COURSE OUTLINE

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	BIOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	BIO_AY01	**SEMESTER**	1
COURSE TITLE	GENERAL CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures and seminars	4 (3 lect. and 1 sem.)	8
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Field of Science (General Chemistry)
PREREQUISITE COURSES:	Typically, there are not prerequisite courses
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek. Teaching may be however performed in English in case foreign students attend the course.
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.upatras.gr/courses/BIO211/

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

By the end of this course the student should be able to:

- Determine the correct number of significant figures to report for the answer to a calculation
- Formulate net ionic equations, classify acids and bases as strong or weak, assign oxidation numbers, balance simple oxidation – reduction reactions, calculate and use molarity.
- Write and handle thermochemical equations, calculate the heat of reaction from stoichiometry, apply the Hess' law, calculate enthalpy of a reaction

using standard enthalpies of formation.

- Use Lewis symbols to represent ionic bond formation and write electron configurations of ions, obtain relative bond polarities, write Lewis formulas using formal charges, relate bond order and bond length.
- Predict molecular geometries, relate dipole moment and molecular geometry, apply valence bond theory, describe molecular orbital configurations.
- Calculate solution concentration, find mole fractions, calculate: the vapor pressure lowering, the boiling-point elevation, the freezing-point depression and using them calculate the molecular weight of the solute, calculate osmotic pressure and determine colligative prorerties of ionic solutions
- Use the Arrhenius equation, write overall chemical equation from a mechanism, determine the molecularity of an elementary reaction and write its rate equation. Determine the rate law from a mechanism with an initial slow step.
- Apply stoichiometry to an equilibrium mixture, write equilibrium-constant expressions and obtain them from reaction composition. Use the reaction quotient, solve equilibrium problems and apply Le Chatelier's principle changing the reaction conditions.
- Identify acid and base species according to the Brønsted-Lowry and Lewis concepts, decide whether reactants or products are favoured in an acid-base reaction, calculate concentrations of H_3O^+ and OH^- in solutions of a strong acid or base.
- Determine K_a and K_b from the solution pH and vice versa, calculate concentrations of species in solutions of a weak acid or base, calculate the pH of a buffer solution.
- Calculate the solubility product constant K_{sp} and the solubility of slightly soluble (or nearly insoluble) ionic compounds. Predict if an ionic salt can precipitate when the ion concentrations are known

Calculate the entropy change ΔS^o for a phase transition, calculate ΔG^o from ΔH^o and ΔS^o, calculate K from the standard free-energy change and ΔG^o and K at various temperatures and describe how the spontaneity or nonspontaneity of a reaction is related to its Free Energy

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma

Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

By the end of this course the student will, furthermore, have developed the following skills (general abilities):

1. Ability to exhibit knowledge and understanding of the essential facts, concepts, theories and applications which are related to General Chemistry.
2. Ability to apply this knowledge and understanding the solution of problems related to General Chemistry
3. Ability to adopt and apply methodology to the solution of non familiar problems of General Chemistry.
4. Study skills needed for continuing professional development.
5. Ability to interact with others in chemical or of interdisciplinary nature problems.

Generally, by the end of this course the student will, furthermore, have develop the following general abilities (from the list above):

- *Searching, analysis and synthesis of facts and information, as well as using the necessary technologies*
- *Adaptation to new situations*
- *Decision making*
- *Autonomous (Independent) work*
- *Exercise of criticism and self-criticism*
- *Promotion of free, creative and inductive thinking*
- *Respect to natural environment*

Work design and management

(3) SYLLABUS

- **Calculations with Chemical Formulas and Equations.** Molecular weight and formula weight. The mole concept. Mass percentages from the formula. Elemental analysis: Percentages of carbon, hydrogen and oxygen. Determining formulas. Molar interpretation of a chemical equation. Amounts of substances in a chemical reaction. Limiting reactant: Theoretical and percentage yields.
- **Chemical Reactions**: Introduction Ionic theory of solutions. Molecular and ionic equations. Precipitation reactions. Acid – base reactions. Oxidation – reduction reactions. Balancing simple oxidation – reduction reactions. Molar concentration. Diluting solutions. Gravimetric analysis. Volumetric analysis.
- **Thermochemistry Energy and its units**. Heat of reaction. Enthalpy and enthalpy change. Thermochemical equations. Applying stoichiometry to heat of reaction. Measuring heat of reaction. Hess's law. Standard enthalpies of formation. Fuels-foods, commercial fuels and rocket fuels.

