Course outlines for academic year 2023-2024

Undergraduate Study Program

Department of Chemistry

School of Sciences and Engineering

University of Crete

CONTENTS

COURSE OUTLINE

CHEM-011 MATHEMATICS I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-011	**SEMESTER**	1
COURSE TITLE	MATHEMATICS I		
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	4	6
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*	General background		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course is an introduction to Calculus in one and several variables. After successfully completing the course, students:

• will be familiar with limiting processes in Mathematics.

• will know basic computational techniques.

• will be able to model simple problems in Physics and Chemistry.

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	*…….*

- Working independently
- Independent, creative and inductive reasoning ability

(3) SYLLABUS

1. Functions and graphs
   (Linear, exponential, trigonometric, parametric)

2. Logarithms
   Exponential functions
   Hyperbolic functions

3. Derivatives:
   Rate of change
   Product and quotient rules
   Chain rule
   Implicit functions
   L'Hopital's rule
   Applications in Physics and Chemistry

4. Integration:
   Indefinite integrals
   Integration techniques
   Riemann sums
   Numerical integration
   Applications in Physics and Chemistry

5. Integration techniques (cont'd)
   Integration by parts
   Partial fractions
   Trigonometric substitutions
   Monte Carlo

6. Power series
   Taylor and Maclaurin series
   Fourier series

7. Vector Analysis
   Inner and cross products
   Lines and planes
   Cylinders and curves
   Polar and spherical coordinates
   Functions of several variables
   Multiple integrals

8. Vector functions
   Vector fields
   Line integrals
   Surface integrals
   Surface area

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Electronic mail
• Departmental website-Study guide
• Classweb</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</td><td>52</td></tr>
<tr><td>Study</td><td>95</td></tr>
<tr><td>Literature project-presentation, Final examination</td><td>3</td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<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>Final three-hour written exam.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

- Thomas, Calculus, Finney-Weir-Giordano
- Class notes

COURSE OUTLINE
CHEM-013 PHYSICS-I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-013	**SEMESTER**	1
COURSE TITLE	PHYSICS-I		
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	4	6
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*	General background Specialised general knowledge		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO but Could		
COURSE WEBSITE (URL)	MS-TEAMS is the main platform for this course. https://www.youtube.com/playlist?list=PL3Ao7O5tGHUEub2oj9uczW2GjadKqp6E-		

(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*

Fundamental concepts of physics and how they apply to chemistry

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	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Production of free, creative and inductive thinking

(3) SYLLABUS

Week 1,2,3

Units and Error analysis, Lab Reports, Motion of bodies, Newton's Laws, Rotational motion

Week 4, 5, 6

Projectiles and Energy, Kinetic Energy, Dynamic Energy

Week 7, 8, 9

Rotational Motion, Conservation of momentum and angular momentum, oscillations, Coulomb's Law, Electric Field,

Week 10, 11, 12

Gauss's, Electricity and Potential, Practical Applications of Electromagnetism, Capacitors, Current and Voltage, Coils, Electrical Connections, Grounding, Multimeters, Simple Circuits,

Week 13

Magnetic Force, Magnetic Field, Faraday's Law

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Hybrid lecture, in person with live streaming via MS-TEAMS and YouTube.
All lectures are recorded and available online.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• The main platform of this course is MS-TEAMS. All material, questions, announcements assignments etc are performed via this platform.
• E-mail
• YouTube live streaming</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</td><td>40</td></tr><tr><td>At Home Labs</td><td>25</td></tr><tr><td>Lab Reports</td><td>25</td></tr><tr><td>Course Material Study</td><td>60</td></tr><tr><td>Course total</td><td>150</td></tr></table></td></tr>
<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,</td><td>Greek language
Students are assigned do it at Home Lab exercises and they subsequently hand in lab reports.
There are in addition test and midterms.
The exam format and the evaluation procedures and criteria are presented in the introductory lecture (and reminded</td></tr>
</table>

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.*	often during the semester). Sample exam questions are handed out and dealt with in class.

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

(1) D. C. Giancoli, 'Φυσική' 7η έκδοση (Επιστημονικές Εκδόσεις Τζιόλα, Αθήνα, 2018)
(2) D. Halliday, R. Resnick, J. Walker 'Φυσική (Μηχανική, Κυματική, Θερμοδυναμική, Ηλεκτρομαγνητισμός, Οπτική)' (Εκδόσεις Γ. ΔΑΡΔΑΝΟΣ - Κ. ΔΑΡΔΑΝΟΣ Ο.Ε., Αθήνα 2014)
(3) R.A. Serway, J.W. Jewett, 'Φυσική για επιστήμονες και μηχανικούς. Μηχανική, Ταλαντώσεις και Μηχανικά Κύματα, Θερμοδυναμική, Σχετικότητα' (Εκδόσεις Κλειδάριθμος, Αθήνα 2012)
(4) R.A. Serway, J.W. Jewett, 'Φυσική για επιστήμονες και μηχανικούς. Ηλεκτρισμός και Μαγνητισμός, Φως και Οπτική, Σύγχρονη Φυσική' (Εκδόσεις Κλειδάριθμος, Αθήνα 2013)

COURSE OUTLINE

CHEM-018 BASIC PRINCIPLES AND APPLICATION IN COMPUTING

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-018	**SEMESTER**	1
COURSE TITLE	BASIC PRINCIPLES AND APPLICATION IN COMPUTING		
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**
Laboratory		2	3
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*	General background Skills development		
PREREQUISITE COURSES:	none		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER148/		

(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*

The course is aimed at first-year students. Its purpose is to familiarize students with the use of computers for surfing the Internet and searching for information, using e-mail and other internet applications as well as familiarizing with the basic applications of an office suite.

Students, after successfully completing the course will be in a position to:

- Maintain the basic principles of the structure of a computing system at Hardware and Software level
- Navigate safely on the internet and know how to use the basic applications (www, ftp, mail)
- Conduct targeted searches on the Internet.
- Use to a satisfactory level a word processor, a spreadsheet and a presentation program.
- Know the computational infrastructure of the Department and how to use it
- Have the bases for attending additional computer based semester courses.

Principles of Green Chemistry and its main applications in organic synthesis.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- promoting of free, creative and inductive thinking

(3) SYLLABUS

1. Introduction to Electronic Computers
1.1 Brief Introduction to Computers
1.2 Computer Structure (Hardware and Software)
1.3 Central processing unit (basic structure and operation)
1.4 Regional devices
1.5 Software, software classes and operating systems
1.6 The concept of programming and the main stages of the creation of a program
2. Internet and its applications
2.1 Networks and categories of networks (basic concepts)
2.2 Basic web applications (mail, ftp, www, etc) the concept of the client-server model.
2.3 Search engines and web searches
3. Office applications
3.1 Word processing
3.1.1 Create and edit a document
3.1.2 Page setup (headers and footers)
3.1.3 Character and paragraph formatting
3.1.4 Introduction of mathematical functions
3.1.5 Managing tables
3.1.6 Importing and managing images
3.1.7 Create charts
3.1.8 Footnotes, hyperlinks, bookmarks and cross references
3.2 Accounting Sheet
3.2.1 Creating a spreadsheet
3.2.2 Cells (cell types and configuration)
3.2.3 Functions and examples of using key functions
3.2.4 Creating graphs
3.3 Presentation program
3.3.1 Creating transparency
3.3.2 Inserting and editing elements in a slide (text, image, audio and video)
3.3.3 Transition and animation of elements on a slide

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Lessons web page • Laboratory ftp server • Use of dropbox & google drive
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.*	

Activity	***Hours***
Three Lectures for the first three weeks (two hours each)	9
Use of Laboratory for the rest of the ten weeks. Students are divided in groups of twenty. The number of groups is five. Each	100

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	group spents two hours a week in the laboratory exercising.	
	Final examination	10
	Course total	119

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.*	Language Greek The final grade of the course is derived from: • 100% of a final examination Final examination is done in groups using a computer in the computer room. Students are examined throughout the subject and the exam includes: ✓ Multi-choice tests to cover the theoretical part ✓ Exercise in word processing ✓ Exercise in use of spreadsheet.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Lecture notes and PowerPoint presentations posted on the course website

COURSE OUTLINE
CHEM-043 GENERAL CHEMISTRY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-043	**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		4	6
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*	General background		
PREREQUISITE COURSES:	Basic knowledge of Organic, Inorganic and Physical Chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The main goals of the course are:

a) Understanding the main principles of Inorganic, Organic and Physical Chemistry, upon the use of modern and updated scientific concepts regarding the structure of the atom and the formation of a chemical bond,

b) Employing the periodicity of the chemical properties of the elements as a means of understanding the chemical properties of molecules,

c) Using the quantum structure of an atom for interpreting the geometry of atoms and small molecules by means of atomic and molecular orbitals,

d) a first contact with coordination chemistry.

