to you to put in the work to master the material. To this end, I provide homework assignments that help you practice. Finally, the exam is "game time" where you need to perform and show what you have learned.

I know it is difficult as a student to balance all of the many things you need to do, and that you are trying to be efficient. However, I believe if you will think of your assignments as practice, and if you will not let yourself off the hook when you don't understand something, you will get a lot more out of the class (and get a much better grade)!

## FAQ

*Q: Why don't you give out copies of your lecture notes? I have a hard time writing quickly.*

A: There are several reasons that I don't give out my notes. The primary reason is that it is my experience that most students, most of the time, learn better when they take their own notes. Taking notes is a useful way to engage with technical content. I also don't give out my notes because sometimes they contain mistakes, and I don't want my notes to become the *de facto* book for the course. I try to pace the lecture so that it is possible to take notes and be engaged. If you are struggling with this, please come talk to me and we will work something out.

*Q: Why do you use your course website instead of Learning Suite?*

A: I use an external website, so persons not enrolled in the course have access to course materials. Sometimes my colleagues at BYU or other universities are interested in what we are doing, and it is an easy way to share. Also, you may find it useful after you have left the course to revisit some of the notes I post online.

*Q: Why do you do weekly homework?*

A: I think that a mature student is able to manage their schedule to turn in a longer homework assignment once a week instead of needing to be rigidly tied to an assignment every lecture. The weekly homework format also allows me to ask questions that involve multiple concepts within a single problem. This helps you to learn better and better prepares you for the exam. Finally, the problems inherent to statistical thermodynamics are sometimes longer and more

involved than you have seen in the past, so it makes sense to give you more time to solve these longer problems.

*Q: Why do you do so much math?*

A: Stat thermo is inherently a mathematically rigorous subject. It is time to learn to love math!

*Q: Is the course curved?*

A: Yes and no. The grade scale given above is an absolute scale that I guarantee will not be made harder (i.e. an 'A' will never require more than 93%). Additionally, I do not curve exams, nor do I intentionally make them extra hard or confusing. From my perspective, there is nothing stopping everyone from earning an 'A'. That said, I do not shy away from challenging you, so to make things as fair as possible, at the end of the semester, I may revise the grade scale downward (e.g. an 'A' might become a 92%, an 'A-' starts at 89%, etc). I use my discretion to make this shift in the grade scale, (e.g. I think an exam was too difficult).

*Q: Do I need to buy the book?*

A: Yes. Please buy the book. You will also likely want to keep the book. It will be valuable for you in your research and in your future technical endeavors.

## BYU Policy Statements

### Academic Honesty

The first injunction of the BYU Honor Code is the call to "be honest". Students come to the university not only to improve their minds, gain knowledge, and develop skills that will assist them in their life's work, but also to build character. President David O. McKay taught that "character is the highest aim of education" (The Aims of a BYU Education, p. 6). It is the purpose of the BYU Academic Honesty Policy to assist in fulfilling that aim. BYU students should seek to be totally honest in their dealings with others. They should complete their own work and be evaluated based upon that work. They should avoid academic dishonesty and misconduct in all its forms, including but not limited to plagiarism, fabrication or falsification, cheating, and other academic misconduct.

### Honor Code

In keeping with the principles of the BYU Honor Code, students are expected to be honest in all of their academic work. Academic honesty means, most fundamentally, that any work you present as your own must in fact be your own work and not that of another. Violations of this principle may result in a failing grade in the course and additional disciplinary action by the university. Students are also expected to adhere to the Dress and Grooming Standards. Adherence demonstrates respect for yourself and others and ensures an effective learning and working environment. It is the university's expectation, and every instructor's expectation in class, that each student will abide by all Honor Code standards. Please call the Honor Code Office at 422-2847 if you have questions about those standards.

### Preventing Sexual Misconduct

As required by Title IX of the Education Amendments of 1972, the university prohibits sex discrimination against any participant in its education programs or activities. Title IX also prohibits sexual harassment-including sexual violence-committed by or against students, university employees, and visitors to campus. As outlined in university policy, sexual harassment, dating violence, domestic violence, sexual assault, and stalking are considered forms of "Sexual Misconduct" prohibited by the university.

University policy requires any university employee in a teaching, managerial, or supervisory role to report incidents of sexual misconduct that come to their attention through various forms

including face-to-face conversation, a written class assignment or paper, class discussion, email, text, or social media post. If you encounter Sexual Misconduct, please contact the Title IX Coordinator at [t9coordinator@byu.edu](mailto:t9coordinator@byu.edu) or 801-422-2130 or Ethics Point at <https://titleix.byu.edu/report> or 1-888-238-1062 (24-hours). Additional information about Title IX and resources available to you can be found at <http://titleix.byu.edu>.

**Students  
Disability**

Brigham Young University is committed to providing a working and learning atmosphere that reasonably accommodates qualified persons with disabilities. If you have any disability which may impair your ability to complete this course successfully, please contact the University Accessibility Center (UAC), 2170 WSC or 422-2767. Reasonable academic accommodations are reviewed for all students who have qualified, documented disabilities. The UAC can also assess students for learning, attention, and emotional concerns. Services are coordinated with the student and instructor by the UAC. If you need assistance or if you feel you have been unlawfully discriminated against on the basis of disability, you may seek resolution through established grievance policy and procedures by contacting the Equal Employment Office at 422-5895, D-285 ASB

**Inappropriate  
Use Of Course  
Materials**

All course materials (e.g., outlines, handouts, syllabi, exams, quizzes, PowerPoint presentations, lectures, audio and video recordings, etc.) are proprietary. Students are prohibited from posting or selling any such course materials without the express written permission of the professor teaching this course. To do so is a violation of the Brigham Young University Honor Code.