

CME 314. Material and Energy Balance

Credits and Contact Hours: 3 credits; 2 hours and 40 minutes

Course Instructor: *Al Tobin*

Text(s): Introduction to Chemical Engineering Thermodynamics (6th ed.) J.M. Smith, H.C. Van Ness, M.M. Abbott, McGraw Hill Publications.

Brief description of the Content: First and second laws of thermodynamics, PVT behavior of pure substances, equations of state for gases and liquids, phase equilibria, mass and energy balances for closed and open systems, reversibility and equilibrium, application of thermodynamics to flow processes, heat effects during chemical reactions and combustion.

Pre- or Corequisite(s): CME 304: minimum of B- in CME 304

Course category: Required course for the major

Specific goals for the course: Equilibrium and the Phase Rule, VLE model and K-value correlations, chemical potential and phase equilibria for ideal and non-ideal solutions, heat effects and property changes on mixing, application of equilibria to chemical reactions, Gibbs-Duhem and chemical potential for reacting systems, liquid/liquid, liquid/solid, solid/vapor and liquid vapor equilibria, adsorption and osmotic equilibria, steady state flow and irreversible processes. Steam power plants, internal combustion and jet engines, refrigeration cycle and vapor compression, liquefaction processes. [3 credits]

a. specific outcomes of instruction, ex. the student will be able to explain the significance of current research about a particular topic

CTPC "3a-k" Outcomes	% contribution
A. Ability to apply knowledge of math, engineering, and science	25%
B1. Ability to design and conduct experiments	10%
B2. Ability to analyze and interpret data	15%
C. Ability to design system, component or process to meet needs	20%
D. Ability to function on multi-disciplinary teams	
E. Ability to identify, formulate, and solve engineering problems	10%
F. Understanding of professional and ethical responsibility	
G. Ability to communicate effectively	
H. Broad education	
I. Recognition of need an ability to engage in life-long learning	
J. Knowledge of contemporary issues	
K. Ability to use techniques, skills, and tools in engineering practice	20%
Any other outcomes and assessments?	
	100%

Brief list of topics to be covered:

Week 1: Equilibrium and the Phase Rule

Week 2: Models for vapor/liquid equilibrium

Week 3: Partial molar properties, chemical potential and phase equilibria in multi-component systems

Week 4: Ideal gas mixtures, ideal solutions and excess properties

Week 5: Heat effects and property changes in mixing

Week 6: Equilibrium constants and chemical reaction processes

Week 7: Review and Midterm

Week 8: Models for VLE, LLE, SLE, SVE equilibria

Week 9: Analysis of steady state flow processes

Week 10: Irreversible processes

Week 11: Steam and power plants

Week 12: Internal combustion, jet, diesel and rocket engines

Week 13: Carnot refrigerator and vapor compression cycle

Week 14: Heat pumps; liquefaction processes

Week 15: Review/ Final Exam