



CHEM/ENGR 3810

Chemical Process Principles

Fall 2007 (T, R – 3:30 to 4:45 pm)

Instructor

Dr. Sharmistha Basu-Dutt

Room: 2131 TLC

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Office Hours

M: 9 – 11 am, W: noon – 2 pm

T, R, F: 11 am – noon, 2 – 3 pm

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Textbook

Elementary Principles of Chemical Processes, Richard M. Felder and Ronald W. Rousseau, 3rd Edition, Wiley.

Purpose

This course is intended for the student interested in a career in chemical engineering or physical/industrial chemistry. An introductory engineering approach to material and energy balance for physical and chemical processes is developed during the semester. Systems of units, material properties, thermo-physical and chemical concepts are discussed. Emphasis is on the application of material and energy balances to steady and unsteady state physical and chemical processes.

Topics Covered

- 1) Dimensions, units and conversion factors
- 2) Mass balances on processes: single and multiple units, bypassing and purging, recycling and reactive systems
- 3) Physical properties of solids, liquids and gases : equations of state
- 4) Single component and multi-component phase equilibrium
- 5) First law of thermodynamics: energy balances on open and closed systems
- 6) Thermodynamic properties of fluids
- 7) Enthalpy changes associated with latent heat, phase change, heats of solution and reaction
- 8) Psychrometric charts
- 9) Energy balances on reactive processes, heats of formation, heats of combustion
- 10) Unsteady state mass and energy balances

Course outcomes

- 1) Identify and understand unit operations involved in a process, draw process flowcharts, develop relationships between process variables
- 2) Perform simple degree-of-freedom analysis and develop linearly independent mass and energy balances
- 3) Write simple phase equilibrium relationships (e.g. Raoult's and Henry's laws) and use phase diagrams
- 4) Extract data for pure compounds and mixtures from tables, charts, graphs or phase diagrams and estimate these through theoretical or empirical equations

- 5) Apply the ideal gas rule and equations of state for real gases
- 6) Use solubility data, miscibility charts, psychrometric charts and phase relationships to calculate equilibrium composition of multiphase, multicomponent systems
- 7) Apply the first law of thermodynamics to perform energy balances on steady-state, non-reactive and reactive processes
- 8) Determine enthalpy and internal energy changes associated with changes in temperature, pressure, mixing, phase change, and chemical reaction from appropriate heat capacities, heats of solution, latent heats, and heats of formation and combustion
- 9) Solve material and energy balances simultaneously on chemical process systems
- 10) Set up and solve transient mass and energy balances

Exams

There will be *two take-home (mid-term and final) exams*, each worth 100 points for a total of **200 points**. The *mid-term* is due October 4, 2007 (start of the class period) and the *final* is due December 13, 2007 (latest by 2 pm).

There will be *twelve take home assignments* each worth 25 points for a total of **300 points**.

Grading

The final score will be based on 500 points and the following scale:

> 90 %:A, 80 - 89%:B, 70 - 79%:C, <69%:D