

Module Outline

1. GENERAL

SCHOOL	OF SCIENCE AND TECHNOLOGY		
PROGRAMME	Studies in Natural Sciences		
LEVEL OF STUDIES	Level 6 of the Hellenic and European Qualifications Framework		
MODULE CODE	FYE-12	YEAR	1 st
MODULE TITLE	General and Inorganic Chemistry		
INDEPENDENT TEACHING ACTIVITIES <i>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</i>		HOURS	CREDITS
Weekly workload: 17-18 hours x 32 weeks		560	20 ECTS
MODULE TYPE <i>Compulsory/Elective/ Mandatory Optional</i>	Compulsory		
MODULE DESCRIPTION <i>general background, special background, specialised, general knowledge, skills development</i>			
PREREQUISITE MODULES	There are no prerequisites for this module		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	Greek		
IS THE MODULE OFFERED TO ERASMUS STUDENTS	No		
MODULE WEBSITE (URL)	The Module has its own space in the digital learning environment of HOU (https://study.eap.gr/login/index.php) with controlled access (use of password) for students and Teaching Staff. The electronic Web page of the FYE-12 Module is the following: https://www.eap.gr/el/programmata-spoudwn/177-spoudes-stis-fysikes-epistimes/diarthrwnsi/403-4fc8fd8087500c236e505bdcc5e793bf		

2. LEARNING OUTCOMES

Learning outcomes

The learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the Module 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*

LEARNING OUTCOMES

Knowledge:

Upon successful completion of the Module, students are expected to:

- acquire knowledge of basic concepts, principles and applications of modern chemistry, with applications in the modern interdisciplinary professional and/or academic career of their choice
- understand the theoretical directives of general and inorganic chemistry, and be able to apply the principles that govern it.
- acquire knowledge of the basic characteristics of qualitative chemical research in modern inorganic chemistry and understand its role in chemical science and in modern applications on modern hybrid technological materials.

Skills:

Upon successful completion of this Module, students will be able to:

- develop their own personal skills and judgment in basic knowledge of general, inorganic chemistry and advanced materials chemistry
- use their knowledge in addressing chemical problems, understanding chemical phenomena, and applying basic knowledge in pursuing experiments and theoretical research that validates experimental results.

Thus, a student, at that stage, will be able to:

- Describe the properties of electrons, protons, and neutrons (the atomic structure)
- Describe isotopes and their composition
- Calculate atomic weights from isotopic abundance and isotopic masses
- Name and write formulas for common binary and ternary inorganic compounds
- Use chemical formulas to solve various kinds of chemistry problems
- Relate names to formulas and charges of simple ions
- Combine simple ions to generate and write formulas and names of ionic compounds
- Recognize and use formula weights and mole relationships
- Interconvert masses, moles, and formulas
- Determine percent composition in compounds
- Determine formulas from composition
- Write balanced chemical equations to describe chemical reactions
- Interpret balanced chemical equations and calculate moles or masses of reactants and products involved in reactions
- Determine the percent yield of a reaction
- Calculate concentrations of solutions emerging upon dilution
- Carry out calculations, involving use of solutions in chemical reactions
- Describe the wave properties of light and the relationship of light wavelength with frequency and speed
- Interpret the wave-particle duality
- Interpret the contribution of atomic spectra to the development of atomic theory
- Describe the main points of the quantum mechanical formulation of the atom