Upon successful completion of the course, the students:

- will be able to use the basic chemical tool-box for understanding the formation of the chemical bonds and understand/predict the atomic/molecular geometries.
- will be familiar with all types of intermolecular interactions, and thus will be able i) to understand physical properties, and 11) to move from molecular scale to bulk materials.
- will comprehend the basic principles of Organic and Inorganic Chemistry, as well as aspects of Physical Chemistry.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Production of free, creative and inductive thinking
- Criticism and self-criticism

(3) SYLLABUS

1. Chemistry and Measurements
   Introduction to Chemistry, Experimental measurements.
2. Atoms, Molecules and Ions
   Atomic theory and atomic structure, Chemical compounds: Types and nomenclature, Chemical reactions/equations
3. Gaseous phase
   Gas laws, Kinetic-Molecular theory.
4. Atomic Quantum theory
   Light waves, photons, Bohr theory, Quantum mechanics and quantum numbers.
5. Electronic Structures and Periodicity
   Atomic electronic structure, Periodicity of the elements.
6. Ionic and Covalent Bond
   Ionic and covalent bonds.
7. Molecular geometry and Chemical Bond Theory
   Molecular geometry, Molecular Orbitals' theory.
8. States of Mater: Liquids and Solids
   Changes of mater: liquids and solids
9. Transition metals and coordination compounds
   Properties of the transition metals, Complex ions and coordination compounds.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb
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	***Hours***
Lectures	52
Study	70
Final examination	28
Course total	150

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.*	Greek language The final grade of the course comes from: • Final written examination, lasting 3 hours, (100% of the final grade)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- ΧΗΜΕΙΑ, ΔΟΜΗ ΚΑΙ ΙΔΙΟΤΗΤΕΣ (ΚΩΔΙΚΟΣ ΕΥΔΟΞΟΥ: 102070023) - Συγγραφείς: Tro Nivaldo J.
- ΓΕΝΙΚΗ ΧΗΜΕΙΑ (ΚΩΔΙΚΟΣ ΕΥΔΟΞΟΥ: 5697) - Συγγραφείς: Darell Ebbing, Steven Gammon

COURSE OUTLINE
CHEM-044 QUALITATIVE AND QUANTITATIVE ANALYSIS

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-044	**SEMESTER**	1
COURSE TITLE	QUALITATIVE AND QUANTITATIVE ANALYSIS		

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	38	
Laboratories	14	
Other	6	
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*	General background
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	
COURSE WEBSITE (URL)	https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER139/

(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*

Upon successful completion of the course, students will:

• Have been introduced to fundamental concepts of Chemistry and gained an in-depth understanding of the principles and laws governing matter and chemical processes.

• Have developed problem-solving skills related to chemistry, both at a computational and conceptual level.

• Possess basic knowledge of chemistry in fields that will be further developed in subsequent courses and laboratory sessions (Analytical/Inorganic/Organic Chemistry and Physical Chemistry).

• Be prepared and strengthened in terms of theoretical knowledge for a better understanding of the General Chemistry Laboratories conducted concurrently in the first semester.

• Have been introduced to the fundamental concepts of analytical chemistry, which is one of the key pillars of applied chemistry.

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…*
	…….

- Searching, analyzing, and synthesizing data and information, using the necessary technologies
- Adaptation to new situations, decision-making, working independently, teamwork, working in an international environment, working in an interdisciplinary environment
- Generating new research ideas, Project design and management, Respect for diversity and multiculturalism, Respect for the natural environment
- Demonstrating social, professional, and ethical responsibility and sensitivity to gender issues
- Exercising critical thinking and self-criticism
- Promoting free, creative, and inductive thinking

(3) SYLLABUS

Chemical Reactions

• Ions in aqueous solution

• Types of chemical reactions

Solution Handling
• Molar concentration
• Dilution of solutions
Quantitative Analysis
• Gravimetric analysis
• Volumetric analysis
Solutions
• Solution formation
• Colligative properties
• Colloid formation
Reaction Rates
Chemical Equilibrium
• Description of chemical equilibrium
• Use of the equilibrium constant
• Changes in reaction conditions
• Le Chatelier's principle
• Logarithmic pH - logC diagrams
Acid-Base Theories
• Acid-base theories
• Strength of acids and bases
• Self-ionization of water, pH
• Equilibria of weak acids and bases
• Solutions of weak acids or bases
• Ionization equilibria of acids
• Polyprotic acids
• Ionization equilibria of bases
• Acid-base properties of salt solutions
• Solutions of weak acids or bases in the presence of other dissolved substances
• Common ion effect
• Buffer solutions
• Acid-base titration curves
Solubility and Complex Ion Equilibria
• Solubility equilibria
• Complex ion equilibria
• Applications of solubility equilibria
Thermodynamics and Equilibrium
• Enthalpy
• Spontaneous processes and entropy
• Concept of free energy
• Free energy and equilibrium constants

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Bibliographic Searches: Scopus, Web of Science, Google Scholar • Assignments are submitted via e-Class • Lecture notes and slides are provided through e-Class • All course announcements are posted on e-Class

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	*Hours*
Lectures	38
tutorial	14
Study and course works	92
progress	3
Final examination	3
Course total	150

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.

Greek language

Grading Options

Option 1

- Midterm Exam: 50%
- Assignments: 20% (bonus)
- Final Exam: 50%

Option 2

- Assignments: 20% (bonus)
- Final Exam: 100%

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Analytical Chemistry 2.1 by David Harvey (2016) (Ελληνική Μετάφραση e-book)
- ΧΗΜΕΙΑ3 (Συγγραφέας Burrows et al.)
- Συναφή επιστημονικά περιοδικά: Journal of Chemical Education

COURSE OUTLINE

CHEM-052 ENGLISH FOR CHEMISTRY FOUNDATION I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-052	**SEMESTER**	1
COURSE TITLE	ENGLISH FOR CHEMISTRY FOUNDATION I		

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	
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*	It is compulsory course that provides a general background on General Chemistry vocabulary in English and academic skills development.
PREREQUISITE COURSES:	Basic knowledge of English (Level B1)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://chemistryenglish.files.wordpress.com/2018/07/efc-programme-2018-2019.pdf and http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/

(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*

The course introduces the student to the field of Academic English and in particular it enhances student understanding and production of academic texts in the field of Chemistry.

Through the course the students will acquire the basic knowledge for the writing conventions for abstracts, summaries, paraphrasing, graphs and charts. They will also practice lectures in English in Chemistry and oral presentation of Chemistry subjects. It includes the presentation of specific texts and techniques that have been established in the field of Academic and Technical Writing.

The course offers extensive analysis of written and spoken language genres in General Chemistry.

Students, after successfully completing the course:

- will acquire the basic principles for writing a laboratory reference in English
- will be familiar with key chemical terms
- will have be aware of key principles of writing and oral presentation of chemistry-related topics.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas
- Critical Thinking

(3) SYLLABUS

English for Chemistry 1 Foundation

1. Properties and States of Matter
   Reading skills, Collocations, Note-taking styles. Paragraph structure; topic sentences
2. Chemical Elements, Periodic Table trends & Structure of Atom
   Cohesion and Coherence, Formality and register
3. Reactions, interactions and cycles: Academic presentations: signposting language, Formality; nominalisations
4. Chemical Bonding, reactions and intermolecular forces
   Paraphrasing skills. Identifying moves in a lecture
5. (EFB) Cell Biology and Cell Division Academic presentation skills; making analogies
   Summarising skills
6. (EFB) DNA Replication; Transcription and Translation
   Avoiding wordiness. Subject-verb agreement
7. (EFB) Genetics, principles of heredity & mutations Avoiding negative statements. Prepositional phrases
8. (EFB) Ecology, evolutionary change & bioethics Paraphrasing strategies. Using evaluative language. Writing an argumentative essay
9. Scholarly paper structure and presentation guidelines

10-12 Student Presentations

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom) and Flipped
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Edmodo and • Course site
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	***Hours***
Lectures	30
Study	20
Literature project-presentation	12
Final examination	8
Course total	70

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.*	English language During the last period of the teaching activity a personalised obligatory literature project is given to each student, in order to prepare an oral presentation and submit a short summary. The specific subject related to the content of the course comes from the scientific literature, usually peer-reviewed international journals. The final grade of the course comes from: • Oral presentation and personalized project (50% of the final grade) • Final written examination, lasting 3 hours, (50% of the final grade)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Katsampoxaki-Hodgetts K. (2018) English for Chemistry EAP Disigma Publications; Thessaloniki
- Katsampoxaki-Hodgetts K. (2019) Academic English for Biology. Disigma Publications, Thessaloniki
- Robinson and Stroller (2008) Write like a Chemist. Oxford University Press

COURSE OUTLINE
CHEM-111 GENERAL CHEMISTRY LABORATORY I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-111	**SEMESTER**	1
COURSE TITLE	GENERAL CHEMISTRY LABORATORY I		
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	4	6
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*	General background Skills development		
PREREQUISITE COURSES:	NO		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The General Chemistry Laboratory I introduces primary year students in experimental chemistry through a series of experiments, in order to consolidate and understand basic chemical concepts. Throughout the course, students:

