CBEMS 40B CHEMICAL ENGINEERING THERMODYNAMICS
(Required for ChE; Elective for MSE)

Catalog Data: **CBEMS 40B Chemical Engineering Thermodynamics (Credit Units: 5)** 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)

Textbook: Smith, Van Ness, and Abbot, *Introduction to Chemical Engineering Thermodynamics,* 7th edition, 2004

References:

Coordinator: Daniel R. Mumm

Course Outcomes: Students will:

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 liquifaction, and be able to calculate relevant system efficiencies for these processes.
Apply mass, energy and entropy balances to flow processes.
Understand 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 in writing regarding principles of the thermodynamic aspects of engineering design.
Be knowledgeable in mathematics, science and engineering, and apply that knowledge to problems involving thermodynamics.
Function on multi-disciplinary teams in the conduct of engineering design and scientific exploration.

Prerequisites By Topic: Mass balance and energy balance analysis; Chemical stoichiometry

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: Meets for 5 hours of lecture each week for 10 weeks.

Computer Usage: Matlab, C, C++, or Fortran; Excel

Laboratory Projects: Design project assesses alternatives for energy production from both energetic and pollution perspectives. Requires knowledge and understanding of material, energy and mass balances. This project is also structured as a team effort (three students), emphasizing working in multi-disciplinary teams.

Professional Component: This course is designed to contribute to the students' knowledge of engineering topics and design experience related to basic concepts in Thermodynamics. The following considerations are included in this course: the professional and ethical aspects of system design choices.

Relationship to Program Outcomes: ChE: This course relates to Program Outcomes a, c, d, e, f, g, h, j, k, l, and m as stated at:
http://undergraduate.eng.uci.edu/degreeprograms/chemical/mission
MSE: This course relates to Program Outcomes a, c, d, f, and g as stated at: http://undergraduate.eng.uci.edu/degreeprograms/materials/mission

Design Content Description
Approach: Students work in teams 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:	25%
Midterm exam:	25%
Design project:	10%
Final exam:	30%
	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 2007

CEP Approved: Fall 2002