

Fall 2002 Course Schedule

_____Sept. 04 2002: Lecture 1: _____

Introduction and Course Description

Introduction to the Subject

_____Sept. 06 2002: Lecture 2: _____

Course Survey

Preview of Entire Course

_____Sept. 09 2002: Lecture 3: _____

Thermodynamic Variables

Thermodynamic variables versus microscopic variables
Intensive and Extensive Variables
Zeroeth Law of Thermodynamics

_____Sept. 11 2002: Lecture 4: _____

State Variables and Functions

State Functions
Some Example State Functions
Derived Intensive Variables
Equivalence of heat and work

_____Sept. 13 2002: Lecture 5: _____

Thermodynamic Systems and Processes

First Law
Types of systems
Types of Processes
Composition vs Concentration

Sept. 16 2002: Lecture 6: _____

Energy and Work

Energy
Internal energy
Types of Work
Work of Polarization
Magnetic Work
Models for magnetic materials

Sept. 18 2002: Lecture 7: _____

Properties of Materials

Chemical Work
Elastic Work
Models for Anisotropic materials

Sept. 20 2002: Lecture 8: _____

Stored Energy in Solids, First Law for Fluids

Summary: Forms of Work in the First Law
Work performed by Simple Fluids

Sept. 25 2002: Lecture 9: _____

Quasistatic Processes

Reversibility
Heat Capacities

_____Sept. 27 2002: Lecture 10: _____

Heat Capacities and Gaseous Behavior

The Difference in Heat Capacities at Constant Volume and at Constant Pressure

Models for Gaseous Behavior

_____Sept. 30 2002: Lecture 11: _____

Internal Energy and Enthalpy for Fluids

Internal Energy of an Ideal Gas

A New Thermodynamic State Function: Enthalpy

Another State Function

_____Oct. 02 2002: Lecture 12: _____

Thermodynamic Functions for General Systems

The Unexpected State Function: Entropy

Another Thermodynamic Function

Yet Another (and Very Important) Thermodynamic Function

_____Oct. 04 2002: EXAM I _____

_____Oct. 07 2002: Lecture 13: _____

The Second Law

The Second Law of Thermodynamics

An Illustrative Example

Alternative Statements of the Second Law (There are many)

_____Oct. 09 2002: Lecture 14: _____

Heat Stored during Phase Changes

The Change of Temperature with the Addition of Heat
Heat of Transformation
Phase Fractions
Hot Ice Melts and Cold Water Freezes

_____Oct. 11 2002: Lecture 15: _____

Gibbs Free Energy

Nature Prefers Low Enthalpies at Low T and Large Entropies at High T
The Temperature where Universe's Entropy Change is Zero
The behavior of during a phase change.

_____Oct. 16 2002: Lecture 16: _____

Entropy in Materials

Behavior of Gibbs Free Energy near a Phase Change
The Third Law of Thermodynamics
A Survey of Molar Entropies
Microscopic Origins of Entropy in Materials

_____Oct. 18 2002: Lecture 17: _____

Conditions of Equilibrium

Equilibrium Thermodynamics
Unconstrained Equilibrium

Oct. 21 2002: Lecture 18: _____

Describing the State of an Alloy

Equilibrium for Systems with Internal Degrees of Freedom
Composition Variation and Phase Fractions
An Illustrative Example
A Concrete Example

Oct. 23 2002: Lecture 19: _____

Generalized Conditions for Equilibrium

Equilibrium for a System with Internal Degrees of Freedom
Equilibrium with constraints that are more practical
That which is Minimized at Equilibrium for Constant P and T
That which is Minimized at Equilibrium for Constant V and T
The Potential to add a Chemical Species

Oct. 25 2002: Lecture 20: _____

The Chemical Potential

The Chemical Potential in a Closed System
Models for Chemical Potentials in Solutions
Equilibrium Compositions in an Ideal Reacting Gas Mixture
Equilibrium Compositions in an Ideal Reacting Gas Mixture-Part 2

Oct. 28 2002: Lecture 21: _____

Mathematics of Thermodynamics

Mathematics of Exact Differentials in Thermodynamics
The Other Energy Functionals: The Legendre transformations
LeChatelier's Principle

_____Oct. 30 2002: Lecture 22: _____

Mathematical Relations and Changing Variables

Maxwell's Relations
Change of Variable

_____Nov. 01 2002: Lecture 23: _____

Mathematics and Stability

Further Considerations of Equilibrium

_____Nov. 04 2002: *Equilibrium States With More Than One Variable*
More Mathematical Thermodynamics: Homogeneous Functions
The Gibbs-Duhem Relation

_____Nov. 06 2002: Lecture 25: _____

Symmetry and Equilibrium

Further Restrictions on Material Properties
Conditions of Multiphase Equilibrium

_____Nov. 08 2002: Lecture 26: _____

The Gibbs Phase Rule and its Application

The Gibbs Phase Rule
Single Component Phase Equilibria

_____Nov. 13 2001: EXAM II _____

Nov. 15 2002: Lecture 27:

Gibbs Free Energy and Phase Diagrams

Addition of a Soluble Species

Nov. 18 2002: Lecture 28:

Uniformity of Chemical Potential at Equilibrium

Conditions for the Appearance of a New Phase
Graphical Constructions for the Free Energy of Solutions

Nov. 20 2002: Lecture 29:

Important Geometrical Constructions

Equilibria between Phases
The Common Tangent Construction

Nov. 22 2002: Lecture 30:

Phase Diagrams

Construction of Phase Diagrams from Gibbs Free Energy Curves
A Menagerie of Binary Phase Diagrams
Classifying the Invariant Points: Drawing Phase Diagrams

Nov. 25 2002: Lecture 31:

Using Phase Diagrams

Interpreting Phase Diagrams

Nov. 27 2001: Graduate Student Presentation

Dec. 02 2002: Lecture 32: _____

Solution Thermodynamics

Ternary Phase Diagrams

Solution Free Energies that Generate Phase Diagrams

Limiting Solution Behavior

Dec. 04 2002: Lecture 33: _____

Unstable Solutions

Non-Ideal Solution Behavior

Behavior of the Regular Solution Model

Spinodal Decomposition

Nucleation and Growth

Dec. 06 2002: Lecture 34: _____

Equilibrium Conditions for Solid Solutions

Equilibria for Reactive Solids and Vapors (Oxidation)

The Standard Approximation

An Example of a Gaseous Reaction with Pure Condensed Phase

Ellingham Diagrams

Dec. 09 2002: Lecture 35: _____

Equilibrium Conditions for Charged Species

Electrochemistry

Systematic Treatment of the Electrochemical Potential

An Example

Dec. 11 2002: Lecture 36:

Introduction to Surface Thermodynamics

Estimate of the Excess Energy Associated with Surfaces

Gibbs Treatment of the Interfacial Energy

Curvatures of Simple Surfaces

Fundamental relations for surfaces

The Conditions of Equilibrium where Several Surfaces Intersect

The Shapes of Things

?? Dec. ?? 2002

FINAL EXAM place:TBA Time:TBA