- gain experience in handling chemical reagents, keeping lab book and writing reports
- learn main laboratory techniques,
- become familiar with the use of basic laboratory equipment
- learn how to work with responsibility and safety into a chemistry lab.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work

(3) SYLLABUS

(1) Solutions - filtrations
(2) Chemical equilibrium
(3) Electrolytes: pH, Indicators
(4) Salt hydrolysis
(5) Buffer solutions
(6) Volumetric methods of analysis (acid-base titration)
(7) Volumetric methods of analysis (complexometric titration)
(8) Oxidation–reduction
(9) UV-VIS Spectrophotometry

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face (laboratory)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Electronic mail
• Departmental website-Study guide
• Classweb
• E class</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></td><td></td></tr>
<tr><td>Laboratory practice</td><td>52</td></tr>
<tr><td>Report writing</td><td>28</td></tr>
<tr><td>Study</td><td>70</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<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>Greek language

The overall grade will be computed (calculated) from 2 factors:

• the laboratory grade -based on oral examinations, written tests, experiment reports and laboratory attitude during the semester (60% of the final grade) and
• Final written examination (40% of the final grade).</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

COURSE OUTLINE
CHEM-012 MATHEMATICS II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-012	**SEMESTER**	2
COURSE TITLE	MATHEMATICS II		
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	4	6
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*	General background		
PREREQUISITE COURSES:	Mathematics I		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The first half of the course is an introduction to the concepts of Linear Algebra, including vectors, matrices and their algebra. The second half of the course is an introduction to differential equations, including linear ordinary differential equations of the 1st and 2nd order. The aim of the course is that the student learns mathematical techniques which ate useful for the solution of problems in Chemistry and the Natural Sciences.

The students will be able to:

- Work with vectors and matrices.
- Recognise the use of matrices in problems of Chemistry as, for example, in simple space transformations.
- Solve linear differential equations that give, for example, the rate of chemical reactions.
- Construct simple differential equations which describe processes in Chemistry.
- Recognise and study solutions of partial differential equations.

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	*…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. Linear Algebra

1.1 Vectors. Vector functions, parametric representation of curve.
1.2 Scalar product. Vector product.
1.3 Vector spaces and subspaces. Linear dependence. Basis and dimension.
1.4 Determinants and properties.
1.5 Matrices. Product of matrices. Inverse and transpose of a matrix.
1.6 Diagonalisation of matrices.
1.7 Complex matrices.
1.8 Similarity transformations.
1.9 Eigenvalues and eigenvectors.
1.10 Applications in physics and chemistry.

2. Differential Equations.

2.1 Differential equations of the 1st order. The initial value problem.
2.2 Separable equations. Homogeneous equations.
2.3 The general differential equation of the 1st order. Method of the integrating factor.
2.4 Differential equations of the 2nd order.
2.5 Linear differential equations with constant coefficient (homogeneous, non-homogeneous, Laplace method).
2.6 Applications in Chemistry.
2.7 Partial Differential equations.
2.8 Application in Physics and Chemistry. Harmonic oscillator (Hermite equation). Motion in a ring. Motion on sphere (Legendre equation). The Coulomb potential.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Hybrid lecture, in person with live streaming via MS-TEAMS and YouTube. All lectures are recorded and available online.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• The main platform of this course is MS-TEAMS. All material, questions, announcements assignments etc are performed via this platform. • E-mail • YouTube live streaming
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*	

Activity	***Semester workload***
Lectures	40
At Home Labs	25
Lab Reports	25
Course Material Study	60
Course total	150

according to the principles of the ECTS	
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.*	Greek language. Students are assigned do it at Home Lab exercises and they subsequently hand in lab reports. There are in addition test and midterms. The exam format and the evaluation procedures and criteria are presented in the introductory lecture (and reminded often during the semester). Sample exam questions are handed out and dealt with in class.

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

D. C . Giancoli, PHYSICS FOR SCIENTISTS AND ENGINEERS, Vol. A (Tziolas editions, Athens, 2013)
D. C . Giancoli, PHYSICS FOR SCIENTISTS AND ENGINEERS, Vol. B (Tziolas editions, Athens, 2014)

COURSE OUTLINE
CHEM-017 PHYSICS-II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-017	**SEMESTER**	2
COURSE TITLE	PHYSICS-II		
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	4	6
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*	General background Specialised general knowledge		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO but could		
COURSE WEBSITE (URL)	MS-TEAMS is the main platform for this course. https://www.youtube.com/playlist?list=PL3Ao7O5tGHUEeJGbcjcUKhWif0q6rEJYE		

(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*

Fundamental concepts of physics and how they apply to chemistry

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	*…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Production of free, creative and inductive thinking

(3) SYLLABUS

Week 1 and 3

Error Analysis, Lab reports, Geometric Optics, Mirrors and Lenses, Optical Devices, Light Sources, Polarized Light, Physical Optics, Interference Phenomena, Diffraction, Refraction

Weeks 4 and 5

Discrete and Continuous Values, Probability Definition, Average <A>, Variance and Errors <ΔA> = <A2> - <A> 2, Probabilistic Density (distributions), Microcanonical ensemble, Canonical ensemble

Week 6 and 7

Photoelectric effect, Body Black Radiation, Heat Capacity of Solids, De Broglie wavelength, Born Wave Function, Schroedinger Equation

Weeks 8 and 10

Linear motion of Particles, Particle on a ring , Particle on a Sphere, the Hydrogen atom, atomic orbotals

Week 11 and 12

Quantum Mechanics Axioms, Operators, the uncertainty principle

Week 13

Spectroscopic term symbols, Selection rules, atomic spectra

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Hybrid lecture, in person with live streaming via MS-TEAMS and YouTube.
All lectures are recorded and available online.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• The main platform of this course is MS-TEAMS. All material, questions, announcements assignments etc are performed via this platform.
• E-mail
• YouTube live streaming</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</td><td>40</td></tr><tr><td>At Home Labs</td><td>25</td></tr><tr><td>Lab Reports</td><td>25</td></tr><tr><td>Course Material Study</td><td>60</td></tr><tr><td>Course total</td><td>150</td></tr></table></td></tr>
<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,</td><td>Greek language.

Students are assigned do it at Home Lab exercises and they subsequently hand in lab reports.

There are in addition test and midterms.

The exam format and the evaluation procedures and criteria are presented in the introductory lecture (and reminded often during the semester). Sample exam questions are handed out and dealt with in class.</td></tr>
</table>

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.*	

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

D. C . Giancoli, PHYSICS FOR SCIENTISTS AND ENGINEERS, Vol. A (Tziolas editions, Athens, 2013)
D. C . Giancoli, PHYSICS FOR SCIENTISTS AND ENGINEERS, Vol. B (Tziolas editions, Athens, 2014)

COURSE OUTLINE
CHEM-019 COMPUTERS IN CHEMISTRY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-019	**SEMESTER**	2
COURSE TITLE	COMPUTERS IN 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**
Laboratory		2	3
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*	General background Skills development		
PREREQUISITE COURSES:	none		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER108/		

(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*

The course is aimed at first-year students. Its purpose is to educate and familiarize students with specific packages that are deemed necessary for use during their studies in the chemistry department. These packages refer to specialized programs for laboratory data analysis and modeling (originlab), and molecular stracture design(chemdraw). At the same time, an effort is made to understand basic statistical principles to support data analysis and study of the results. For the last few weeks, students will be introduced to the basic programming principles using the Fortran programming language.

Students, after successfully completing the course will be able to

• Understand the basic principles of statistics (populations, samples, measures of central tendency, dispersion measures and distributions)

• Create and evaluate a linear model from a laboratory sample

• Create, improve and evaluate a non-linear model from a laboratory sample, but also understand the results of analysis conducted with the use of either excel or originlab.

• Draw relatively complex molecule structures using chemdraw.

