CH-160(en)

Advanced general chemistry (english)

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Cursus	Sem.	Type
Environmental Sciences and Engineering	BA1	Obl.
Life Sciences Engineering	BA1	Obl.
Materials Science and Engineering	BA1	Obl.

Language of teaching	English
Coefficient	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**5 weekly**
Courses	3 weekly
Exercises	2 weekly
Number of positions	**218**

Summary

This course aims to teach essential notions of the structure of matter, chemical equilibria and reactivity. Classes and exercises provide the means to analyze and solve, by reasoning and calculation, novel problems of geeneral chemistry.

Content

1. Atomic theory : Electronic structure of atoms, atomic orbitals, spectroscopy, the periodic table

2. Chemical bonding : Lewis dot structures, octet rule, ionic bond, covalent bond, bond energy, VSEPR model, geometry of molecules, molecular orbitals, dipolar moment, van der Waals and London forces, intermolecular bonds.

3. Chemical quantities : Atomic/molecular mass, isotopes, notion of mole, chemical formulas, concentrations.

4. Chemical reactions and stœchiometry : Chemical equations, limiting reactant, electrolytes, ideal gas law, partial pressures.

5. Thermochemistry : Internal energy, first principle of thermodynamics, enthalpy of physical and chemical transformations, entropy, second principle, Gibbs free energy.

6. Chemical equilibria : Gibbs free energy of a mixture, chemical potential and activity, reaction quotient, equilibrium constant, influence of reactions parameters on equilibria.

7. Properties of solutions : Dissolution and solvation, solubility of solids.
8. Proton transfer : Acid-base equilibria: Brønsted-Lowry theory, acid-base couples, ionization constant, pH scale, calculation of pH values, acid-base titration.

9. Electron transfer : Electrochemistry: Balancing redox equations, electrochemical cells, standard potentials, batteries and rechargeable cells, Nernst's equation, Faraday's law, electrolysis.

10. Chemical kinetics : Reaction rate, rate law, molecularity and reaction order, activated complex theory, Arrhenius' law, catalysis.
Selected applications of the chemistry principles to Materials , Environment or Life sciences will be discussed in French in courses CH160(a) or CH160(e) during weeks 11 to 14.

Learning Outcomes

By the end of the course, the student must be able to:

- Explain the structure and basic properties of atoms
- Describe the various types of chemical bonds
- Use chemical quantities to make stoechiometric calculations

- Predict quantitatively energy exchanges associated to physical and chemical transformations
- Apply the principles of thermodynamics to solve equilibrium problems
- Compute the pH value of an aqueous solution by applying adequate approximations
- Work out / Determine the spontaneous direction, the energetics, and the equilibrium of a redox reaction
- Apply integrated rate laws and determine the kinetics of a reaction at different temperatures

Teaching methods

Course with exercises

Assessment methods

Written exam

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Bibliography

General Chemistry: Principles and Modern Applications
by Petrucci, Herring, Madura and Bissonnette
Chimie générale ; Hill, Petruci, McCreary, Perry, Editions du renouveau pédagogique
Chimie des solution ; Hill, Petruci, McCreary, Perry, Editions du renouveau pédagogique
Exercices de chimie générale; Comninellis; Friedli, Sahil Migirdicyan; Presses polytechniques et universitaires romandes

Ressources en bibliothèque

- Chimie des solutions / Hill
- General chemistry / Petruccu
- Chimie générale / Hill
- Exercices de chimie générale / Comninellis

Moodle Link

- https://go.epfl.ch/CH-160_en