

**ChE 301 – Chemical Engineering Thermodynamics I**  
**9:30 a.m.—10:20 a.m. MWF Jett Hall 283**  
Spring Semester 2008



**Catalog Description:**

ChE 301: Chemical Engineering Thermodynamics I. Credit 3.  
Applications of the first and second law to chemical process systems, especially phase and chemical equilibria and the behavior of real fluids. Development of fundamental thermodynamic property relations and complete energy and entropy balances. Chemical engineering majors must earn C or better in this course. Restricted to majors.

**Prerequisites:** ChE 201 and Math 291.

Students who have not received a grade of C or better in ChE 201 do not have the prerequisites and must immediately drop this class.

**Textbook:**

- Sandler, Stanley I., *Chemical, Biochemical, and Engineering Thermodynamics*, 4<sup>th</sup> edition, John Wiley and Sons, 1999, ISBN# 0-471-66174-0.

**Supplementary Text:**

- Smith, J. M., H. C. Van Ness, and M. M. Abbott, *Introduction to Chemical Engineering Thermodynamics*, 7<sup>th</sup> edition, McGraw-Hill.

**Course Objectives:**

At the end of this course the student will be able to (the mapping of these objectives to ABET outcomes a-k):

- Define a system, outcome (a) an ability to apply knowledge of mathematics, science, and engineering;
- Construct and solve problems using the energy balance appropriate for a system (First Law of Thermodynamics), outcome (a)
- Construct and solve problems using the entropy balance appropriate for a system (Second Law of Thermodynamics), outcome (a)
- Evaluate, manipulate and use thermodynamic partial derivatives, outcome (a)
- Correctly use a thermodynamic property chart and the steam tables, outcome (a) and outcome (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
- Use an appropriate equation of state for a particular problem, outcomes (a) and (k)
- Apply the Third Law of Thermodynamics, outcome (a)
- Use the criteria for thermal, mechanical and chemical equilibrium
- Calculate system properties using phase equilibrium properties for single component systems, outcome (a).

**Topics Covered:**

1. Conservation of Mass and Energy
2. Applications of Mass and Energy Balances
3. Entropy and Entropy Balances
4. Heat, Work, Engines and Entropy
5. Applications of the Entropy Balance
6. Evaluation of Thermodynamic Partial Derivatives
7. Evaluation of Property Changes for a Real Gas
8. Equations of State
9. The Third Law of Thermodynamics
10. Criteria for Equilibrium
11. Stability of Thermodynamic systems
12. Phase Equilibria
13. Molar Gibbs Free Energy and Fugacity
14. Vapor Pressure
15. Gibbs Phase Rule
16. Thermodynamic Properties of Phase Transitions

**Contribution of course to meeting the professional component:**

This course addresses the following professional components as prescribed by ABET for Chemical Engineering and similarly named programs:

- A working knowledge of material and energy balances applied to chemical processes
- An introduction to thermodynamics of physical and chemical equilibria
- An introduction to chemical reaction engineering and process design

**Relationship of course to departmental outcomes:**

This is the second chemical engineering course taken by NMSU chemical engineering majors. It addresses the Department's mission and objectives by developing the student's foundation to successfully practice chemical engineering by building on skills in solving chemical engineering science, design and practice. Teamwork and communication skills are also developed as is the student's recognition of ethical behavior in the profession.

Outcomes describe what students are expected to know and be able to do by the time of graduation from the Chemical Engineering curriculum at NMSU. In this course, students work toward developing the following outcomes:

- An ability to apply fundamental knowledge of mathematics, science, and engineering;
- An ability to design a system, component, or process to meet desired needs;
- An ability to identify, formulate, and solve engineering problems;
- An ability to communicate effectively.

**Class Schedule:** 9:30 a.m. — 10:20 p.m. MWF, Jett Hall 283

**Final Exam:** 8:00 a.m.—10:00 a.m. Monday May 5, 2008

**Grading:**

Exams and homework will be based on the problems at the end of each chapter, as well as supplementary material supplied in class. Questions on the problems will be answered at the beginning of each class. Exams will cover all material since the last examination. **A comprehensive make-up examination will be offered on May 2, 2008 at 2:00 p.m. for an unavoidable absence from one examination.** Notify Dr. Mitchell by April 25, 2008 if you plan to take this make-up examination.

The final examination will be two hours in length and will be **comprehensive**. The final examination is scheduled for Monday, May 5, 2008 from 8 a.m. to 10 a.m. Any student with a conflict must bring it **immediately** to the attention of Dr. Mitchell. **No make-up final examination will be given.**

Homework will be coordinated with lectures and will be due approximately one week after assignment. Additional homework drawn from reference material may be assigned. Late homework may be submitted for grading, but will be assigned the following penalties: 1 day late: 50% credit, 2 days late: 25% credit, 3 days late: 10% credit. Homework can be turned in early if a student expects to be absent. The total of all homework will be 200 points.

