Syllabus

Course title
Chemistry

faculty	**Fields of study:**	Environmental Engineering, Environmental Protection,Materials Science, Geology, Metallurgy, Mechanical Engineering, Energy/Power Engineering, Chemical Technology and others where general knowledge of chemistry is required
	Specialisation:	all
	Level of study:	Undergraduate and graduate
	System of education:	Full-time and extra-mural

Course: mandatory or elective				**ECTS points: 7**			
Semester	No. of hours	L	**C**	P	Lab	Seminar	Completion/Exam
Fall and/or Summer	60	45			15		Exam

Course content (Lectures)

The course is designed to give basics of modern chemistry and the structure of matter, elements, chemical bonds, molecules, properties of matter and chemical reactions. General foundations to inorganic and organic chemistry are given.

Introduction to the nature of matter. Classification of chemical substances. Chemical elements and compounds. Substances and mixtures. The three states of matter. Physical and chemical properties of matter. Fundamental chemical laws. Law of mass and energy conservation.

Atomic structure. The electron and nucleons. Atomic number, mass number, structure of nucleus. Isotopes, their natural abundance, atomic weight. Nuclear interactions and stability of nucleus. Radioactivity. Nuclear reactions. Natural radioactive decay series. Nuclear power plant and nuclear bomb.

Principle of wave mechanics. Radiation. The Heisenberg's uncertainty principle. The de Broglie's hypothesis. Planck's quantum theory. Rutherford's (nucleus), Thompson's (electron) and Thompson's (electron charge) experiments. Photons and electrons. Wave function and its physical meaning.

The electron structure of hydrogen atom. The Schrödinger's equation – wave equation. The movement of electron in the nucleus potential electrostatic field. Application of wave mechanics to hydrogen atom. The solutions of Schrödinger's equation. Wave functions, orbitals. Energy levels in hydrogen atom. Quantum numbers. Electron Many-electron atoms. Electronic configurations and periodic classification of elements. Periodic Table. Energy levels in atom; the Pauli's exclusion principle, Hund's rule..

Chemical reaction. The chemical bond – electronic theory. Molecule. The theory of molecular orbitals. Types of molecular orbitals.

Homonuclear diatomic molecules – electronic configuration of H_2, O_2, N_2, Cl_2 molecules.

Heteronuclear diatomic molecules. Polarisation. Polar and nonpolar molecules. Energy diagrams for homo and heteronuclears molecules.

Hybridisation. The electronic structure of manyatom molecules: NH_3, H_2O, CH_4, C_6H_6. Mathematical and physical sense of hybridisation. The symmetry of molecule.

Chemical reaction, chemical equation. Chemical kinetics. The rate of the reaction. The rate laws. The mechanism of a chemical reaction.

Chemical and physical processes. The concept of chemical equilibrium.

Equilibrium constant. Le Chatelier's principle.

The liquid state. The structure and properties of water. Phase changes, phase equilibrium , phase diagram of water. Gibbs' principle.

Solvent – solution interaction, concentration, units. Types of solutions. Solubility. Solubility product. Henry's law – solubility of solids. Temperature and pressure dependences of solubility.

Electrolytes and non-electrolytes. Osmosis, osmotic pressure. Semipermeable membranes. Ionization, solvation.

Water as a solvent. Autoionization of water. The ion product constant. The ion product of water, pH factor, a

measure of acidity.
Acids and bases. Acid-base equilibria. Arrhenius theory of acids and bases. Broensted theory of acids and bases. Criteria of strong and weak electrolytes. Percent ionization, ionization constant. Salts. Hydrolysis. Buffer solutions. Oxidation-reduction. Degree of oxidation. Red-ox reactions. Introduction to electrochemistry. Nernst equation for electrode potential. Electrolysis. Electrochemical cell. Electro-Motor-Force (EMF) for the cell.
Metallurgy and the chemistry of metallurgical processes. Chemical and electrochemical processes in metallurgy. Iron and steel making. Aluminium, copper, alkali metals.
Gases. The gas laws. The ideal gas equation. Deviations from ideal behavior. Surface active substances.Surfactants and detergents.
Intermolecular forces. Solids. Crystals and amorphous solids.
Chemistry of carbon. Graphite, diamond, fullerenes. Inorganic compounds of carbon.

References (Basic):
1. Raymond Chang , Chemistry, McGraw-Hill 1998

References (Additional):
2. Loretta Jones, Peter Atkins 3. Michell J. Sienko, Robert A. Plane 4. Linus Pauling, Peter Pauling **Optional for Polish students books in Polish** 5. Michell J. Sienko, Robert A. Plane, Chemia- Podstawy i zastosowania, Wyd. Nauk.-Techn., Warszawa,1992 6. Lech Pajdowski, Chemia ogólna, Wyd. Nauk. PWN, Warszawa 1999

Expected learning outcome:	Understanding the structure of matter and chemical processes.
Language of instruction:	English
ERASMUS subject code:	13.3 (chemistry)
Prerequisites:	No prerequisites for foreign students. Suggested requirement for Polish students : completion of General Chemistry course in Polish.
Assessment method:	Examination (written or oral)
Unit:	Department of Environmental Sciences in Energy Research, Faculty of Energy Research and Fuels
Lecturer:	**Prof. Janusz Gołaś**
Modified:	January, 2009