• Create simple programs in fortran that will contain all the basic programming structures (repetition and contitional execution)

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- promoting of free, creative and inductive thinking

(3) SYLLABUS

1. Basic principles of statistics

1.1 Populations and samples

1.2 Measures of central tendency (mean, media, mode)

1.3 Measures of dispersion (Standard deviation), distributions and normal distribution

2. Linear and nonlinear models

2.1 Linear and non-linear regression (basic concepts). Independent and dependent variables, R2 and Residuals.

2.2 Use of software to create linear and nonlinear models. Analysis of the results.

2.3 Use originlab package to create linear and nonlinear models and analyze results. Examine other capabilities of the originlab package. Create and edit graphics with originlab. Embedding and using a new function in the originlab. Export graphs to word. Understanding errors

3. Basic programming principles

3.1 Basic programming concepts

3.2 Algorithms and Basic Structures (Repetition and conditional execution)

3.3 The fortran programming language. Creating programs in fortran. Compilation and execution.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Lessons web page • Laboratory ftp server • Use of dropbox & google drive
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	***Hours***
Three Lectures for the first three weeks (two hours each)	9
Use of Laboratory for the rest of the ten weeks. Students are divided in groups of twenty. The number of groups is five. Each group spents two hours	100

	a week in the laboratory exercising.	
	Final examination	10
	Course total	119

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.*	Language Greek The final grade of the course is derived from: • 100% ftom a final examination Final examination is done in groups using a computer in the computer room. Students are examined throughout the subject and the examination includes: ✓ Exercise in word processing ✓ Exercise in use of spreadsheet. ✓ Writing a simple fortran program

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Lecture notes and power point presentations posted on the course website

COURSE OUTLINE
CHEM-046 INTRODUCTION TO BIOLOGY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-046	**SEMESTER**	2nd
COURSE TITLE	INTRODUCTION TO BIOLOGY		
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	4	6
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*	General background Obligatory course		
PREREQUISITE COURSES:	N/A		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

This course aims to introduce the students to general principles of Molecular and Cell Biology, Biochemistry and Genetics. It also aims to inform students of recent advances in contemporary aspects of Biology such as Cancer and Biotechnology, familiarize them with the evolution of life and species on earth, and help them identify and address scientific and research questions from a different scientific subject than Chemistry.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Working in an interdisciplinary environment
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

(1) Introduction to cells
(2) Chemical composition of cells
(3) Energy, catalysis and biosynthesis
(4) DNA and chromosomes
(5) Transcription, DNA repair and DNA recombination
(6) From DNA to proteins

(7) Regulation of gene expression
(8) Cell membranes
(9) Membrane transport
(10) Cell communication
(11) Cell division
(12) Cell tissues and Cancer
(13) Genes evolution
(14) Genetic and molecular basis of inheritance
(15) DNA technology and proteomics

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Power point presentations
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	52
Study	98
Literature project-presentation, Final examination	
Course total	150

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*	Greek language The final grade of the course comes from the final written examination, lasting 3 hours, (100% of the final grade)

work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Basic Principles of Cell Biology (in Greek), 4th edition. Alberts B., Bray D., Hopkin K., Johnson A., Lewis J., Raff M., Roberts K., Walter P. 2018
- Lectures notes.

COURSE OUTLINE
CHEM-053 ENGLISH FOR CHEMISTRY FOUNDATION 2

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-053	**SEMESTER**	2
COURSE TITLE	ENGLISH FOR CHEMISTRY FOUNDATION 2		
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	0
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*	It is compulsory course that provides a general background on General Chemistry vocabulary in English and academic skills development.		
PREREQUISITE COURSES:	Basic knowledge of English (Level B1)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://chemistryenglish.wordpress.com/english-2/ and http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course introduces the student to the field of Academic English and in particular it enhances student understanding and production of academic texts in the field of Chemistry.

Through the course the students will acquire the basic knowledge for the writing conventions for abstracts, summaries, paraphrasing, graphs and charts and aboratory reports. They will also practice lectures in English in Chemistry and oral presentation of analytical data at international Chemistry conferences. It includes the presentation of specific texts and techniques that have been established in the field of Academic and Technical Writing.

The course offers extensive analysis of written and spoken language genres in Chemistry, as well as a large number of vocabulary used in the General, Environmental, Analytical, Organic and Biochemistry disciplines.

Students, after successfully completing the course:

- will acquire the basic principles for writing a laboratory reference in English
- will be familiar with key chemical terms
- will have be aware of key principles of writing and oral presentation of chemistry-related topics.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently

- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas
- Critical Thinking

(3) SYLLABUS

English for Chemistry 2 Foundation

1. Introduction to Organic Chemistry principles and key biomolecules
2. Enzymes
3. Experimental language and laboratory reports
4. Laboratory safety issues and equipment
5. Separation techniques: TLC, Filtration etc.
6. Scientific Method and Genre analysis
7. From electricity to electrochemistry and electrolysis
8. Acids and Bases. Writing a report for graphs and charts
9. Water treatment methods. Argumentative Essay guidelines
10. Polymer properties and applications
11. Student presentations
12. Student presentations

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Edmodo and • Course site
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*	
STUDENT PERFORMANCE EVALUATION	English language

Activity	***Semester workload***
Lectures	30
Study	20
Literature project-presentation	12
Final examination	8
Course total	70

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.*	During the last period of the teaching activity a personalized obligatory literature project is given to each student, in order to prepare an oral presentation and submit a 1000-word documented argumentative essay The specific subject related to the content of the course comes from the scientific literature, usually peer-reviewed international journals. The final grade of the course comes from: • Oral presentation and personalized project (50% of the final grade) • Final written examination, lasting 3 hours, (50% of the final grade)

(5) ATTACHED BIBLIOGRAPHY

- -Suggested bibliography:

- Katsampoxaki-Hodgetts K. (2018) English for Chemistry EAP Disigma Publications; Thessaloniki
- Katsampoxaki-Hodgetts K. (2019) Academic English for Biology. Disigma Publications, Thessaloniki
- Robinson and Stroller (2008) Write like a Chemist. Oxford University Press

COURSE OUTLINE
CHEM-112 GENERAL CHEMISTRY LABORATORY II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-112	**SEMESTER**	2
COURSE TITLE	GENERAL CHEMISTRY LABORATORY II		
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		4	6
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*	General background Skills development		
PREREQUISITE COURSES:	General Chemistry Laboratory I		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The main objective of the course is to

- study the chemical behavior and reactions of the most common ions in qualitative analysis experiments
- become familiar with the main methods and techniques of quantitative analysis.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work

(3) SYLLABUS

I) Qualitative analysis

Qualitative analysis of cations by group (known- unknown sample)

Qualitative analysis common anions (known- unknown sample)

II) Quantitative analysis

Acid- Base titrations: Determination of acetylsalicylic acid (ASA) content in aspirin tablets

Redox titrations: Iodometry - Iodimetry

Gravimetric determination of nickel

Complexometric determination of metals

Photometric determination of manganese in steel

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (laboratory)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb • E class
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*	
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.*	Greek language The overall grade will be computed from 2 factors: • The laboratory grade -based on oral examinations, written tests, experiment reports and laboratory attitude during the semester- (60% of the final grade) and • The final written examination (40% of the final grade)

Activity	***Semester workload***
Laboratory practice	52
Study	70
Report writing	28
Course total	150

(5) ATTACHED BIBLIOGRAPHY

-Suggested bibliography:

COURSE OUTLINE
CHEM-201 ORGANIC CHEMISTRY I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-201	**SEMESTER**	2
COURSE TITLE	ORGANIC CHEMISTRY I		
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		4	6
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*	General background		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES (as a reading course)		
COURSE WEBSITE (URL)	https://www.chemistry.uoc.gr/eclass/		

(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*

Some of the most important learning tasks are given below:
1) Deep understanding of the basic principles of organic chemistry such as hybridization, the formation of chemical bonds, the energy diagram of a reaction, the transition state and intermediate of a chemical reaction, etc.
2) Good understanding of the stereochemistry of organic compounds and reactions.
3) Good understanding of the mechanism of a free radical chain reaction.
4) Detailed study of the electrophilic additions to a double, or a triple, carbon-carbon bond from mechanistic and stereochemical perspectives.
5) Study of the acidity of the terminal alkyne proton and its use in organic synthesis.
6) Deep understanding of the stability of the allylic radical and the allylic carbocation and familiarization with resonance structures and tautomerization.
7) Full mechanistic understanding of the nucleophilic substitution and elimination reactions.
8) The student should be able to extract useful information about the structure of an organic compound by reading the MS, UV and IR spectra.
9) Understanding of the difference between conjugated dienes and alkenes, as well as, detailed study of the characteristics and the usefulness of the Diels-Alder cycloaddition.
Students, after successfully completing the course will have acquired the basic knowledge that is necessary for the implementation of the courses Organic Chemistry II and III in the forthcoming semesters.

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…*
	…….

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

- Working independently
- Production of free, creative and inductive thinking
- Criticism and self-criticism
- Production of new research ideas

(3) SYLLABUS

1. Structure and bonds
2. Bonds and molecular properties
3. Nature of organic compounds: Alkanes and cycloalkanes
4. Stereochemistry of alkanes and cycloalkanes
5. Overview of organic reactions
6. Alkenes: Structure and reactivity
7. Alkenes: Reactions and synthesis
8. Alkynes
9. Stereochemistry
10. Alkyl halides
11. Reactions of alkyl halides: Nucleophilic substitutions and eliminations
12. Structural elucidation: Mass spectrometry and infrared spectroscopy
13. Conjugated dienes and ultraviolet spectroscopy

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	•Electronic mail •Departmental website-Study guide •Classweb
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	52
Study	70
Final examination	28
Course total	150

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.*	Greek language Two mid-term written exams (50% each, optional) or final written exams lasting 3 hours (100% of the final grade).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- John McMurry, Organic Chemistry, textbook translated in Greek.
- David Klein "Organic Chemistry I" 2nd edition, translated in Greek by Utopia press.