- Describe the four quantum numbers, and relate their values to specific atomic orbitals
- Describe the shapes of orbitals and arrange orbitals according to their relative energies
- Write electron configurations of atoms
- Relate the electronic configuration of an atom to its position on the periodic table
- Describe the periodic table and important relationships it projects
- Develop chemical periodicity in relation to the following physical properties: Atomic radius, Ionization energy, Electron affinity, Electronegativity
- Write Lewis dot representations of atoms
- Predict whether bonding between specified elements is primarily ionic, covalent, or polar covalent
- Compare and contrast characteristics of ionic and covalent compounds
- Describe how elements bond by electron transfer (ionic bonding)
- Describe energy relationships in ionic compounds
- Predict the formulas of ionic compounds
- Describe how elements bond by sharing electrons (covalent bonding)
- Write Lewis dot and dash structures for molecules and polyatomic ions
- Recognize exceptions to the octet rule
- Calculate and write formal charges for atoms in covalent compound structures
- Describe resonance and know when and how to write resonance structures
- Describe the basic ideas of Valence Shell Electron Pair Repulsion (VSEPR) theory
- Use VSEPR theory to predict the molecular geometry of polyatomic molecules and ions
- Describe the relationship between molecular shape and polarity in a molecule
- Predict whether a molecule is polar or nonpolar
- Describe the main features of Valence Bond (VB) theory
- Distinguish between hybrid orbitals in polyatomic molecules and ions
- Use hybrid orbitals to describe bond formation in double and triple bonds
- Describe the basic concepts of Molecular Orbital Theory (MOT)
- Draw a molecular orbital diagram of a diatomic molecule from the corresponding atomic orbitals
- Distinguish among bonding, antibonding, and nonbonding molecular orbitals
- Determine bond order in diatomic molecules and ions
- Relate bond order to bond stability
- Use the concept of electron cloud delocalization for molecules, in which Valence Bond theory applies the effect of resonance
- Recognize and describe nonelectrolytes, strong electrolytes, and weak electrolytes
- Describe the Arrhenius theory of acids and bases
- Describe the Brønsted-Lowry theory of acids and bases
- List properties of aqueous solutions of acids and bases
- Arrange binary acids (acids and hydrides) in order of increasing strength
- Arrange ternary acids (oxy-acids) in order of increasing strength
- Describe Lewis theory of acids and bases
- Complete and balance equations for acid base reactions
- Define acidic and basic oxides and salts
- Explain amphoterism
- Balance oxidation-reduction equations
- Explain the common ion effect and provide relevant examples
- Recognize buffer solutions and describe their chemistry-function
- Describe how to prepare a buffer solution of a specified pH value
- Explain what acid-base indicators are and how they work
- Describe which chemical species are present in the various stages of a titration between (a) strong acids and strong bases, (b) weak acids and strong bases, and (c) polyprotic acids and strong bases

- Carry out calculations based on titration curves of (a) strong acids and strong bases, (b) weak acids and strong bases, and (c) polyprotic acids and strong bases
- Write mathematical expressions of solubility product constants
- Use K_{sp} constants in chemical calculations
- Recognize certain common, slightly soluble ionic compounds
- Describe fractional precipitation and how it can be used in the separation of ions
- Describe the occurrence in nature and use of the main-group elements
- Describe compounds of the main-group elements, their reactions, properties, and uses
- Describe the main sources of metals
- Describe techniques for pre-treatment of ores
- Describe reduction methods that lead to the production of free metals
- Describe some techniques for the purification of metals
- Identify d-transition metals and describe some of their important properties
- Describe typical oxidation states of transition metals
- Describe the specific metallurgies of three metals: titanium, iron, and copper
- Recognize coordination compounds
- Use the terminology describing coordination compounds
- Apply contemporary nomenclature for naming coordination compounds
- Recognize common structures of coordination compounds
- Describe different types of structural isomerism and distinguish between structural isomers
- Recognize stereoisomers
- Apply Valence Bond Theory and Crystal Field Theory in the description of bonding in coordination compounds
- Explain the origin of color in complex compounds
- Use the spectrochemical series to explain colors of a series of complexes
- Provide examples of applications of complexes in daily life

Competences:

Upon successful completion of the module, students are expected to:

- develop critical thinking and practice methodological and practical issues that may arise from their involvement of the modern education or research in chemistry
- are able to conduct research, analysis and synthesis of data and information, using the necessary technologies
- promote associations that lead to decision-making
- are able to conduct autonomous work involving chemistry
- are able to design experiments, construct experimental setups in chemical processes, perform chemistry experiments, interpret them, draw conclusions and use them in the implementation of their original goals (natural, artificial phenomena, etc.)

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 Module aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology

Adapting to new situations

Decision-making

Working independently

Team work

Working in an international environment

Working in an interdisciplinary environment

Production of new research ideas

Project planning and management

Respect for difference and multiculturalism

Respect for the natural environment

Showing social, professional and ethical responsibility and sensitivity to gender issues

Criticism and self-criticism

Production of free, creative and inductive thinking

The general skills that the students will acquire are:

- Search for, analysis and synthesis of data and information by the use of appropriate technologies

- Adaptation to new situations
- Decision-making
- Individual/Independent and autonomous work
- Respect for the natural environment
- Exercise of criticism and self-criticism
- Working in an interdisciplinary environment
- Development of free, creative, and inductive thinking

3. SYLLABUS

Purpose of Module

The main goal of this module is for the students to become familiar with the fundamental principles of Chemistry, the close relationship of Chemistry with related scientific fields (Biology, Physics, etc.) as well as the central role of Chemistry in the evolving technological revolution.

