PROGRAMME OF COURSES

Academic year 2022/2023 – 1st semester (For 1st year students)

Full name of the subject: Általános és szervetlen kémia (elmélet) I., Általános és szervetlen kémia (gyakorlat) I.

Program: undivided program (pharmaceutical)

Schedule: full-time

Short name of the subject: Gen. and Inorg. Chem.

English name of the subject: General and Inorganic Chemistry (theory) I., General and Inorganic Chemistry (practice) I.

German name of the subject: Allgemeine und Anorganische Chemie (Vorlesung) I, Allgemeine und Anorganische Chemie (Praktikum) I

Neptun code of the subject: GYKASK266E1A

Type of registration: **obligatory**/obligatory elective/elective/criteria requirement

Responsible department: Institute of Chemistry, Department of Analytical Chemistry, ELTE

Responsible tutor:	**Title, academic degree:**
Szabolcs Béni **István Szalai** **Norbert Szoboszlai**	associate professor full professor associate professor

Contact information:

Szabolcs Béni
Phone: +36208250489
E-Mail: beni.szabolcs@pharma.semmelweis-univ.hu
István Szalai
Phone: 3722500 / 1902
E-Mail: szalai.istvan@chem.elte.hu
Norbert Szoboszlai
Phone: 3722500 / 6430
E-Mail: szobosz@chem.elte.hu

Name of the persons responsible for the teaching of the subject:	**Title, academic degree:**
Norbert Szoboszlai (head of laboratory)	assistant professor
Gitta Vázziné Schlosser	assistant professor
Anikó Zsigrainé Vasanits	assistant professor
Edina Kiss	assistant professor
István Molnár	research assistant
3 PhD students	PhD students

Classes per week:	**Credit point(s):**
3 lecture(s) **4** practice(s)	**lecture 3, practice 4**

Professional content, intent of acquirement and it's function in order to implement the goals of the program:

To provide a basic knowledge in chemistry from the pharmaceutical industry/pharmacy point of view and to establish a solid background for advanced (bio)chemistry courses.

Short description of the subject:

Elementary particles: electron, proton, neutron. The Bohr model of the atom. Properties of the electron. Heisenberg's uncertainty principle. Schrödinger's equation and the quantum numbers. Pauli's exclusion principle and Hund's rule. Periodic table and periodic properties. Ionic bond and the types of ions. Covalent bond and its representation in Lewis structures. Hybridization of orbitals. The valence bond theory. Molecular geometry, the VSEPR theory. The formation of molecular orbitals. Bond polarity and the polarity of the molecules.

Single and multiple bonds. Electronegativity and its determination. The ionic character of covalent bonds. Covalent radius, bonding energy, network covalent bonds. Metallic bonding. Weak bonding forces. Dispersion, dipole forces and hydrogen bonding. Multicenter bonds.

Chemical equilibria, the law of mass action. *K*p and *K*c. The Le Chatelier principle. The temperature and pressure dependence of the equilibrium constant. Acid/base equilibria. Conjugated acid-base pairs and their strengths. The acid/base equilibria of water. The pH and its calculation. Strength of acids and bases. Hydrolysis. Buffer systems. Complex formation equilibria. Types of ligands. Mass balance equations, calculation of complex equilibria. Heterogeneous equilibria, the solubility product constant, solubility.

Chemical kinetics. Reaction order and molecularity. First order reactions. Age determinations based upon radioactive decompositions. Second order, pseudo-first order and zero order reactions. Reaction mechanisms. The temperature dependence of the reaction rate, collision theory. Catalysis. Autocatalytic reactions. Enzyme catalyzed, induced and oscillatory reactions.

Thermochemistry. Hess's law. Internal energy and enthalpy changes of reactions. Entropy. Spontaneity of chemical reactions, the free energy. Coupled reactions and their spontaneity. Photochemistry and radiation chemistry. States of matter. Properties and kinetic theory of gases. Properties of liquids. The surface tension. Freezing, boiling. The phase diagram of water. Crystal structures, unit cell. The rate of crystallization. Sublimation. The mechanism of dissolution. Types of concentrations. Rules of dilute solutions. Determination of MM by colligative properties.

Course data

Recommen-ded term	**Contact hours (lecture)**	**Contact hours (practice)**	**Contact hours (seminar)**	**Individual lectures**	**Total number of contact hours/semes-ter**	**Normal course offer**	**Consultations**
1	42	56			98	Autumn semester* Spring semester* Both semesters* (* Please underline)	

Program of semester

Topics of theoretical classes (pro week):

1. week: States of matter, phase changes and the most common purification methods. Purification of water.