COURSE OUTLINE
CHEM-048 PHYSICAL CHEMISTRY-I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-048	**SEMESTER**	**3**
COURSE TITLE	PHYSICAL CHEMISTRY-I (MOLECULAR SPECTROSCOPY)		
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		4	6
Problem solving sessions		2	
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*	General background Specialised general knowledge		
PREREQUISITE COURSES:	Basic knowledge of the following 1st year courses: Principles of Chemistry (CHEM-043), Physics I and II (CHEM-013, -017), Mathematics I and II (CHEM-011, -012)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	e-class: http://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER123/ (lecture ppt slides, problem sets, worked problems)		

(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*

The course introduces students to the microscopic properties of matter presenting the basic concepts concerning the quantum mechanical description of atoms and molecules and their application in the study and understanding of the atomic and molecular structure via the use of spectroscopic methods.

In the context of the course, a systematic view is provided into the structure and energy of atoms and molecules on the basis of the relevant wavefunctions (atomic and molecular orbitals) and the corresponding quantum states. Different types of transitions between energy states which take place as a result of interaction of electromagnetic radiation (light) with matter are examined and the basic theoretical principles of electronic spectroscopy of many-electron atoms as well as rotational, vibrational and electronic spectroscopy of molecules are detailed. The basic concepts of molecular symmetry and group theory (symmetry point groups) are introduced as a tool enabling the description of molecular orbitals and normal modes of vibration on the basis of molecular symmetry.

The course requires certain background knowledge from 1st year courses: Principles of Chemistry, Physics I and II, Mathematics I and II. It is taught in parallel with the Laboratory of Physical Chemistry-I (XHM-311) which introduces students to optics and spectroscopy with a series of experiments aiming to show how light is used to study matter and its properties

After successfully attending the class the students are expected to:

- Have a basic working knowledge of the main application of quantum theory in determining the structure of atoms and molecules and their energy states.
- Get to know the basic principles governing interactions of light with matter and the main spectroscopic methods used in the study of atoms and molecules.
- Be in a position to apply their knowledge to understand basic concepts related to the structure of matter and light-matter interactions in order to follow subsequent courses in the syllabus.

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

Working independently *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. **Introduction on Spectroscopy**
   What is a spectrum. General description. Examples.
   Beer-Lambert law for absorption. Molecular extinction coefficient. Quantum mechanical interpretation. Einstein coefficients. Spectral lines and broadening (natural, Doppler).
2. **Review of basic concepts of Quantum Mechanics**
   Operators. Postulates of Quantum Mechanics.
   Solutions and applications of Schrödinger equation for simple problems (particle in infinite potential well, particle on a disk or a sphere). Energy and angular momentum quantization.
3. **Electronic structure of many-electron atoms. Atomic spectroscopy**
   Reviewing the H-atom. Energy levels. Wavefunctions (atomic orbitals)
   The helium atom and many-electron atoms. Electronic structure. Aufbau. Shielding.
   Qualitative description of the Hartree-Fock SCF method.
   Many-electron atom wavefunctions. The role of spin. Anti-symmetric wavefunctions. Slater determinants.
   Spin-orbit coupling. Spectroscopy terms and energy states. Atomic transitions. Selection rules.
   Photoelectron spectroscopy (inner shell atomic orbitals).
4. **Introduction to the molecular structure**
   Diatomic molecules. Born-Oppenheimer approximation.
5. **Rotational Spectroscopy**
   Rigid and non-rigid rotor. Energy levels. Spectroscopic transitions and selection rules.
   Study, understanding and simple simulations of rotational spectra.
6. **Vibrational spectroscopy**
   Review of the 1D-harmoinic oscillator problem. Energy states and wavefunctions.
   Vibrational spectroscopy. Selection rules. Transition dipole moment.
   Anharmonic oscillator. Morse potential. Vibrational spectra. Overtones and hot bands.
   Rotational structure of vibrational spectra. P, Q, R branches.
   Raman spectroscopy. Transitions and selection rules, Polarizability.
   Classical interpretation of IR and Raman spectroscopy. Rotational Raman spectroscopy

Polyatomic molecule vibrations

7. **Molecular Symmetry. Group theorty**

Molecular symmetry. Elements of symmetry and operations.
Group theory. Point groups. Geometric transformations. Character tables.
Symmetry and geometric description of molecular vibrations in polyatomic molecules.
Normal modes of vibrations. IR and Raman spectra of polyatomic molecules.

8. **Chemical bonds. Molecular Orbitals. Electronic structure of molecules**

Molecular orbitals. σ, π bonding. LCAO.
Electronic structure of homo- and hetero-nuclear diatomic molecules.
Energy states and spectral terms for diatomic molecules. The case of O_2. Triplet ground state.
Electronic structure of polyatomic molecules. Energy of molecular orbitals.
Symmetry of molecular orbitals. Symmetry adapted linear combinations of atomic orbitals (SALC's). Examples (H_2, O_2, H_2CO, H_2O, C_2H_4, C_6H_6)

9. **Electronic spectroscopy of molecules**

Selection rules. Vibronic transitions. Franck-Condon principles.
Spectral terms for polyatomic molecules based on the MO symmetry.
Energy states. Jablonski diagrams. Absorption, Fluorescence, Phosphorescence.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom) Remote teaching (MS Teams platform) if needed
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• E-class – course website (lecture ppt slides, problem sets, worked problems) • MS Teams – course website (lecture ppt slides, problem sets, worked problems) • E-mail
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*	
STUDENT PERFORMANCE EVALUATION	Greek language

Activity	***Semester workload***
Lectures	52
Problem solving sessions	20
Study	52
Mid-terms (2), Final exam	26
Course total	150

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.*	Two mid-term exams (M1, M2) during the semester. (Written exam, Multiple-choice questions) - Mid-term 1 (5th week, Sections 1-3) - Mid-term 2 (10th week, Sections 4-7) Final exam (F) (Written cumulative exam, Critical questions and calculations, Open book/notes exam) Overall grade G (0-10 scale) = 0,1*M1 + 0,1*M2+0.8*F F must be > 4 The exam format and the evaluation procedures and criteria are presented in the introductory lecture (and reminded often during the semester). Model exam questions are handed out two weeks before the mid-term or final exams.

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

1. P.W. Atkins, J. de Paula, J. Keeler 'Φυσικοχημεία' (Πανεπ. Εκδόσεις Κρήτης, Ηράκλειο 2020) [ΕΥΔΟΞΟΣ]
2. R. Chang, J. W. Thoman Jr, 'Φυσικοχημεία' (Broken Hill Publishers Ltd, Λευκωσία, Κύπρος, 2021 [ΕΥΔΟΞΟΣ]
3. J.N. Murrel, S.F.A. Kettle, J.N. Tedder, 'The Chemical Bond' (Crete University Press, Heraklion 1999) [ΕΥΔΟΞΟΣ]
4. S. Trahanas, 'Quantum Mechanics I' (Crete University Press, Heraklion 2005)
5. T. Engel, P. Reid, 'Physical Chemistry' (Pearson Education Inc. San Francisco 2010)
6. D.C. Harris, M.D. Bertolucci, 'Symmetry and Spectroscopy' (Dover, NY 1978)
7. J.M. Hollas, 'Modern Spectroscopy' (John-Wiley & Sons, NY 1996)
8. C. N. Banwell, E.M. McCash, 'Fundamentals of Molecular Spectroscopy' (McGraw Hill, 1999)
9. P. Dais, 'Spectroscopy' (Hellenic Open University, Patras 2001)
10. M. P. Sigalas, N. D. Charistos, L. D. Antonoglou, 'Molecular Symmetry and Group Theory, Theory and Applications' (ΣΕΑΒ 2016). https://www.openbook.gr/moriaki-symmetria-kai-thewria-omadwn/

- Lecture ppt slides

COURSE OUTLINE
CHEM-202 ORGANIC CHEMISTRY II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-202	**SEMESTER**	3
COURSE TITLE	ORGANIC CHEMISTRY II		
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		52	
Laboratories			
Other		52	
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*			
PREREQUISITE COURSES:	Basic knowledge of Organic Chemistry I		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes 1		
COURSE WEBSITE (URL)	https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER154/		

(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*

The course develops a good level knowledge of one dimensional NMR spectroscopy. A thorough analysis of different classes of organic compounds is conducted (see syllabus below); including, the physical properties, methods for their synthesis, chemical reactions of the compounds and their spectroscopic properties. Special emphasis is given to subjects like aromaticity, electrophilic and nucleophilic aromatic substitutions, the acidity of alcohols, phenols and carboxylic acids, hydrogen bonding, the protection of -OH groups, the nature of the oxirane ring and different ways to open it up, nucleophilic additions to aldehydes and ketones, acyl substitution reactions of carboxylic acid derivatives, polymerization, enol-keto tautomerisation, the reactivity of the a-position of a carbonyl, and, finally, condensation reactions of carbonyls.

After the successful completion of the course the students should:

• Know the physical properties, the preparation, the chemical reactions and the spectroscopic characteristics of all the classes of organic compounds included in the course.

