Chemistry BSc

Study Abroad Course List

Tuition fee: 2600-2900 USD

For course syllabi, please contact the Study Abroad Office!

Course title	Semester	Credits (ECTS)
General and Inorganic Chemistry I. lecture	Fall	8
General and Inorganic Chemistry I. seminar	Fall	6
Organic Chemistry I. lecture	Fall	8
General and Inorganic Chemistry II. lecture	Spring	8
General and Inorganic Chemistry II. seminar	Spring	6
Organic Chemistry II. lecture	Spring	8

Scroll down for course descriptions.

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General and Inorganic Chemistry I. lecture

Language of instruction:	English
Form of teaching:	Lecture
Class hours per week:	4
Credits (ECTS):	8
Course description:	Week 1: Subject of chemistry, chemistry and other sciences, chemistry and society. Basic terms of chemistry. Stoichiometry: mole-mass relation in chemical reactions. Molar interpretation of a chemical equation. (molecular formula, empirical formula, Avogadro's number, kind of chemical reactions) Week 2: Atomic structure (Rutherford's experiment, the Bohr theory of hydrogen atom, quantum mechanics model). Quantum numbers and atomic orbitals. Week 3: Electron structure of atoms. Electron configurations and orbital diagrams. Pauli exclusion principle, building-up principle, Hund's rule. The periodic table. Periodic classification of the elements. Periodic properties (atomic radius, ionization energy, electron affinity). Week 4: Metallic bonding, ionic bond. Covalent bond, electronegativity, polar covalent bond, dipole moment. Week 5: Molecular geometry, VSEPR-model, valence bond (VB) theory, molecular orbital (MO) theory. Week 6: **Test I.** Change of state. Phase change (boiling point, melting point). Phase diagrams. Type of solids. (crystalline and amorphous solids). Intermolecular forces (London-forces, dipole-dipole-forces, hydrogen bonding). Week 7: Type of solution, the solution process, concentration of solutions (mass percentage, mass fraction, molarity, mole fraction, molality). Colligative properties: boiling-point elevation, freezing-point depression, osmosis. Week 8: Colloids. Type of colloids. Type of reactions, heat of reactions. Rate of reaction. Reaction order. Reaction mechanisms, catalysis. Week 9: Reaction of acid, bases. Neutralization. Acid-base concepts (Arrhenius, Bronsted-Lowry, Lewis, Pearson). Water self-ionization, ion-product constant for water, pH. Acid-base equilibria in solution (weak acid and base, salt, hydrolysis, common-ion effect, buffers.) Week 10: Oxidation number, oxidation number method. Oxidation-reduction reactions. Electrochemical cells,

	Galvanic cells. Electrode potentials, electrodes, Nernst equation. Electrolytic cells, fuel cell, lead storage cell. Chemical equilibrium - dynamic equilibrium. (equilibrium constant, Le Chatelier's principle). Homogeneous and heterogeneous equilibrium. Week 11: Coordination compounds. Formation and structure of complexes. Naming of coordination complexes. Structure and isomerism in coordination compounds. Week 12: Valence bond theory of complexes. Crystal field theory. Week 13: **Test II.** Pearson acid-base concept (hard/soft acid/base).
Assessment methods:	Active participation, oral exam and written essays.
Teaching period:	Fall semester

General and Inorganic Chemistry I. seminar

Language of instruction:	English
Form of teaching:	Seminar
Class hours per week:	2
Credits (ECTS):	6
Course description:	Week 1: Concentration calculations I. Week 2: Concentration calculations II. Week 3: Concentration calculations III. Week 4: Concentration calculations IV. Week 5: Gas laws I. Week 6: Gas laws II. Week 7: **Written exam I.** Week 8: Solubility of gases Week 9: Properties of diluted solutions Week 10: Stoichiometric calculations I. Week 11: Stoichiometric calculations II. Week 12: Stoichiometric calculations III. Week 13: Stoichiometric calculations IV. Week 14: **Written exam II.**
Assessment methods:	Active participation, written exam and midterm tests.
Teaching period:	Fall semester

Organic Chemistry I. lecture

Language of instruction:	English
Form of teaching:	Lecture
Class hours per week:	4
Credits (ECTS):	8
Course description:	Week 1: Atomic orbitals, molecular orbitals, hybridization, strucrure of molecules, covalent bonds Week 2: Representative carbon compounds: functional groups; Organic reactions and their mechanism; Acids and bases Week 3: Stereochemistry: isomerism, conformation, configuration, chirality; Structure determination of organic compounds Week 4: Alkanes, their structure, conformation, sp^3 hybridization, nomenclature, physical properties, chemical reactions. Week 5: Unsaturated hydrocarbons: their structure, sp^2 and sp hybridization, nomenclature, physical properties, chemical reactions, synthesis. Week 6: Unsaturated hydrocarbons in industry and biology: polymerization, terpenes, steroids, carotenoids). Week 7: Aromatic hydrocarbons: aromaticity, Hückel's rule. Aromatic electrophilic substitution reactions. Week 8: Alkyl halides: the character of a Hlg-C bond, synthesis, chemical reactions, their role in industry. Week 9: Organometallic compounds: structure; synthesis; reactivity, S_N and A_E reactions, reactions of Mg, Li, Cu, Cd, Zn organic compounds, synthesis and application of Si-organic derivatives. Week 10: Alcohols, phenols, ethers and their derivatives. Structure, physical and chemical properties, reactions. Their role in biological processes. Week 11: Aliphatic and aromatic nitro compounds, azo and diazo compounds: structure, synthesis, physical and chemical properties and importance. Week 12: Amines: structure, synthesis, physical and chemical properties, basicity. Biologically active amines, alkaloids, drugs and hormones. Week 13: Sulphur containing compounds: structure, physical and chemical properties, reactions. Their role in biological processes.
Assessment methods:	Active participation, oral exam and written essays
Teaching period:	Fall semester