- **Quantum Theory of the Atom.** The wave nature of light. Quantum effects and photons. The Bohr theory of the hydrogen atom. Quantum mechanics. Quantum numbers and atomic orbitals. Electron Configurations and Periodicity Electron spin and the Pauli exclusion principle. Building-up principle and the periodic table. Writing electron configurations using the periodic table. Orbital diagrams of atoms – Hund's rule. Mendeleev's predictions from the periodic table. Periodic properties (atomic radii, ionization energies, electron affinities). Periodicity in the main-group elements.
- **Ionic and Covalent Bond Describing ionic bonds**. Electron configuration of ions. Ionic radii. Describing covalent bonds. Polar covalent bonds. Electronegativity. Writing Lewis electron-dot formulas. Delocalized bonding – Resonance. Formal charge and Lewis formulas. Bond length and bond order. Bond energy.
- **Molecular Geometry and Chemical Bonding Theory**. The VSEPR model. Dipole moment and molecular geometry. Valence bond theory. Description of multiple bonding. Principles of molecular orbital theory. Electron configurations of diatomic molecules of the second-period elements.
- **Solutions.** Types of solutions. Solubility and the solution process. Effect of tempetrature and pressure on solubility. Ways of expressing concentration. Vapor pressure of a solution. Boiling-Point elevation and Freezing-point depression. Osmosis. Colligative properties of ionic solutions. Coloids. 9. Rates of reaction Definition of reaction rate. Experimental determination of rate. Dependence of rate on concentration. Change of concentration with time. Temperature and rate; Collision and transition-state theories. Arrhenius equation. Elementary reactions. The rate law and the mechanism. Catalysis.
- **Chemical Equilibrium.** Chemical Equilibrium-A dynamic equilibrium. The equilibrium constant. Heterogeneous equilibria. Solvents in homogenius equilibria. Qualitatively interpreting the equilibrium contant. Predicting the direction of reaction. Calculating equilibrium concentrations. Removing products or adding reactants. Changing the pressure and temperature. Effect of a catalyst.
- **Acids and Bases.** Arrhenius concept of acids and bases. Brønsted–Lowry concept of acids and bases. Lewis concept of acids and bases. Relative strengths of acids and bases. Molecular structure and acid strength. Self ionization of water. Solutions of a strong acid or base. The pH of a solution.
- **Acid-Base Equilibria Acid-ionization equilibria**. Polyprotic acid. Base-ionization equilibria. Acid-base properties of salt solutions. Common-ion effect. Buffers. Acid-base titration curves
- **Solubility and equilibria of slightly soluble (or nearly insoluble) ionic compounds.** The Solubility Product Constant. Precipitation Calculations and criterion for precipitation.

  Thermodynamics and Equilibrium. First Law of Thermodynamics. Enthalpy. Entropy and the second law of thermodynamics. Standard entropies and the third law of thermodynamics. Free energy and spontaneity. Interpretation of free energy. Relating ΔG^o to the equilibrium constant. Change of free energy with temperature.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Lectures and seminars face to face.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint, video etc.) in teaching. The lectures content of the course for each chapter, all problems, in the form of a series of ppt files, and announces are uploaded on the internet, from where the students can freely download them.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures (3 conduct hours per week × 13 weeks)</td><td>39</td></tr>
<tr><td>Seminars (1 conduct hour per week × 13 weeks) - solving of representative problems</td><td>13</td></tr>
<tr><td>Hours for private study of the student and optional problems solving given in each lecture</td><td>143</td></tr>
<tr><td>Two optional tests during the semester (1 conduct hour × 2 times)</td><td>2</td></tr>
<tr><td>Final written examination at the end of semester (3 conduct hours × 1 time)</td><td>3</td></tr>
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<tr><td>Course total</td><td>200</td></tr>
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<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>1. At the end of the semester there is a final written examination with multiple choice questions and short answer questions (open text books). Minimum passing grade: 5
2. Optional participation in two written "tests" with multiple choice questions and short answer questions during the semester (open text books). The 1/10 of the grade of each test is added to the final examination grade (if it’s higher than 5).</td></tr>
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	Optional delivery of solved problems (at least 2) each week, given in each lecture. Addition of 1 grade to the final exam grade (if it's higher than 5) of the students who have delivered all the solved problems and the percentage of the unit to the others, according to the number of solved problems each person has delivered.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1) «GENERAL CHEMISTRY», Brown, Lemay, Bursten, Murphy, Woodward, Stoltzfus, 13η Edition, (*Greek Translation by* Periklis Akrivos), TZIOLA Publications, Thessaloniki / 2016
2) «GENERAL CHEMISTRY: PRINCIPLES AND MODERN APPLICATIONS», Ralf H. Petrucci, F. Geoffrey Herring, Jeffry Madura, & Carey Bissonette, 11th Edition, Pearson, 2016
3) «GENERAL CHEMISTRY: THE ESSENTIAL CONCEPTS», Raymond Chang and Kenneth Goldsby, 7th Edition, McGraw-Hill education, 2015
4) «MODERN GENERAL CHEMISTRY», Ebbing and Gammon, 10η Edition, (*Greek Translation by* Nikolaos Klouras), P. TRAYLOS Publications, Athens / 2014
5) «INORGANIC CHEMISTRY», G. Pneumatikakis, Ch. Mitsopoulou, K. Methenitis, A. STAMOULIS Publications, Athens / 2005 (in Greek)
6) «CHEMISTRY", Jones and Atkins, 4th Edition, W.H. Freeman and Company, New York 2000
7) «BASIC INORGANIC CHEMISTRY», Nikolaos Klouras, KOSTARAKI Publications, Athens / 1995 (in Greek)

- Related academic journals:

1) Journal of the American Chemical Society (JACS)
2) Chemical Communications (RSC)
3) Journal of Biological Chemistry