• Be able to elucidate the structure of a relatively simple organic compound based on 1D-NMR data.

• Be familiar with aromaticity and the additional stability of aromatic rings.

• Know the mechanistic details of the electrophilic and nucleophilic aromatic substitutions and be able to propose a synthetic strategy towards an aromatic compound.

• Be familiar with the acidity of alcohols, phenols, carboxylic acids and the a-position of carbonyls and the consequences that arise from this characteristic.

• Understand the regio- and stereochemistry of the opening of oxirane rings based on the reaction conditions and the nature of the substrate.

• Developed extensive knowledge of the mechanism of nucleophilic additions to carbonyls, of nucleophilic substitutions of carboxylic acid derivatives, of a-substitutions of the carbonyl group and of carbonyl condensations. The student should be able to combine all this information and develop a strategy for the synthesis of simple organic compounds.

•Become familiar with the extraction of important information from spectroscopic data.

• Be familiar with the relative stability of carboxylic acid derivatives and their interconversions.

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* *Respect for difference and multiculturalism* *Respect for the natural environment*

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*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- 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
- Respect for the natural environment
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

(1) Structure elucidation: nuclear magnetic resonance spectroscopy
(2) Benzene and aromaticity
(3) Chemistry of benzene: electrophilic aromatic substitution
(4) Alcohols and phenols
(5) Ethers and epoxides, thiols and sulphides
(6) Aldehydes and ketones: nucleophilic addition reactions
(7) Carboxylic acids and nitriles
(8) Carboxylic acid derivatives: nucleophilic acyl substitution reactions
(9) a-Carbonyl substitution reactions
(10) Carbonyl condensation reactions

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb
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*	

Activity	***Semester workload***
Lectures	52

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*	Study	49
	Presentation in the class and final examination	49
	Course total	150
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.*	Greek language After teaching of the first 50% of the syllabus (including 50% teaching of the theory and 50% problem solving), the first written examination takes place. It contains questions and problems with different degrees of difficulty (e.g. multiple choice, short-answer, simple and advanced problems). At the end of the semester the second written examination takes place for the remaining 50% of the course. The exam has the same characteristics as the first one. The final course grade comes from: • 50% from the first written examination • 50% from the second written examination For the students who do not attend the first written examination or failed to pass it there is a final examination on the entire syllabus. The evaluation criteria are explained to the students from the first lesson and repeated during the semester.	

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

- John McMurry “Organic Chemisty” 9th edition, translated in Greek by Crete University Press under the scientific care of Prof. I. Smonou and Prof. M. Stratakis.
- David Klein "Organic Chemistry II" 2nd edition, translated in Greek by Utopia press, under the scientific care of Prof. G. Kokotos.
- Leroy G. Wade and Jan William Simek "Organic Chemistry" 9th edition, translated in Greek by Tziola press, under the scientific care of Prof. D. Komiotis.
- Francis A. Carey, Robert M. Giuliano, Neil T. Alison, Susan L. Bane "Organic Chemistry" translated in Greek by Kritiki press, under the scientific supervision of Prof. A. Troganis, Prof. G. Rassias and Prof. A. Tsotinis.

COURSE OUTLINE
CHEM-211 ORGANIC CHEMISTRY LABORATORY I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-211	**SEMESTER**	3
COURSE TITLE	ORGANIC CHEMISTRY LABORATORY I		
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			
Laboratories			
Other		52	
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*			
PREREQUISITE COURSES:	Basic Principles of chemistry, Quantitative and Qualitative Analysis, Organic Chemistry I, General Chemistry Laboratories I&II		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)			

(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*

Students are trained in basic laboratory techniques that are necessary in an organic chemistry laboratory, such as measuring melting point, boiling point, distillation, extraction, solubility study, recrystallization. Chromatographic techniques that are common used in an organic chemistry laboratory, such as column and thin layer chromatography, are also developed.

Students, after successful completion of the laboratory

• Will have learned to work following the prescribed rules of practice and safety in an organic chemistry laboratory

• Will possess the basic principles on which the above laboratory techniques are based

• Will be able to apply these techniques for the separation of mixtures or the isolation of active substances from extracts, natural or synthetic mixtures.

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…*
	…….

1. Search, analysis and synthesis of data and information, using the necessary technologies
2. Independent work
3. Teamwork
4. Promotion of free, creative and inductive thinking
5. Project planning and management
6. Respect for the natural environment
7. Exercise of criticism and self-criticism

(3) SYLLABUS

EXPERIMENT 1: Laboratory Safety - Intermolecular forces
EXPERIMENT 2: Melting Point - Boiling Point
EXPERIMENT 3: Distillation (Alcoholic degrees in wine)
EXPERIMENT 4: Purification of solids (Crystallization – recrystallization)
EXPERIMENT 5: Extraction – drying agents – Purification of diethyl ether
EXPERIMENT 6: Solubility of organic compounds in aqueous solutions of inorganic reagents and in diethyl ether. Classification into solubility groups.
EXPERIMENT 7: Acidic and basic character of organic compounds
EXPERIMENT 8: Separation of benzoic acid - Triphenyl methanol mixture
EXPERIMENT 9: Thin Layer Chromatography (T.L.C.)
EXPERIMENT 10: Oxidation of anthracene to anthraquinone.
EXPERIMENT 11: Column chromatography. Separation of an anthracene-anthraquinone mixture
EXPERIMENT 12: Isolation of caffeine from tea
EXPERIMENT 13: Isolation of nicotine form tobacco
EXPERIMENT 14: Isolation of acetylsalicylic acid, caffeine and 4-acetamidophenol from analgesic tablets

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face (classroom)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>e-class, viber, e-mail</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-experiments</td><td>52</td></tr>
<tr><td>experiment preparation</td><td>21</td></tr>
<tr><td>Reports</td><td>42</td></tr>
<tr><td>Final exam</td><td>35</td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure</td><td>Greek language

Laboratory reports, oral examination 30%
In class tests 20%
Final examination 50%</td></tr>
</table>

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.*	

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

1. Organic Chemistry Laboratory Notes I
2. Modern General Chemistry, Ebbing D. Darrell, Gammon D. Steven, Greek edition 10/2014 Travlos Publications
3. Organic Chemistry Mc Murry E. John, Greek edition 8/2017, University of Crete Publications
4. Chemistry Structure and Properties, Tro J. Nivaldo, Greek edition 2021, Broken Hill
5. A Microscale Approach to Organic Laboratory Techniques, Pavia L. Donald et al, Greek Edition 2020, Broken Hill

COURSE OUTLINE
CHEM-301 ANALYTICAL CHEMISTRY I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-301	**SEMESTER**	3
COURSE TITLE	ANALYTICAL CHEMISTRY I		
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	4	6
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*	Mandatory		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://eilotas.chemistry.uoc.gr/eclass/modules/document/document.php?course=TMA112		

(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*

This course aims at preparing the scientist to understand what analytical chemistry is, the process of sample collection and preparation, using fundamental analytical methodologies. There are three primary objectives of the course:

A) What is an analytical sample, how to treat it, and how to report the results. Why there is a need for instrument calibration, and the information obtained from it regarding to selectivity, sensitivity and detection limit.

B) What is potential, and how it is related to mater. What is the relationship between current, potential, and resistance to matter, and in particular to quantity, quality, and condition.

C) What is the nature of light and its interaction with matter, at the molecular level. How this interaction can be utilized to obtain quantitative and qualitative information on the material under test.

This training will enable the scientist to develop the necessary critical evaluation scientific skills to be able to understand the strengths and limitations of the various analytical methods he has at his disposal to be employed under various working conditions.

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	*Other*
Production of new research ideas	

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Working in an international environment
- Working in an interdisciplinary environment
- Production of free, creative and inductive thinking
- Production of new research ideas
- Project planning and management
- Production of free, creative and inductive thinking

(3) SYLLABUS

(1) Data evaluation analysis and processing.
Introduction to statistical analysis, and measurements.
Experimental errors, Data elimination criteria,
Experimental measurement
Statistical analysis of reproducibility, accuracy and precision
Calibration methods in Instrumental analysis
Introduction to chemometrics for development and optimization of analytical measurements.

(2) Electro-Analytical Chemistry
Fundamentals of electrochemistry
Galvanic-electrochemical cells
Nernst equation
REDOX titrations,
Gravimetric and coulometric analyses,
Potentiometry
Voltammetry
Polarography,
Amperometric titrations.

