TEL AVIV UNIVERSITY אוניברסיטת תל אביב

Syllabus

Course Title	Credits
Physical Chemistry	3

Lecturer

Dr. Assaf Ganoth

Contact details

E-mail: assaf.ganoth@gmail.com

Semester

B

Short Description

Overview

Physical chemistry is a branch in science dealing with the principles of physics involved in chemical interactions. It focuses on understanding the physical properties of atoms and molecules, and how do these properties translate to chemical reactions. What are the principles that determine the behavior of gases? How can you formulate a feasible theory for this behavior? What are the driving forces behind chemical reactions? Why do some reactions occur over a geological timescale whilst others at the nanosecond timescale or even faster? What is going on at the molecular and the atomic level during molecular reactions? What are reaction mechanisms? How do ionic compounds behave in an aqueous solution? Discover the answers to these fascinating and intriguing fundamental questions and more on this course in introductory physical chemistry.

The course covers key principles, ideas and concepts in selected topics of undergraduate physical chemistry. Tentative discussed topics: the kinetic theory of gases, kinetics, thermodynamics, and slightly soluble salts. Emphasis will be placed on a thorough understanding of the taught subjects by practicing theoretical and mathematical problems.

Prerequisite

This is a mandatory course for first year students taking the Life Sciences track of the Liberal Arts Program or the Dual Degree Program with Columbia University. A proper background in general and analytical chemistry is a prerequisite.

Methodology

The course is based on weekly lectures combined with exercises and YouTube clips.

Office hours

There are no official office hours for this course. Instead, please feel free to contact me by E-mail to set up an appointment or whenever you have questions.

Final grade components

The course final grade is composed of two parameters – final exam and quizzes.

- Final exam: 90% of the course grade.
- Quizzes: Home quizzes on Moodle, 10% of the final grade.

Course plan, by topic (tentative)

Topic of lecture	Contents
The kinetic theory of gases	Properties of gases; Gas Laws; Mixture of gases: Dalton's Law, Kinetic-molecular theory of gases; The meaning of temperature; Molecular speeds; The Maxwell-Boltzmann distribution; Gas properties relating to the kinetic-molecular theory: Effusion, Graham's Law, The transport phenomena, Mean free path, Diffusion, Fick's Law.
Kinetics I	Rate of a chemical reaction; Measuring reaction rates; The effect of concentration on reaction rates: The rate Law; Zero-order reactions; First-order reactions; Second-order reactions; Pseudo-first-order reactions; Theoretical models for chemical kinetics: The collision theory, The transition state theory; Reaction profiles, Enzymes; The effect of temperature on reaction rates; Arrhenius's equation.
Kinetics II	Reaction mechanisms: Elementary processes, Multistep reactions and the meaning of the rate-limiting step; Catalysis.
Thermodynamics I	Thermodynamic definitions: Heat, Work; Pressure-volume work; The first Law of thermodynamics; Calorimetry; Enthalpy; Standard states and standard enthalpies of reaction; Heat capacity; Phase change diagram; Hess's Law.
Thermodynamics II	Spontaneity: The meaning of a spontaneous change, Entropy, Entropy change: macroscopic interpretation; The second Law of thermodynamics; Spontaneous and nonspontaneous processes; Absolute entropies; Entropy change: microscopic interpretation; The Boltzmann equation for entropy; The third Law of thermodynamics; Entropy as a function of temperature; Gibbs free energy; The thermodynamic reaction quotient; Free energy and the equilibrium constant; The Van't Hoff equation; Coupled reactions.
Slightly soluble salts	Solubility; Solubility product constant; Common-Ion effect; Criteria for precipitation and its completeness; Fractional precipitation.

Literature

1. General Chemistry: Principles and Modern Applications. R.H. Petrucci, F.G. Herring, J.D. Madura, C. Bissonnette, Publisher: Pearson; 11th edition, 2016.
2. Physical Chemistry. P. Atkins, J.D. Paula, J. Keeler: Publisher: Oxford University Press; 11th edition, 2018.
3. Chemistry. OpenStax College, latest edition. Free textbook for legal downloading: https://opentextbc.ca/chemistry/