THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Chemical Engineering Thermodynamics I

CBE 3508

Credit Hours:
3.00 - 3.00

Course Levels:
Undergraduate (1000-5000 level)

Course Components:
Lecture

Course Description:
Development of the conceptual basis for thermodynamics: energy conservation in open and closed systems (first thermodynamic law), temperature, entropy and reversibility (second thermodynamic law), fundamental equations, and criteria of equilibrium and stability.

Prerequisites and Co-requisites:
Prereq: 2200, and enrollment in CBE, FABEng, or EngPhysics major; or permission of instructor.

Course Goals / Objectives:
- Upon completion of this course, a student should be able to: Understand the fundamental basis of the first and second laws of thermodynamics
- Be familiar with various thermodynamic identities
- Estimate thermodynamic properties of pure gases and liquids using equations of state
- Develop mass and energy balance equations necessary to solve non-reactive steady-state and transient systems by hand or by computer using process simulation software.
- Use tables, charts, or software to estimate physical property data needed to solve material and energy balances
- Calculate fugacity in nonideal solutions.
- Determine whether a system has attained equilibrium

Course Topics:

- Definition of energy in terms of work; Conservation of energy; Molecular level definition of energy and necessity of introducing the concept of heat in macroscopic description of matter.
- Path functions and state functions; Formulation and application of the 1st law of thermodynamics; Properties of ideal gas.
- Impossible processes and statements of the 2nd law of thermodynamics due to Claussius and Kelvin.
- Formulation of 2nd law in terms of entropy; Efficiency of heat engines.
- Fundamental property relation; Entropy of ideal gas; Application of the 1st and 2nd law of thermodynamics for ideal gas.
- Introduction to the thermodynamics of mixtures; partial molar properties; Gibbs-Duhem equation.
- Material, energy, and entropy balances for mixtures; experimental determination of partial molar properties
- Phase equilibrium in multicomponent systems; chemical equilibrium; equilibrium criteria; Gibbs Phase Rule
- Ideal gas mixtures; partial molar Gibbs free energy and fugacity; ideal mixtures and excess properties; fugacity of a component in gas, liquid and solid mixtures
- Activity coefficients; Principle of Corresponding States for mixtures (Kay's Rule)
- Describing vapor-liquid equilibrium using activity coefficient models and equations of state;
- Solubility of a gas in a liquid; liquid-liquid and liquid-liquid vapor equilibrium;
- Partition coefficients; colligative properties: effect of solutes on solvent properties
- Notation for chemical reactions; heat of reaction; chemical equilibrium in a single-phase system
- Heterogeneous chemical equilibrium; multiple reactions in a phase; combined chemical and phase equilibrium

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Designation:

Elective
Required