(3) Molecular Spectrometry
Introduction and applications of UV/VIS spectroscopy,
Molecular absorption spectrometry
Transmittance and absorption measurements
Beer Law
Instrumentation and applications of UV-VIS spectroscopy
Photometric titrations and Flow and Flow Injection Analysis

(4) Molecular Spectrometry
Luminescence fluorescence and phosphorescence
Theory Instruments for measuring fluorescence and phosphorescence
Chemiluminescence

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Open e-class
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and*	

Activity	***Semester workload***
Lectures	52

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*	Study: 70 Literature project-presentation, Final examination: 28 Course total: 150
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.*	Greek language The final grade of the course comes from εeekly tests, or midterm exams and final exams

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

Daniel C. Harris, Quantitative Chemical Analysis 10th Edition
PowerPoint presentation slides and other electronic material used during teaching in the class

COURSE OUTLINE

CHEM-311 PHYSICAL CHEMISTRY LABORATORY I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-311	**SEMESTER**	3
COURSE TITLE	PHYSICAL CHEMISTRY LABORATORY I		
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		2	
Laboratories			
Other		4	
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*	Mandatory		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS			
COURSE WEBSITE (URL)	chemistry.uoc.gr/eclass/courses/CHEM-UNDER125/		

(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*

1. Experimental study of Fundamental concepts and light properties. Spectroscopy, Kinetics, distribution law gases
2. Practice about Physical Chemistry Laboratory. Safety in the Lab , Lab Book Keeping.
3. Error propagation in the final experimental result. Accuracy and precision. Comparison experimental results with published literatures values.
4. Practice in writing a scientific paper.

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	*Other*
Production of new research ideas	

- Searching , analysis and synthesis new data and information by contemporary technology application
- New situatton adaptation
- Working in groups in creative and autonomous mode

(3) SYLLABUS

Week 1: Introduction, Lab Rules, Experiments Overview, Safety in the Lab, Lab-Book instructions, Measurements and errors, Error propagation and statistics, Lab reports.

Week 2: Experimental data depiction and plot designing. Data fitting and interconnection with experiment interpretation. (Library staff): Literature research. Dimitris Anglos Seminars

Week 3: Electromagnetic theory about Light and Optics.

Week 4: Light Interference: Diffraction Polarization, Refraction.

Week5: Spectroscopy instrumentation (light sources, spectrophotometers, detectors)

Week 6: Kinetic Theory of Gases: Velocity distribution.

Week 7: Atomic Spectroscopy. Structure of the atoms. Spectroscopic Terms. (Also in FXI seminars)

Week8 : Fundamental Principles of Chemical Kinetics

Week 9: Molecular Electronic Spectroscopy (Absorbance and Fluorescence) Week10: Laser I:Types and operating principles Week 11: Laser II: Types and operating principles

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• E-class - Email • Video presentation • experiments https://opencourses.uoc.gr/courses/cou
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*** Laboratory — 24 Lectures — 26 Reports — 50 Study — 25 Final exams — 25 **Course total** — **150**
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.*	Greek language Student Assessment Method(s) • Lab reports • Final Examination • Lab boo

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

- P.W. Atkins 'Physical Chemistry (CUP 2014)
- Zevgolis Apllied optics with fiber otrics topics and LASER Αθήνα 2018
- Dais Spectroscopy (Greek Open University Patra 2001)
- C. Garland, J. Nibler, D. Shoemaker 'Experiments in physical chemistry', 7th Edition (McGraw-Hill, New York, 2003)
- D.Lide (ed) 'Handbook of chemistry and physics' 82nd ed. (CRC Press, Boca Raton, FL, 2001-02)
- J. A. Dean (ed) 'Lange's Handbook of chemistry' 15th ed. (Mc Graw Hill, NY, 1999)
- P. Chilton 'Chemical engineers handbook' 5th ed. (Mc Graw Hill, New York, 1973)
- Overview of Experiments , power point (eclass students)

COURSE OUTLINE
CHEM-049 PHYSICAL CHEMISTRY II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-049	**SEMESTER**	4
COURSE TITLE	PHYSICAL CHEMISTRY II		
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		4	6
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*	General Background		
PREREQUISITE COURSES:	Physical Chemistry II course requires the fundamental Knowledge on Chemistry Principles, Mathematics, Physics I and II and basic concepts on Quantum Mechanics.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS			
COURSE WEBSITE (URL)	http://eilotas.chemistry.uoc.gr/eclass/courses/TMA125/		

(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*

The main objective of the course is to provide the students with the resources for the detailed study and understanding of chemical processes, through the investigation of their macroscopic and microscopic properties that determine their outcome. Specifically, the concepts of statistical collection, thermodynamic equilibrium, Free Energy (criterion of spontaneity of a process), Enthalpy and Entropy of systems are clearly introduced, through the study of the Laws of Thermodynamics.

Then, in the context of Chemical Kinetics, the concepts of Reaction Rate Coefficient, Transition State and Dynamic Energy Surfaces are introduced, in order to study systems far from equilibrium and to investigate the parameters that determine the feasibility and outcome of a chemical process at the molecular level. Overall, the Physical Chemistry II course aims to optimize the students' understanding of Chemical Reactivity by examining and prioritizing the determining factors for the completion of a reaction, at the molecular level. Subsequently, the information extracted from the microcosmos is processed using the principles of Statistical Thermodynamics and further used to describe the macroscopic processes.

Therefore, upon successful completion of the course, students will be able to understand the mechanistic characteristics and dynamics of chemical reactions and accurately predict the distribution of reaction products, in a state of equilibrium. Finally, by combining the basic principles of Thermodynamics and Chemical Kinetics, such as Free Energy, Entropy, Enthalpy and Rate Coefficient, Transition State and Reaction Coordinate, students will master the skill of dividing the reaction phase space into reactants and products and therefore to fully perceive the change in the Dynamics of the System approaching the state of equilibrium.

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	*Other*
Production of new research ideas	

- Search, analysis and synthesis of data and information, also utilizing the necessary technologies
- Independent work
- Generating new research ideas
- Promotion of combinatorial, creative and inductive thinking

(3) SYLLABUS

Contents
(P. W. Atkins and Julio de Paula, Physical Chemistry, ed. 9th, Oxford Press, 2010)

Part A. Thermodynamics (Stavros Farantos)

(1) INTRODUCTION-I: Theory for the study of macroscopic and complex systems
(2) INTRODUCTION-II: System – Environment - Procedures
(3) INTRODUCTION-III: The Mathematics of Thermodynamics
(4) THE FOUNDAMENTAL EQUATION OF THERMODYNAMICS: Internal Energy – Entropy – Temperature – Pressure - Chemical Potential
(5) THE THREE LAWS OF THERMODYNAMICS: Energy – Mechanical, Heat
(6) EQUILIBRIUM CONDITIONS: Thermodynamical Equations and Inequalities
(7) THERMODYNAMIC POTENTIALS: Phase Equilibrium
(8) CHEMICAL EQUILIBRIUM: Chemical Reactions
(9) THERMODYNAMIC MODELS: Ideal gases and Solutions
(10) REAL SYSTEMS: Gases and Solutions

Part B. Chemical Kinetics (Vassileios Papadimitriou)

(11) Molecules in Motion (Kinetic Theory of Gases)
(12) The rates of chemical reactions
(13) Molecular reaction dynamics
(14) Catalysis

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Course Instructors web-paged (Notes and Lectures Presentations)
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*	

Activity	***Semester workload***
Lectures	52

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*	<table><tr><td>Study</td><td>50</td></tr><tr><td>Final examination</td><td>48</td></tr><tr><td>Course total</td><td>150</td></tr></table>
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.*	Greek language The final grade of the course comes as the mean grade of the two independently taught branches of Physical Chemistry, as follow: • Thermodynamics (60 %): mid-semester written examination (20 %) and final written examination 80 %) • Chemical Kinetics (40 %): Final written examination The overall duration of the final written examination is 3 hours.

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

- P. W. Atkins, J. De Paula, J. Keeler, "Physical Chemistry", 11th Edition, Oxford University Press, Oxford, 2018
- J. M. Smith, H. C. van Ness, M. M. Abbott, M. T. Swihart, "Introduction to Chemical engineering Thermodynamics", 8th Edition, McGraw Hill, New York, 2018
- Ε. Ν. Οικονόμου, "Στατιστική Φυσική και Θερμοδυναμική. Συνοπτική Θεωρία και Ασκήσεις", 2η Έκδοση, Πανεπιστημιακές Εκδόσεις Κρήτης, Ηράκλειο (2001)

COURSE OUTLINE
CHEM-212 ORGANIC CHEMISTRY LABORATORY II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-212	**SEMESTER**	4
COURSE TITLE	ORGANIC CHEMISTRY LABORATORY II		
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	4	6
	Laboratories		
	Other		
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*	Mandatory		
PREREQUISITE COURSES:	Organic Chemistry Laboratory I Organic Chemistry II		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS			
COURSE WEBSITE (URL)	http://eilotas.chemistry.uoc.gr/eclass/modules/document/document.php?course=TMA112		

(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*

After successfully completing the course, students will have been trained in experiments involving basic organic reactions such as Diels-Alder, Cannizaro, Aldol condensation, Freidel-Crafts, Grignard (etc.), and thus will be able to fully understand concepts that were established in the Organic Chemistry I and II courses by practicing the synthesis of organic compounds.
They will have learned basic techniques of extraction, recrystallization, distillation, thin layer and column chromatography and representative syntheses.
They will have used modern methods for the identification of the produced compounds (NMR, IR, MS, UV).

