Course Syllabus

Ch21c. Physical Chemistry

Thermodynamics, Statistical Mechanics, and Chemical Kinetics

SPRING 2024

Instructors:

Geoffrey Blake  gab@caltech.edu
Mitchio Okumura  mo@caltech.edu

LOCATION: B204 Noyes

Hours: TBD

Course Objective:

This course will introduce take the fundamental concepts you learned in quantum mechanics and spectroscopy (Ch 21a and 21b), and apply them to develop the machinery of statistical thermodynamics that we will then apply to classical thermodynamics and chemical reaction kinetics.

Required Texts:

3. Focus Area 13 (Statistical Thermodynamics) of Vol. 2 of the Atkins, 11th ed. will be made available through the library on the class Canvas site.

Recommended Texts:

Prerequisites:
Ch21ab, Ph1 and Ph2a, Ma1 and Ma2 or equivalents (linear algebra, matrices, vector calculus, differential equations), or taken concurrently. Ch41abc are highly recommended.
*see Instructor for permission if you do not meet these

Students who have had more advanced preparation in statistical mechanics (e.g. Ph2c, Ph12c or BE25) SHOULD NOT TAKE THIS COURSE. They will receive credit for meeting option requirements. Contact Ch Option Rep and Registrar.

COURSE OUTLINE

I. Properties of Gases
   Kinetic Theory of Gases: The Maxwell Distribution
   Real Gases: Intermolecular Forces

II. Thermodynamics
   First Law: Enthalpy, Thermochemistry
   Second and Third Laws: Entropy,
   Free Energies
   Chemical Potential; Mixtures, Chemical Equilibrium

III. Statistical Mechanics
   Probability Distributions, State Counting
   Entropy
   Partition Functions
   Thermodynamic Functions
   Chemical Equilibrium

IV. Applications
   Phase Transitions
   Real Mixtures

V. Kinetics of Chemical Reactions
   Kinetics
   Catalysis
   Transition State Theory

VI. EXTRA TOPICS
   Diffusion
   Relaxation
   Astrochemistry
   Surfaces
   Biological systems