

## CBEMS40B CHEMICAL ENGINEERING THERMODYNAMICS

<b>Catalog Data:</b>	<b>CBEMS40B Chemical Engineering Thermodynamics (Credit Units: 5) S.</b> Basic concepts and use of the thermodynamic functions of free energy, enthalpy, and entropy; properties of pure and mixtures; application of dynamic process and efficiencies. Solution thermodynamics and applications to oxidation reactions. Equilibrium phase diagrams and liquid to solid phase transformations. Prerequisites: CBEMS40A, Mathematics 2J; Engineering CEE10, EECS10, or MAE10. CBEMS40B and MAE91 may not both be taken for credit. (Design units: 1)
<b>Textbook:</b>	Smith, Van Ness, and Abbot, <i>Introduction to Chemical Engineering Thermodynamics</i> , 6 <sup>th</sup> edition.
<b>References:</b>	
<b>Coordinator:</b>	Daniel R. Mumm
<b>Course Objectives:</b>	To introduce students to thermodynamics for application to chemical engineering, chemistry and materials science.
<b>Course Outcomes:</b>	Students will be able to: Understand the terminology associated with engineering thermodynamics. Reiterate the first and second laws of thermodynamics, and understand the practical implications of these laws in engineering design. Understand the concepts of heat, work and energy conversion, and can calculate heat and work quantities for industrial processes. Calculate the properties of ideal and real mixtures based on thermodynamic principles. Determine changes in the properties of gases, fluids and solids undergoing changes in temperature and volume. Explain the underlying principles of phase equilibrium in two-component and multi-component systems. Understand processes involving power production, refrigeration, and liquefaction, and be able to calculate relevant system efficiencies for these processes. Apply mass, energy and entropy balances to flow processes. Understand, and deal with, the professional and ethical consequences of system design choices based on thermodynamic principles, and understand the impact of engineering solutions from a global and societal standpoint. Communicate effectively, both orally and in writing, regarding scientific and engineering principles and the thermodynamic aspects of engineering design. Be knowledgeable in mathematics, science and engineering, and apply that knowledge to problems involving thermodynamics. Design and conduct experiments, and analyze and interpret data appropriately in the selection and design of advanced material systems and the design of chemical processes. Function on multi-disciplinary teams in the conduct of engineering design

and scientific exploration.

Recognize the need for life-long learning in order to remain effective as a scientist or engineer.

**Prerequisites By Topic:** Mass balance and energy balance analysis.

**Lecture Topics:** Introduction, Definitions, and the First Law of Thermodynamics. (week 1)  
Volumetric Properties of Pure Fluids and Heat Effects. (week 2)  
The Second Law of Thermodynamics Properties of Fluids. (week 3)  
Thermodynamics Properties of Fluids and Thermodynamics of open systems. (week 4)  
Power production, refrigeration and liquefaction. (week 5)  
Catch up, review, and assessment days. (week 6)  
Solution Thermodynamics. (week 7)  
Theory and Application. (week 8)  
Phase Equilibria and Chemical-Reaction Equilibria. (week 9)  
Catch up days, project and review. (week 10)

**Class Schedule:** Each class meets 5 hours per week for 10 weeks.

**Computer Usage:** Students must be able to program in C, C++, or Fortran to complete homework assignments. Knowledge of Microsoft Excel is also needed.

**Laboratory Projects:** Design project assesses alternatives for energy production from both energetic and pollution perspectives. Requires knowledge and understanding of material, energy and mass balance.

**Professional Component:** Contributes toward the Chemical Engineering Topics Courses and Major Design experiences.

**Relationship to Program Outcomes:** ChE: This course relates to Program Outcomes 1, 3, 5, 10, 11, and 13 as stated at: [http://www.eng.uci.edu/dept/objective\\_chemical](http://www.eng.uci.edu/dept/objective_chemical)  
MSE: This course relates to Program Outcomes 1, 3, 6, and 7 as stated at: [http://www.eng.uci.edu/dept/objective\\_materials\\_science](http://www.eng.uci.edu/dept/objective_materials_science)

### **Design Content Description**

**Approach:** Students work alone to assess whether power production can be made more efficient, utilizing alternative energy technologies. The design project involves preparation of a research report, and class presentation of the report summary.

**Lectures:** 100%

**Laboratory Portion:** 0%

### **Grading Criteria:**

Quiz:	10%
Homework:	15%
Midterm exam:	30%
Design project:	10%
Final exam:	<u>35%</u>
	100%

### **Estimated ABET Category Content:**

Mathematics and Basic Science: 0 credit units or 0%  
Engineering Science: 4 credit units or 80%  
Engineering Design: 1 credit units or 20%

**Prepared by:** Daniel R. Mumm **Date:** July 2005

**CEP Approved:** Fall 2002