האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

CHEMICAL PRINCIPLES - 71074

Last update 21-09-2018

HU Credits: *7*

Degree/Cycle: *1st degree (Bachelor)*

Responsible Department: *Biochemistry & Food Sciences*

Academic year: *0*

Semester: *1st Semester*

Teaching Languages: *Hebrew*

Campus: *Rehovot*

Course/Module Coordinator: *Dr. Merav Fichman*

Coordinator Email: *merav.fichman@mail.huji.ac.il*

Coordinator Office Hours: *Tuesday 11:00-13:00, Sunday 14:00-16:00*

Teaching Staff:

Dr. Merav Fichman
Mr. Oren Levinger
Ms.
Mr.
Ms. Yael Tal

Course/Module description:

This course introduces key topics in general and physical chemistry. Students will acquire basic knowledge in the following subjects: (1) Properties and Measurement of Matter,(2) The Atomic Theory (protons, electrons and neutrons) and the Periodic Table, (3) Chemical Compounds and Reactions, (4) The Gaseous state, (5) Thermochemistry and chemical Thermodynamics, (6) Chemical Equilibrium, (7) Chemical Bonding (Liquids, Solids, and Intermolecular Forces), (8) Solutions and physical properties of solutions, (9) Acids and Bases (Titration Curves. Buffer solutions and Solubility Products), and (10) Chemical Kinetics and Electrochemistry

Course/Module aims:

1.Teach students to think about the properties and behavior of the macroscopic world in terms of the structure and arrangement of the constituent molecules and atoms.
2.lay the foundation for students to pursue more specialized studies in other fields of science and engineering.

Learning outcomes - On successful completion of this module, students should be able to:

•Predict the chemical and physical properties of elements and chemical compounds using the periodic table and calculate the molecular formulae of substances.
•Classify matter by its bonding behavior; predict the geometry and polarity of covalent molecules.
•predict the behaviour of ideal gases and qualitatively describe the differences between solids, liquids, and gases at a molecular level.
•Use the basic thermodynamic concepts of enthalpy, entropy, and free energy to explain chemical processes and chemical equilibria
•Describe solutions, solubility of substances, and colligative properties
•Define acidity and basicity and calculate the pH of solutions of strong and weak acids or bases and account for the behaviour of buffer solutions
•Apply basic concepts in chemical kinetics, including rate equations, reaction order, and the effect of temperature and catalysts on the reaction rate
•Apply basic concepts in Electrochemistry including electrochemical cells , electrochemical potentials , Nernst equation and Electrolysis

Attendance requirements(%):

- *Submission 12 of 14 home exercises is mandatory for participation in the final exam*

- *Attendance in 80% of student's exercising group meetings provides extra 5% to course final grade*

Teaching arrangement and method of instruction: Frontal lectures
Frontal Exercises

Course/Module Content:

Lecture Topics:

1. Matter – Properties and Measurement: Matter composition, The Atomic Theory, Chemical Compounds, Chemical Reactions. Chemical Elements, Atomic Masses, Isotopes, Molecular and Ionic Compounds,

Molecular Mass,The Mole and Molar Mass. Chemical Reactions, Chemical Equations and Stoichiometry, Determining the Limiting reagent.

2.The Gaseous State:

Properties of Gases: Gas Pressure, The Simple Gas Laws, Combining the Gas Laws, The Ideal Gas Equation and The General Gas Equation Applications of the Ideal Gas Equation Mixtures of Gases, Kinetic—Molecular Theory of Gases

3.Thermochemistry:

Heat, Heat of Reaction and Calorimetry, Work, The First Law of Thermodynamics, Internal Energy, Enthalpy, Hess's Law and Standard Enthalpies of Formation.

4.Chemical Thermodynamics:

Spontaneity: The Meaning of Spontaneous Change, The Concept of Entropy, Evaluating Entropy and Entropy Changes Criteria for Spontaneous Change: The Second Law of Thermodynamics,

Standard Free Energy Change, ΔG°.

5. Chemical Equilibrium:

Dynamic Equilibrium, The Equilibrium Constant Expression, Relationships Involving Equilibrium Constants, The Significance of the Magnitude of an Equilibrium Constant,

The Reaction Quotient, Altering Equilibrium Conditions: Le Châtelliers Principle, Equilibrium Calculations.

6 - 7. Electrons in Atom:

Electromagnetic Radiation, Atomic Spectra, Quantum Theory, The Bohr Atom, Quantum Numbers and Electron Orbitals , Interpreting and Representing Orbitals of the Hydrogen Atom, Electron Spin, Multi-electron Atoms, Electron Configurations and the Periodic Table, , Metals and Nonmetals and Their Ions, The Sizes of Atoms

and Ions, Ionization Energy, Electron Affinity.

8-9.Chemical bonding, intermolecular forces and solutions:

Covalent Bonding, Polar Covalent Bonds Writing Lewis Structures, Resonance, Exceptions to the Octet Rule, The Shapes of Molecules, Bond Order and Bond Lengths, Bond Energies,

Multiple Covalent Bonds, Molecular Orbital Theory, Intermolecular Forces, Phase Diagrams, Van der Waals Forces, Hydrogen Bonding Crystal structures, molecular , ionic , ,metallic, covalent solids,

Types of Solutions, Solution Concentration, Intermolecular Forces and the Solution Process, Solution Formation and Equilibrium Colligative properties: Osmotic Pressure Freezing-Point Depression and Boiling-Point Elevation of Solutions.

10-12 Acid and Bases:

The Arrhenius Theory, Brønsted-Lowry Theory ,The Self-Ionization of Water and the pH Scale, Strong Acids and Strong Bases, Weak Acids and Weak Bases, Polyprotic Acids, Ions as Acids and Bases, Molecular Structure and Acid-Base Behavior, The Common-Ion Effect in Acid-Base Equilibria, Buffer Solutions, Acid-Base Indicators, Neutralization Reactions and Titration Curves.

13. Chemical Kinetics:

The 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, Theoretical Models for Chemical Kinetics, Activation Energy, The Effect of Temperature on Reaction Rates, Reaction Mechanisms, Catalysis

14. Electrochemistry:

Redox reactions. Electrochemical cells, Electrode Potentials and Their Measurement, Standard Electrode Potentials , Ecell, ΔG, and Keq relationship, Ecell as a Function of Concentration: Nernst equation,

Electolysis Processes.

Required Reading:

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Additional Reading Material:

-General Chemistry 9th edn., R.H. Petrucci, W.S. Harwood and F.G. Herring. Prentice Hall, New Jersey 2007.

-General Chemistry 8th edn. D.D Ebbing, S.D Gammon. Hougton Mifflin Company. New York.

Course/Module evaluation:

End of year written/oral examination 70 %

Presentation 0 %

Participation in Tutorials 0 %
Project work 0 %
Assignments 0 %
Reports 0 %
Research project 0 %
Quizzes 30 %
Other 0 %

Additional information:
Mid-Semester Exam - 30% (optional , Will only be weighted through the final exam pass)
Final Exam – 70%