Introduction to Inorganic Chemistry

1. GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**XA127**	**SEMESTER**	**1st**
COURSE TITLE	INTRODUCTION TO INORGANIC 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	3	5
Seminars	1	
Laboratory work	1	
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 (Inorganic Chemistry) and Skills Development (Experimental General and Inorganic Chemistry).
PREREQUISITE COURSES:	Typically, there are not prerequisite course.
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/CHEM2089/

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 will be able to:

1. Use the law of conservation of mass, the significant figures in calculation, convert from one temperature scale to another, and calculate the density of a substance.
2. Write nuclide symbols, determine atomic weights from isotopic masses and fractional abundances, write an ionic formula given the ions, write the name and formula of an anion from the acid, and balance simple equations.
3. Calculate the formula weight from a formula, calculate the mass of an atom or molecule, convert moles of substance to grams and vice versa, calculate the percentage composition from the formula, calculate the mass of an element in a given mass of compound, determine the empirical formula from percentage composition, relate quantities in a chemical equation and find the limiting reactant.
4. Formulate net ionic equations, classify acids and bases as strong or weak, assign oxidation numbers, balance simple oxidation – reduction reactions, calculate and use molarity.

5. Relate wavelength and frequency of light, calculate the energy o a photon, determine the wavelength or frequency of a hydrogen atom, apply the de Broglie equation, and use the rules for the equation numbers.
6. Apply the Pauli exclusion principle, determine the configuration of an atom using the building-up principle or the period and group numbers, apply the Hund's rule.
7. Use Lewis symbols to represent ionic bond formation and write electron configurations of ions, compare ionic radii and obtain relative bond polarities, write Lewis formulas using formal charges, relate bond order and bond length, estimate ΔH from bond energies.
8. Predict molecular geometries, relate dipole moment and molecular geometry, apply valence bond theory, describe molecular orbital configurations.
9. 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 H3O+ and OH– in solutions of a strong acid or base.
10. Write the IUPAC name given the structural formula of a coordination compound and vice versa, decide whether isomers are possible, describe the bonding in a complex ion, predict the relative wavelengths of absorption of complex ions.

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	*Others*
Production of new research ideas	

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

1. Ability to solve cumulative-skills theoretical and practical problems. These problems require two or more operational skills earnt in the present or in previous chapters.
2. Skills enabling the student to solve simple and complex stoichiometry problems.
3. Ability to apply the key relations between position of the elements in the periodic table, their electron configuration and their physical and chemical properties.
4. The "heart" of the course is the chemical bond and the student should be able to determine the type of bonding in each substance and to describe the formation of bonds in various substances.
5. Ability to explain some important properties of compounds, as solubility, melting point, boiling point, vapor pressure and so on.
6. Developing the ability to explain magnetic properties, colour and geometry of complexes and to decide whether isomers are possible. Finally, the student should be able to give some examples of applications of complexes in our daily life.

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

Group work

Exercise of criticism and self-criticism

Promotion of free, creative and inductive thinking

Respect to natural environment

Work design and management

3. SYLLABUS

1.Chemistry and Measurements

Law of conservation of mass. Matter: Physical state and chemical constitution (solids, liquids and gases. Elements, compounds and mixtures). Measurements and significant figures. SI units. Derived units. Units and dimensional analysis.

2. Atoms, Molecules and Ions

Atomic theory of matter. The structure of the atom. Nuclear structure–Isotopes. Atomic weights. Periodic table of the elements. Chemical formulas–Molecular and ionic substances. Organic compounds. Naming simple compounds. Writing chemical equations. Balancing chemical equations.

3. 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.

4. 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.

5.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.

6. 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.

7.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. Exceptions to the octet rule. Formal charge and Lewis formulas. Bond length and bond order. Bond energy. Intermolecular forces (dipole-dipole forces, London forces, van der Waals forces and the properties of liquids, hydrogen bonding.

8. 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. Molecular orbitals and delocalized bonding.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, seminars and laboratory work face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Information and Communication Technologies (ICTs) (e.g. PowerPoint) in teaching. The lectures content of the course for each chapter are uploaded on the internet, in the form of a series of ppt

Use of ICT in teaching, laboratory education, communication with students	files, where from the students can freely download them using a password which is provided to them at the beginning of the course.

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

Activity	*Semester workload*
Lectures (3 contact hours per week x 13 weeks)	39
Seminars (1 contact hour per week x 10 weeks) - solving of representative problems; techniques and theory associated to each laboratory experiment)	10
4 Laboratory Exercises (3 contact hours per 3 weeks)	12
Hours for private study of the student and preparation of home-works (4 per semester), for Introduction in Inorganic Chemistry, and reports, for the Laboratory, and preparation for the Laboratory (study of techniques and theory)	16
Final examination (3 contact hours)	3
Hours of Private Study of the Student for the preparation of the Final Examination	45
Course total	***125***

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.

1. Oral examination during the seminars on problems given as homework in the lectures. The mark of the seminars is added to the final mark only when the student secures the minimum mark of 5 in the final written examination.
2. (Optional)10-min presentation of subjects related to the courses by two-student groups. The mark of the The mark of the seminars is added to the final mark when the student secures the minimum mark of 5 in the final written examination.
3. Final written examination. Greek grading scale: 1 to 10. Minimum passing grade: 5.

5. ATTACHED BIBLIOGRAPHY

1. N. Klouras, "Modern General Chemistry", 1η Edition, Greek Language Translation of D.D. Ebbing και S.D. Gammon "General Chemistry", 10th Edition 2013
2. D.D. Ebbing and S. D. Gammon, "General Chemistry", 9thEdition, Houghton Mifflin Company, 2009.
3. R.H. Petrucci, W.S. Hawood, G.E Herring and J. Madura, "General Chemistry: Principles and Modern Applications", 9th Edition,Prentice Hall, 2006.
4. R. Chang, "General Chemistry: The Essential Concepts", McGraw-Hill Science Engineering, 2007.
5. T.E. Brown, E.H. LeMay and B.E. Bursten, "Chemistry: The Central Science", 10th Edition, Prentice Hall, 2006.
6. J. McMurry, R.C. Fay and L. McCarty, "Chemistry", 4th Edition, Prentice Hall, 2003.
7. S.S. Zumdahl, "Chemistry", 7th Edition, Houghton Mifflin College Div., 2007.