2. week: Chemical equilibria and the factors affecting the chemical equilibrium. Law of mass action. Acid-base theories.

3. week: Acid-base equilibria and the pH. pH calculations.

4. week: Elementary particles. Basic interaction. Standard model. Electron, proton neutron. Structure of atoms. Bohr model. Schrödinger equation. Quantum numbers. Structure of atoms**.**

5. week: Redox reactions. Spontaneous redox processes.

6. week: Galvanic cell and electrolysis.

7. week: Colligative properties. Complex formation, characterization of complexes.

8. week: Heterogeneous equilibria.

9. week: Periodic table and the periodic properties of the elements. Ionic and covalent bonds. Lewis structure. Octet rule. Valence shell electron pair repulsion theory. Geometry of molecules. The dipole moment.

10. week: Weak bonding forces. Dispersion, dipole forces and hydrogen bonding

11. week: Valence bond theory.

12. week: Molecular orbital theory

13. week: Thermochemistry and thermodynamics.

14. week: Reaction kinetics

Topics of practical classes (pro week):

1st week	Grading requirements. General instructions, safety in laboratory. Opening inventory. Nomenclature of inorganic compounds. **Observation of osmosis (p. 159).**
2nd week	*Short test I.* Problem solving: concentrations, mixing and diluting of solutions. **Recrystallization of alum (p. 63). Sublimation of iodine (p. 71).**
3rd week	*Short test II.* Problem solving: basics of stoichiometry, acid-base reactions. **Purification of hydrochloric acid by distillation (p. 69)**.
4th week	*Short test III* Problem solving: stoichiometry, gas laws. **Water purification using ion-exchange resins (p.72).**
5th week	*Short Test IV.* Hydrolysis, **Observation of hydrolysis of some salts (p. 96)**. **Preparation of copper(II) sulfate (p. 93).**
6th week	*Short test V.* Balancing redox equations, standard potential. Experimental observation of redox reactions, direction of spontaneous change. **Observation of some oxidation-reduction reactions (p. 119).**
7th week	*Short test VI.* **Determination of mass of a magnesium sample (p. 144).**
8th week	**Test Paper I.** **Preparation of metallic substances: copper and manganese (p.123-124).**
9th week	*Short test VII.* Problem solving: pH calculations, Part I. **Preparation of copper(I) oxide (p. 128**). ”Chemical volcano”: thermal decomposition of ammonium dichromate.
10th week	*Short test VIII.* Problem solving: pH calculations, Part II. **Buffer solutions and buffer action (p. 145).**
11th week	*Short test IX.* *Thermal decomposition,* **Observation of thermal decomposition of inorganic substances (p. 102** Theory: Preparation of precipitated sulfur.
12th week	*Short test X.* **Preparation of a double salt, Mohr’s salt (p. 128)**
13th week	**Preparation of a coordination compound, [tetraammin copper(II)] sulfate (p. 139).**
Final test	
14th week	Theory: Reaction kinetics: Landolt reaction. Observation of reaction rates..

Final test retake. *Short test retake and make-up labs.* Closing inventory.

Schedule of consultations:

upon request prior major tests

Course requirements

Prerequisites: -

Conditions of attending the classes, amount of acceptable absents, way of presentation of leave, opportunity for makeup:

Students should pass the major test with an average of 2.0.

Number, topics and dates of tests during the semester, opportunities of makeup and improvement of results:

Two major test (see schedule for the dates) with retake possibilities.

Requirements of signature:

Successful completion of the laboratory requirements.

Number and type of projects students have to perform independently during the semester and their deadlines:

lab reports must be presented

Type of the semester-end examination: signature/practical grade/semi-final/final

semi-final exam

Form of the semester-end examination*:*
oral exam

Prescribed practices outside of the university: -

Scientific, course related researches, publications, assays:

course materials provided in the Moodle system
Lásztity-Noszál: Practical Inorganic and General Chemistry. Bp.
Lásztity-Gyimesi: Qualitative Inorganic Analysis. Bp.
Kőrös: General Chemistry. Bp.
Kőrös: Inorganic Chemistry.
Masterton-Hurley: Chemistry. Principles and Reactions. Saunders College Publishing, 1998.

Necessary equipment: -

The course description was prepared by:

István Szalai, Norbert Szoboszlai, Szabolcs Béni