ChE 63a Jan 2018 SYLLABUS

1. Introduction

   Historical

   Nature, Scope and Applications of Thermodynamics

   Terms: system vs. surroundings, closed system vs. control volume
   equilibrium, state variables, process, intensive vs. extensive
   ideal gas

   Pressure and relationship to momentum flux

   Temperature and the Zeroth Law of Thermodynamics,

   Temperature scales, Thermometry

   Volumetric Properties of Pure Fluids, Two p-v-T phase diagrams

2. First Law of Thermodynamics for Closed Systems

   Joule's Experiments, definition of Internal Energy

   types of inernal energy

   preliminary statement of 1^{st} Law

   Definition of Heat and final statement of 1^{st} Law

   Types of work: shaft work, p-V work

   Illustrative examples of p-V work

   Reversible and irreversible processes and relation with work

   Enthalpy: definition and illustrative examples for closed systems

3. First Law for Control Volume (Open Systems)

Derivation and origin of enthalpy flows

Examples: Compressors, Throttling devices, Flow through Valves, Vessel filling problems, Vessel emptying problem

4. Thermochemistry

   Heat capacities as functions of temperature

   Enthalpy of formation, enthalpy of reaction

   First law applications to systems with chemical reactions

5. Entropy and the Second Law

   Directionality of Processes, Reversible and Irreversible Processes

   Statistical treatment of Entropy and the Second Law

   Classical Treatment of Entropy and the Second Law, Kelvin-Planck and Clausius statements, Carnot Cycle, Clausius inequality, definition of entropy and statement of the second Law.

   Calculations of ΔS

   Examples of second law applications

6. Power and Refrigeration Cycles

   Rankin Cycle, Sterling Cycle

   Internal Combustion Engines (Otto cycle, Diesel cycle)

   Vapor Compression Refrigeration

7. Thermodynamic Property Relations

   Fundamental Identities, Maxwell Relations

Calculations of Δu, Δh, Δs from equations of state with T,v and T,p independent variables

Departure Functions

Joule Thomson Expansion and Liquefaction

ChE 63a Jan 2018 Homework Policy

Students are required to work out the solution of each problem in detail and neatly to allow easy grading by the TA. Exchange of information between students is allowed concerning the general approach to the problem solution, but the detailed derivation and calculations should performed by each student individually.

The grade will be based 30% on homework, 30% on the midterm, and 40% on the final.

ChE 63a Textbook and References

1. Textbook: Koretsky Engineering and Chemical Thermodynamics

2. C.B.P Finn: Thermal Physics

3. K. Denbigh: The Principles of Chemical Equilibrium (3rd edition)

   Atkins: Physical Chemistry

4. Smith, Van Ness, Abbott: Introduction to Chemical Engineering Thermodynamics

References 1-4 will be on reserve in SFL