- Predict relationships between two different properties (e.g. vapor pressure and heat of vaporization)

Classical thermodynamics *cannot*

- Describe the condition or state of individual atoms or molecules.
- Predict physical behavior of a material without some previous experimental measurements.
- By itself predict a rate or how long some change will take, because this requires describing departure from equilibrium.

Course Objectives

This class is not your first exposure to thermodynamics (and hopefully will not be your last). As students and instructor, we will be learning and relearning this material together. The main objective of this course is to develop your ability and confidence to apply the principles of thermodynamics to solve problems in three areas:

1. Changes of state, including for open systems
2. Phase equilibria
3. Chemical equilibria

A secondary objective is for you to gain experience using computational tools (e.g. Mathcad) to solve real-world engineering problems. Specific skills and knowledge are described in the list of *Student Outcomes* below.

Mastery of the material in this course means much more than being able to plug numbers into an equation. There is virtually an infinite number of problems and applications that thermodynamic analysis can address, and so you should learn to analyze problems starting from fundamental relationships. This is quite different from expecting to pull a pre-digested equation out of a book to solve every problem, and students who overcome this urge will experience less frustration and improved performance. Your goal should be to practice this kind of analysis until it becomes automatic.

Text

The required text is Smith, Van Ness, and Abbott, *Introduction to Chemical Engineering Thermodynamics*, 7th ed., McGraw-Hill, 2005.

Coursework Activities

You should spend approximately 9 hours per week on this class: 3 in the classroom and 6 on outside work. Some students will need to put in more time than this to earn the grade they desire. Coursework activities include the following:

- **Assignments.** Completing homework assignments is essential for your learning. Assignments are due at the beginning of class on the indicated due date. Late homework will not be accepted for credit unless approved by the instructor given a compelling reason, such as

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illness. For instance, if you are taking an unofficial spring break, plan on submitting your homework before you leave.

Problems in thermodynamics often require solving simultaneous and implicit equations. Also, a large number of properties and constants are used. Consequently, to complete many of the assignments you will need to use Mathcad, which provides solving capabilities and automatic unit conversions. You should review principles covered in ChEn 263 (there is a tutorial on the department website as well).

Solutions to the homework sets will be made available on Learning Suite after you have submitted the assignment. I have instructed the TAs to give points for "reasonable effort" on problems, so no matter how many points you earn on a problem you should still carefully review the solution key to ensure that you know how to properly solve the problem or to identify a more efficient solution procedure.

- **Quizzes.** Occasionally there will be a short quiz covering concepts, including reading assignments. Missed quizzes cannot be made up except in cases of illness.

- **Active Learning.** You should bring your textbook and a calculator to class each day. Each day you must sit next to at least one other student so you can do pair-share activities. You may be called upon to present your ideas and solutions to the rest of the class. I encourage you to review your notes after class each day and come to office hours to clear up uncertainties, instead of waiting to do this at exam time. Studying as part of a group is encouraged and is an important engineering survival skill.

- **Exams.** My assessment method in this class is different than you are used to. It is built on the philosophy that learning new skills requires repeated opportunities for feedback. There will be a short midterm exam approximately every two weeks (five total), and each will count for approximately 7% of your final grade. I encourage you to use them to improve your learning process throughout the semester so you will be prepared for the final.

  Secondly, I want you to do more than "sort of get" the material, but instead to *master* a set of problems that represents the breadth of thermodynamics. Each midterm and the final will be 100% multiple choice, open book, closed notes, and will be given in the testing center. Each will contain a mixture of concept and quantitative questions, with most of the points from the latter. In order to maximize your learning and mastery, each midterm will have a *pre-exam* and a *post-exam*. The pre-exam contains 4–5 practice problems. The actual quantitative exam problems will be chosen from these practice problems, though input numbers and other changes will be made so that they are not exactly identical. Because the exams are multiple choice (no partial credit) and closed notes, you must fully master a quantitative problem in order to get credit on the exam. On the other hand, by providing the quantitative problems before you take the test, I am giving you an opportunity to master them in a lower pressure environment. The post-exam is a chance for you to re-solve any missed quantitative problems after the exam and get 50% credit for correct answers. Final exam quantitative problems will, like for the mid-terms, be selected from the practice problems given out during the semester.

- **Department Requirements.** This course is designated to ensure you complete department requirements for attending Dean's Lectures and meeting with your academic advisor. Not doing either of these things will result in a one-third letter grade reduction (e.g. B to B-).

  The Dean's lectures are planned for 11 am on the first Thursday of February, March, and April, in the JSB Auditorium (Rm 140). You must attend at least *two* lectures to fulfill the

requirement. If illness or your work schedule do not permit you to attend the regular Dean's Lectures, your remedy is to view a recording of the lecture on the college website (if available) or substitute attendance at a graduate-level research seminar sponsored by our department or another engineering or science department.

To ensure that you are prepared for the senior year in Chemical Engineering, you are required to meet with your academic advisor this semester. During this meeting, items such as elective offerings, graduation clearances, and required courses will be discussed.

Grading

The final course score will be weighted as follows:

Assignments and quizzes	30%
Midterm exams ($\approx$ 7% each)	35%
Final exam	35%

I generally use a straight scale in assigning course grades, with some minor modifications to boundary lines based on my perception of course difficulty and student effort. The average grade in the class is likely to be a B.

Contact Information and Office Hours

Instructor/TA	phone	email
Dean Wheeler	801-422-4126	dean_wheeler@byu.edu
James Low		low.bicycle@gmail.com
Peter Shiozawa		pshiozaw@gmail.com
Chien-Wei "Ben" Chao		s943536@gmail.com

	Mon	Tues	Wed	Thur	Fri	Sat
9:00 AM 9:30 AM		Peter		Peter		
10:00 AM 10:30 AM	ChEn 373		ChEn 373		ChEn 373	Peter
11:00 AM 11:30 AM						
12:00 PM 12:30 PM	Peter	James	Peter	James	James	
1:00 PM 1:30 PM		James	Dr. Wheeler	James	Dr. Wheeler	
2:00 PM 2:30 PM						
3:00 PM 3:30 PM	Dr. Wheeler			Ben		
4:00 PM 4:30 PM	Ben	Ben	Ben		Ben	
5:00 PM 5:30 PM						

- TA office hours will generally be in either 206 CB (TA office) or 308 CB (computer lab), depending on how computer-intensive the homework assignment is. If you are looking for the TA, check both places.