



Short Syllabus



Course Title	Credits
Physical Chemistry	3
Lecturer	
Dr. Assaf Ganoth	
Contact details	
E-mail: assaf.ganoth@gmail.com	
Semester	
Fall	
Short Description	
<p>Overview</p> <p>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.</p> <p>The course covers key principles, ideas, and concepts in selected topics of undergraduate physical chemistry. Tentative discussed topics: the kinetic theory of gases, thermodynamics, kinetics, soluble salts. Emphasis will be placed on a thorough understanding of the taught subjects by practicing theoretical and mathematical problems.</p>	
<p>Prerequisite</p> <p>This is a mandatory course for second-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.</p>	
<p>Methodology</p> <p>The course is based on weekly lectures combined with exercises and video clips.</p>	
<p>Office hours</p> <p>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.</p>	
<p>Final grade components</p> <p>The course final grade is composed of two parameters – final exam and quizzes.</p> <ul style="list-style-type: none">• Final in-class exam¹: 90% of the course grade.• Quizzes: Bi-weekly home quizzes on Moodle, 10% of the final grade.	

¹ Subject to change should in-class exam not be possible.



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Course plan, by topic (tentative)

Topic of lecture	Contents
The kinetic theory of gases	Kinetic-molecular theory of gases; Distribution of molecular speeds; The meaning of temperature; Derivation of Boyle's Law; Gas properties relating to the kinetic-molecular theory; The transport phenomena, Diffusion, Effusion.
Thermodynamics I	Thermodynamic definitions; Heat; Work; The first Law of thermodynamics; Heat capacity; Calorimetry, Enthalpy; Standard states and standard enthalpies of reaction; Hess's Law; Phase change diagram.
Thermodynamics II	Spontaneous and Nonspontaneous processes; Entropy; The Boltzmann equation for entropy; Entropy change: mathematical and microscopic interpretation; The second Law of thermodynamics; Absolute entropies; Entropy as a function of temperature; The third Law of thermodynamics; Gibbs free energy; The thermodynamic reaction quotient; Free energy and the equilibrium constant; The Van't Hoff equation; Coupled reactions.
Kinetics I	Rate of a chemical reaction; Measuring reaction rates; Effect of concentration on reaction rates: The rate law; Zero-order reactions; First-order reactions; Second-order reactions; Pseudo-first-order reactions.
Kinetics II	Theoretical models for chemical kinetics; The effect of temperature on reaction rates; Reaction mechanisms; Catalysis.
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.