Minnesota State University Moorhead

CHEM 455: Physical Chemistry I Lab

A. COURSE DESCRIPTION

Credits: 1

Lecture Hours/Week: 0

Lab Hours/Week: 3

OJT Hours/Week: *.*

Prerequisites:
MATH 262 - Calculus II AND PHYS 161 - College Physics II AND CHEM 210 - General Chemistry II

Corequisites: CHEM 450

MnTC Goals: None

Measurement of thermodynamic properties of gases, thermochemistry, electrochemistry, transport properties, and treatment of experimental data.

B. COURSE EFFECTIVE DATES: 05/19/1999 - Present

C. OUTLINE OF MAJOR CONTENT AREAS

1. Fundamental concepts of Thermodynamics
2. Thermochemistry
3. Entropy and the Second and Third Laws of Thermodynamics
4. Chemical Equilibrium
5. Properties of Real gasses
6. Phase Diagrams and the Relative Stability of Solids, Liquids, and Gasses
7. Ideal and Real Solutions
8. Electrolyte Solutions
9. Electrochemical Cells
10. Heat, Work, Internal Energy and the First Law of Thermodynamics
11. The importance of the State Functions: Internal Energy and Enthalpy

D. LEARNING OUTCOMES (General)

1. Apply the First law of thermodynamics and the quantitative expression of the first law, concept of state functions; internal energy, enthalpy. Recognition path-functions heat and work. Proficient in calculations involving state and path functions, equilibrium. reversible, irreversible, isothermic, isobaric and adiabatic processes.
2. Derive the ideal gas law and real gas equations of state and the limitations of their applicability. Explain the compression factor, Law of Corresponding states, concept fugacity and distinguish the thermodynamic equilibrium constant from equilibrium thermodynamic constant.
3. Describe the determination of enthalpy and internal energy changes during chemical reactions and the temperature dependence of such enthalpy and internal energy changes. Apply Hess¿s Law.
4. Describe the macroscopic description of matter in terms of bulk properties and basic concepts of thermodynamics. Meaning of state in thermodynamics and relationships of state variables in the equations of sate.
5. Explain enthalpy, entropy and Gibbs free energy of ion formation in solutions. Use the concept of activities, activity coefficients, and calculate the ionic, solute activity coefficients and chemical equilibrium in electrolytic solutions.
6. Explain ideal and real solutions and ideal dilute solutions. Calculate the properties of real solutions and chemical equilibrium in solutions using activity coefficients. Explain colligative properties qualitatively and quantitatively.
7. Explain the effect of electrical potential on chemical potential. Understand the construction reversible electrodes, electrochemical cells. Use electrochemical potentials and cell to determine activity coefficients. Experimentally determine the Gibbs energy and entropy of reactions from electrochemical measurements.
8. Explain the factors determining the stability of matter in solid, liquid and gas states. Generate phase diagrams of pure substances and binary systems. Explain the vapor pressure variation with temperature of binary systems.
9. Perform calculations involving internal energy and variation of internal energy with volume and temperature. Perform calculations involving enthalpy and variation of enthalpy with temperature and pressure. Explain Joule-Thompson effect and liquefaction of gases.
10. Predict the spontaneity of processes where starting and ending states with same volume and temperature, Helmholtz free energy. Predict the spontaneity of processes where starting and ending states with same pressure and temperature, Gibbs free energy. Predicting equilibrium composition of chemical reactions.
11. Understand the concept of entropy and the Second Law of thermodynamics. Explain the concept entropy and its utility in predicting spontaneity, the natural direction of processes in isolated systems.

E. Minnesota Transfer Curriculum Goal Area(s) and Competencies

None

F. LEARNER OUTCOMES ASSESSMENT

As noted on course syllabus

G. SPECIAL INFORMATION

None noted