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General and Inorganic Chemistry II. lecture

Language of instruction:	English
Form of teaching:	Lecture
Class hours per week:	4
Credits (ECTS):	8
Course description:	Week 1: Nonmetals and their compounds. Hydrogen and its isotopes, its use and application. Hydrides. Week 2: General characterization of metals. Alkali metals, their occurrence, physical and chemical properties. The hydrides, halides, oxides, hydroxides, sulfides, polysulfides and carbonates of alkali metals. The crystal energy and solubility of alkali salts. The biocoordination chemistry of alkali metals (introduction). Week 3: Alkaline earth metals, their occurrence, physical and chemical properties. Their compounds and use. Week 4: The elements of group III and their physical and chemical properties. Hydrides, oxides. Their compounds and use. Preparation of boron and aluminum. Organic compounds of boron and aluminum. Week 5: The elements of group IV and their physical and chemical properties. Comparison of C and Si compounds. The stereochemistry of C, the main types of carbon compounds. Hydrides and halides. Oxides, oxoacids, oxohalides. The characterization of some compounds with C-N bond, their practical importance. Carbides. Week 6: The elements of the nitrogen group, their occurrence, physical and chemical properties. Their compounds, the comparison of the stereochemistry of N and P. Hydrides, the synthesis of NH_3. Oxides and oxoacids, their structure and chemical properties, their practical importance. Week 7: Chalcogens, physical and chemical properties, their compounds with hydrogen and halogens. Water. Oxo-compounds of S, Se, and Te. Week 8: The occurrence of halogens, physical and chemical properties. Interhalogens. Hydrogen halides and oxo-compounds (oxides, oxoacids). The structure and properties of oxoacids. Week 9: The occurrence of noble gases, their physical and chemical properties. General characterization of transition metals, physical and chemical properties. The variability of their oxidation states and their electronic structure. Complex formation and its

	consequences. The optical and magnetic properties of transition metal complexes. The production of transition metals, reduction of oxides and halides, thermal decomposition of halides and carbonyls, electrolysis. Transition metal hydrides, halides, their structures, and stabilities. Halogeno-complexes. Transition metal oxides, hydroxides, sulfides, cyanides, thiocyanates. Carbonyl complexes and their bonding properties. Week 10: Ti, Zr, Hf and their compounds. V, Nb, Ta and their compounds. Week 11: Cr, Mo, W and their compounds. Mn, Tc, Re and their compounds. Week 12: Fe, Co, Ni and their compounds. Platinum metals and their most important compounds. Cu, Ag, Au and their compounds. Zn, Cd, Hg and their compounds. The biocoordination chemistry of Fe and Cu (introduction). Week 13: Lanthanides and actinoids. The electronic structure of lanthanides, the atomic and ionic radii. The production of transurane elements. Complexes and practical applications of lanthanides and actinoids.
Assessment methods:	Active participation, oral exam and written essays
Teaching period:	Spring semester

General and Inorganic Chemistry II. seminar

Language of instruction:	English
Form of teaching:	Seminar
Class hours per week:	2
Credits (ECTS):	6
Course description:	Week 1: Detailed Balancing of chemical equations Week 2: Redox calculations I. Week 3: Redox calculations II. Week 4: Redox calculations III. Week 5: Electrolysis I. Week 6: Electrolysis II. Week 7: **Written exam I.** Week 8: Galvanic cells Week 9: pH calculations of strong acids and bases I. Week 10: pH calculations of strong acids and bases II. Week 11: pH calculations of weak acids and bases I. Week 12: pH calculations of weak acids and bases II. Week 13: pH calculations of weak acids and bases III. Week 14: **Written exam II.**
Assessment methods:	Active participation, written exam and midterm tests
Teaching period:	Spring semester

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Organic Chemistry II. lecture

Language of instruction:	English
Form of teaching:	Lecture
Class hours per week:	4
Credits (ECTS):	8
Course description:	Week 1: Aldehydes and ketones – structure, physical, chemical properties, reactions, important representatives. Week 2: Nucleophilic addition and condensation reactions of aldehydes and ketones Week 3: Monosaccharides – structure, mutarotation, reactions and biological importance. Week 4: Di- and polysaccharides – food reserve and structural material polysaccharides. Week 5: Carboxylic acids and their derivatives – structure, physical, chemical properties Week 6: α-Position substituted carboxylic acid derivatives, di- and polycarboxylic acids, representatives; Esters of inorganic acids, biological significance (phosphatides, phospholipids). Week 7: α-Amino acids, peptides and proteins, biological importance. Week 8-9: Heterocycles (5- and 6-membered heteroaromatic compounds, structure, biologically important representatives, chemical mode of action of coenzymes); Week 10: Heterocycles in nucleotides, nucleosides, nucleic acids. Week 11-12: Vitamins. Week 13: Degradation of organic compounds and their effect on biological environment (ozone degradation, pesticides, chemical fertilizer, combustion end-products)
Assessment methods:	Active participation, oral exam and written essays
Teaching period:	Spring semester

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