Chemistry 2274A

PHYSICAL CHEMISTRY I: THERMODYNAMICS AND KINETICS

[This is a tentative outline of a new course]

Prerequisite(s): Chemistry 1301A/B, Chemistry 1302A/B, 0.5 course from Calculus 1000 A/B, Calculus 1500A/B, Numerical and Mathematical Methods 1412A/B, and any other 0.5 course at the 1000-level from Calculus, Applied Mathematics, Mathematics, or Numerical and Mathematical Methods. Integrated Science 1001X may be used as a substitute for the combination of Chemistry 1302A/B and Calculus 1301A/B.

Antirequisite(s): Chemistry 2214A/B, former Chemistry 2374A

Calendar Description: Foundations of classial physical chemistry. Topics include chemical thermodynamics, quantitative description of phase transitions and chemical equilibrium, chemical kinetics, reaction dynamics, diffusion and transport processes.

Course structure: 3 lecture hours, 1.5 laboratory hours (3 hours every other week).

Course Topics

1. State functions and equations of state. The first law of thermodynamics. Heat, work and energy. Enthalpy, heat capacity, standard enthalpy of formation, thermochemistry.
2. The statistical and classical definitions of entropy. The second and third laws of thermodynamics. The Helmholtz and Gibbs energies, spontaneous processes.
3. Phase transitions, chemical potential, ideal and non-ideal mixtures, colligative properties.
4. Chemical equilibrium. Relation between the standard reaction Gibbs energy and the equilibrium constant. Electrochemical cells, the Nernst equation.
5. Chemical kinetics. Reaction rates, integrated rate laws, the Arrhenius equation, energy landscapes, reaction mechanisms.
6. Reaction dynamics: collision theory, transition-state theory.
7. Molecular motion, transport parameters, pure liquids, electrolyte solutions, diffusion.

Course Learning Outcomes

1. Scientific principles: Be able to describe, illustrate, and apply the fundamental principles of chemical thermodynamics and kinetics.

2. Knowledge of methods: Develop problem-solving skills in chemical thermodynamics and kinetics by working on assignments, quizzes, and through discussions of the lecture material.
3. Laboratory skills: Develop experimental skills through laboratory experiments designed to illustrate the principles of chemical thermodynamics and kinetics.
4. Communication: Develop the ability to prepare informative written lab reports.
5. Awareness of the limitations of the discipline: Recognize the limitations of the models and assumptions used in chemical thermodynamics and kinetics, being able to illustrate these limitations with specific examples.
6. Autonomy and impact: Develop the ability to work productively, being able to illustrate the relevance of the discipline to chemical research and society as a whole.