Subjects covered

The subjects of the module include the following:

1. Atomic Structure - Periodic System - Properties of Atoms
2. Chemistry of coordination and organometallic compounds
7. Modern trends and applications of inorganic chemistry

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	• Distance teaching and learning with six (6) Group Counseling Meetings (GCMs) of 2.5 hour duration each, during the academic semester on weekends. • Distance learning with six (6) Supportive Group Counseling Meetings (SGCMs) of 2.5-hour duration each, during the academic semester on weekends. • Personal communication and feedback (advisory role of Adjunct Faculty members).				
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	During GCMs, SGCMs, and teaching the following are used: • Remote meetings tools (Webex, Teams, Zoom), • Presentation software (PowerPoint, educational videos–animations, etc.), • Specialized software (Chemical Drawing Software όπως ACD/ChemSketch, MedChem Designer, MarvinSketch - Create and Design, etc.), databases for the subjects under study (NCBI PubMed, Elsevier, etc.). In addition, students use office automation tools, text-editors, web browsers and e-reader for digital books. <u>Communication with the students is supported by:</u> • The digital platform of HOU (https://study.eap.gr/login/index.php) (course information, educational material posts, announcements, messages, examination results, user groups, discussion fora, etc.). • E-mail • Meetings through Zoom • Telephone consultations				
TEACHING METHODS	<table border="1"> <thead> <tr> <th data-bbox="694 2040 1129 2078">Activity</th> <th data-bbox="1129 2040 1355 2078">Year Workload</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> </tr> </tbody> </table>	Activity	Year Workload		
Activity	Year Workload				

<i>The manner and methods of teaching are described in detail.</i> <i>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.</i> <i>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</i>	6 (GCMs) (x 2.5 hours each)	15
	6 (SGCMs) (x 2.5 hours each)	15
	6 Written Reports (x 20 hours each)	120
	Personal Study (12-13 hours x 32 weeks)	400
	Exams (5 x 2 = 10 hours)	10
	Total Workload	560
STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>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</i> <i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i>	Students' evaluation – Grade assessment of a Module: • Preparation of six (6) written assignments during the academic year. The average of the grades contributes to the formulation of the final grade of the module by 30%, if that grade allows further participation in the final or retake exams (vide infra). • As a prerequisite to participation in the final exam, the cumulative grade of all six written assignments should be 30 (6x5=30). • The score of the written assignments (GE) is activated only with an average score equal to or above the base (≥ 5) in the final or retake exams. • Final written exams, the grade of which contributes to the formulation of the final grade of the module by 70% (35% for the examination of Part 1 and 35% for the examination of Part 2). • All evaluation criteria are posted on the course website https://www.eap.gr/el/programmata-spoudwn/177-spoudes-stis-fysikes-epistimes/diarthrws/403-4fc8fd8087500c236e505bdcc5e793bf Language of evaluation: Greek	

5. ATTACHED BIBLIOGRAPHY

• Suggested Bibliography Publications of the Hellenic Open University: Volume A: Atomic Structure, Periodic Table, Properties of Atoms, Hellenic Open University, Patras 2008. Volume B: Chemical Bonding, Hellenic Open University, Patras 2008. Volume C: Chemistry of Aqueous Solutions, Hellenic Open University, Patras 2008. Volume D: Representative Elements and their Compounds, Hellenic Open University, Patras, 2008 Volume E: Transition Elements and Inclusion Compounds, Hellenic Open University, Patras 2008. • Parallel Texts (Uncertainty in Measurements - Dimensional Analysis - Oxidation - Reduction Standard Reduction Dynamics) (N. Klouras) Additional supplementary digital material (and multimedia) is available within the study platform (study).

- **Related Scientific Journals**

1. Inorganic Chemistry (American Chemical Society)
2. Inorganic Chemistry Frontiers (Royal Society of Chemistry)
3. Dalton Transactions (Royal Society of Chemistry)
4. Journal of Chemical Education (American Chemical Society)