The project, worth 100 points, will be a team project, assigned in March and due at the end of the semester. The project will involve proposing a solution to an engineering problem, and presenting material, energy and entropy balances as part of this proposed solution. Each group will give submit a written and an oral presentation of its solution.

A class participation grade will be assigned based on attendance, short quizzes, a student's interaction during in-class assignments, questions asked and preparedness, including bringing the text, the syllabus, and any supplementary material to **each** class session. The participation total will be 100 points.

The total point accumulation and final grade distribution for this course will be as follows:

Exams (3)	450 Points			
Project	100 points	900—1000 Points	(90—100%)	A
Final	200 Points	800—899.99 Points	(80—89%)	B
Homework	150 Points	700—799.99 Points	(70—79%)	C
Participation	100 Points	600—699.99 Points	(60—69%)	D
Total	1000 Points	<600.00 Points	(< 60%)	F

**Attendance Policies:**

Attendance at all classes is strongly recommended. The participation score will be assigned by the instructor based on class attendance and interaction (asking questions, participation in in-class activities and assignments, etc.). Attendance is required for all examinations. If a student arrives late for any examination, the student must complete the examination or quiz at the same scheduled time as all other students.

### **Withdrawals:**

Students **will not** receive an automatic drop for persistent absences or persistent failure to complete assignments. The responsibility for withdrawals is completely up to the student.

### **Academic Misconduct:**

Teamwork on homework and laboratory projects is encouraged for learning purposes. However, all assignments turned in by the student must show the **student's own work**. Any evidence that a student has access to and/or is copying homework answers from the *Instructor's Manual* for the text for this course will result in that student receiving zero for **all** homework for this course. All examination answers must be **strictly one's own work**. Department policy is that any student suspected of cheating or aiding other students to cheat will receive a zero for that assignment and a sealed letter (with a confidential copy to the student) detailing the incident marked "Destroy on Graduation" will be placed in the Department Head's sealed files. A second incident of suspected cheating is deemed sufficient cause for expulsion of that student from the Department. The student is referred to the Student Code of Conduct in the *NMSU Student Handbook* for policy and procedures that will be strictly followed in the event of any academic misconduct.

### **Incomplete Grades:**

A grade of Incomplete (I) is given **only if the student is passing** and can not complete the required work for reasons beyond the student's control that develop after the last day to withdraw from the course. The student is referred to the current *NMSU Undergraduate Catalog* for the new regulations that apply to removing or changing an I grade.

### **Make-up Work:**

Late homework may be submitted for grading, but will be assigned the following penalties: 1 day late: 50% credit, 2 days late: 25% credit, 3 days late: 10% credit. Homework can be turned in early if a student expects to be absent.

### **Extra Credit:**

There will be several opportunities over the course of the semester to earn extra credit points (by attending AIChE meetings, etc.). These opportunities will be announced in class. The extra credit will be considered when assigning final grades.

### **ADA:**

If you have (or believe you have) a disability and would benefit from classroom accommodation(s), please contact the Services for Students with Disabilities (SSD) Office located at Corbett Center, Room 244 [Phone: 646-6840; TTY: 646-1918]

### **Student Responsibilities:**

1. Register with SSD and obtain accommodation documents early in the semester;

2. Deliver the completed accommodation and testing form(s) to the instructor(s) within the first two weeks of beginning of classes (or within one week of the date services are to commence);
3. Retrieve the signed form(s) from faculty and return to SSD within (5) days of the receipt from faculty and at least one week before any scheduled exam; and,
4. Contact the SSD Office if the services/accommodations requested are not being provided, not meeting your needs, or if additional accommodations are needed. Do not wait until you receive a failing grade. Retroactive accommodations cannot be considered.

### **Faculty Responsibilities**

1. Sign the *ACCOMMODATION REQUEST FORM* and *TESTING ACCOMMODATION FORM* (when presented), retain a copy, and return the original to the student within five (5) working days of receipt;
2. Contact SSD immediately if there are any questions or disputes regarding accommodation(s), disruptive behavior, etc.; and,
3. Refer the student to SSD for any additional accommodations.

Feel free to call Jerry Nevarez, Director of Institutional Equity, at 505-646-3635 with any questions you may have about NMSU's Non-Discrimination Policy and complaints of discrimination, including sexual harassment.

If you have a condition which may affect your ability to exit from the premises in an emergency or which may cause an emergency during class, you are encouraged to discuss this in confidence with the instructor and/or the director of Disabled Student Programs.

Feel free to call Michael Armendariz, Coordinator of Services for Students with Disabilities, at 505-646-6840 with any questions you may have on student issues related to the Americans with Disabilities Act (ADA) and/or Section 504 of the Rehabilitation Act of 1973. All medical information will be treated confidentially.

### **Coordinator:**

Dr. Martha C. Mitchell, Professor and Department Head of Chemical Engineering, New Mexico State University

Office: 259 Jett Hall 646-2093 martmitc@nmsu.edu

Office Hours: MWF 10:30 a.m.—11:20 a.m., TR 2:30 p.m.—3:00 p.m., *or by appointment.*

Date prepared: January 14, 2008