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	*Other*
Production of new research ideas	

1. Search, analysis and synthesis of data and information, using the necessary technologies
2. Independent work
3. Teamwork
4. Promotion of free, creative and inductive thinking
5. Respect for the natural environment
6. Exercise of criticism and self-criticism

(3) SYLLABUS

EXPERIMENT 1: Introduction – Laboratory Safety Rules

EXPERIMENT 2: Oxidation of Benzyl Alcohol

EXPERIMENT 3: Diels-Alder reaction

EXPERIMENT 4: Cannizaro reaction

EXPERIMENT 5: Aldol condensation

EXPERIMENT 6: Freidel-Crafts reaction

EXPERIMENT 7: Grignard reaction (2 laboratory sessions)

EXPERIMENT 8: Wittig reaction EXPERIMENT 9: Esterification EXPERIMENT 10: Saponification of fats - Basic hydrolysis of esters EXPERIMENT 11: Preparation of soap EXPERIMENT 12: Preparation of (S)-3-hydroxy-ethyl butanoate EXPERIMENT 13: Photochemical Reaction

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face (classroom)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>e-class, viber, e-mail</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></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Study</td><td>70</td></tr>
<tr><td>Literature project-presentation, Final examination</td><td>28</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<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</td><td>Greek language

Laboratory reports, oral examination 30%
Test in class 20%
Course total 50%</td></tr>
</table>

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

1. Organic Chemistry Laboratory Notes II
2. Organic Chemistry, Mc Murry E. John, Greek Edition, 8/2017, University of Crete Publications
3. Organic Chemistry, Carey A. Fransis et al, Greek Edition10/2020, Kritiki Publications
4. Organic Chemistry, Loudon Marc, Parise Jim, Greek Edition, 8/2019, Broken Hill
5. Organic Chemistry, Klein David, Greek Edition, 11/2015, Utopia

COURSE OUTLINE
CHEM-401 INORGANIC CHEMISTRY I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-401	**SEMESTER**	4
COURSE TITLE	INORGANIC CHEMISTRY I		
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		4	6
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*	General background Compulsory course		
PREREQUISITE COURSES:	Basic knowledge of General Chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (selected lectures are delivered in English)		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/demadis/home.html (follow the link “teaching”)		

(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*

The course introduces the student to the field of Inorganic Chemistry. Following the 1st year of Basic / General Chemistry courses, students will acquire the basic and more specialized knowledge of Inorganic Chemistry, which deals principally with the structure and properties of compounds containing metal ions. In particular, it includes and focuses on the composition, structure and physicochemical properties of coordination compounds, with emphasis on those containing transition metals. The course offers extensive analysis of the chemistry of complexes, including extensive analysis of ligands, electronic structure, complex geometries and their spectroscopic properties. Theories that explain the complex structure and properties (such as crystal field theory, molecular orbital theory) and many examples, as well as applications, are presented.

Students, after successfully completing the course will:

• Possess the basic principles of chemistry of coordination compounds (complexes).

• Be familiar with chemical species and molecules that can act as ligands for metal centers.

• Be able to predict the electronic spectra of specific complexes.

• Familiarize themselves with the distortions of the various geometric complexes, as well as with the rules governing them.

• Will possess the theories proposed to explain properties of the complexes.

• Will have gained knowledge on the types of isomerism in complexes.

• Have knowledge of selected applications of complexes in industry, medicine, pharmaceuticals, catalysis, 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 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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new developments and technologies
- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas
- Criticism and self-criticism

(3) SYLLABUS

(1) INTRODUCTION TO THE COORDINATION COMPOUNDS (METAL COMPLEXES)
(2) STRUCTURES OF METAL COMPLEXES
(3) LIGANDS AND COORDINATION TYPES
(4) TYPES OF METAL COMPLEXES
(5) METAL CARBONYLS
(6) BONDING IN METAL COMPLEXES
(7) CRYSTAL FIELD THEORY
(8) SPECTROSCOPIC TERMS
(9) LIGAND FIELDS
(10) DIATOMIC MOLECULES
(11) JAHN-TELLER EFFECT
(12) MOLECULAR ORBITAL THEORY
(13) COMPARISONS BETWEEN THE THEORIES OF CRYSTAL FIELD AND MOLECULAR ORBITAL
(14) ELECTRONIC SPECTRA OF METAL COMPLEXES
(15) RUSSELL-SAUNDERS COUPLING
(16) TRANS EFFECT

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Social Media (closed group in Facebook) • Departmental website-Study guide • Classweb
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*	

Activity	***Semester workload***
Lectures	52
Study	70
Literature project-presentation, Final examination	28
Course total	150

as the hours of non-directed study according to the principles of the ECTS	
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.*	Student performance evaluation is based on two activities: A mid-term exam (during the semester), and (b) The final exam at the end of the semester. The language of the course, as well as the evaluation process, is Greek. However, selected lectures are delivered in English. An optional mid-term exam is offered during the semester. The final grade of the course is derived from: • 30 % of the mid-term exam • 70 % of the final exam of 3 hours duration. The criteria are accessible to students who become members of the closed group on Facebook and on MS Teams.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- «Inorganic Chemistry» (Volume 1), translation in greek, authors: F. Armstrong, M. Weller, T. Overton, J. Rourke, Broken Hill Publishers
- CHEMISTRY OF COORDINATION COMPLEXES, I. Tossidis, Ziti Publishers
- PowerPoint presentation slides and other electronic material used during teaching in the class

COURSE OUTLINE
CHEM-408 ANALYTICAL CHEMISTRY II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-408	**SEMESTER**	4
COURSE TITLE	ANALYTICAL CHEMISTRY II		
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		52	
Laboratory			
Other		28	
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*	General		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS			
COURSE WEBSITE (URL)	https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER140/		

(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*

Course Description

This course introduces students to the field of modern instrumental analytical chemistry. Students will learn the physicochemical principles underlying the operation of instruments used for the determination of a wide range of analytes.

The instrumental analytical techniques covered in the course are based on:

• Spectrometric measurements of the interaction between matter (analytes) and electromagnetic radiation
• Emission of electromagnetic radiation from matter
• Mass spectrometry for measuring the mass of molecular or atomic ions

A major emphasis is placed on various types of interferences encountered in the analysis of complex samples, including environmental, food, biological, and material samples. Additionally, the course introduces students to separation techniques, focusing on gas chromatography (GC) and liquid chromatography (LC) for the separation of analytes in such samples.

Learning Outcomes

Upon successful completion of the course, students will:

• Understand the fundamental principles of various instrumental analytical techniques, including atomic absorption and emission spectrometry, inductively coupled plasma mass spectrometry (ICP-MS), and molecular mass spectrometry techniques such as electron ionization (EI), chemical ionization (CI), electrospray ionization (ESI), matrix-assisted laser desorption/ionization (MALDI), and atmospheric pressure chemical ionization (APCI).
• Understand the basic principles of modern separation techniques for molecules and ions.
• Be familiar with the instrumentation used in all the above techniques.
• Recognize the advantages and limitations of each analytical technique and understand the criteria for selecting the appropriate analytical method based on the specific requirements of an analysis.

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	*……*
	Others…

environment *Production of new research ideas*	…….

- Searching, acquiring and analyzing data and information, using the necessary technologies
- Adaptation to new situations
- Decision-making
- Independent work
- Teamwork
- Promotion of free, creative, and inductive thinking
- Generation of new research ideas

(3) SYLLABUS

Atomic Spectrometry

a. Introduction to atomic spectrometry
b. Atomization processes in flames, furnaces, and plasmas
c. Atomic Absorption Spectrometry (AAS): operating principles, analytical characteristics, interferences, and applications
d. Atomic Emission Spectrometry (AES): operating principles, analytical characteristics, interferences, and applications
e. Inductively Coupled Plasma Mass Spectrometry (ICP-MS): operating principles, analytical characteristics, interferences, and
applications
f. Comparison of atomic spectrometry techniques and their applications

Mass Spectrometry

a. Introduction to mass spectrometry
b. Ionization sources in mass spectrometry: Electron Ionization (EI), Chemical Ionization (CI), Electrospray Ionization (ESI), Matrix-Assisted Laser Desorption/Ionization (MALDI), Atmospheric Pressure Chemical Ionization (APCI)
c. Mass analyzers: magnetic sector (with and without electrostatic filter), quadrupole, time-of-flight (TOF), ion traps
d. Chromatography coupled with mass spectrometry
e. Applications of mass spectrometry

Introduction to Separations in Analytical Chemistry

a. Solvent extraction
b. Introduction to chromatography
c. Separation efficiency
d. Chromatographic peak broadening

Gas Chromatography (GC)

a. Separation processes in gas chromatography
b. Types of chromatographic columns
c. Properties of mobile and stationary phases
d. Sample injection techniques
e. Detectors in gas chromatography
f. Applications of GC: analysis of environmental and biological samples, applications in archaeometry and anti-doping control

High-Performance Liquid Chromatography (HPLC)

a. Separation processes in HPLC
b. Types of HPLC columns, mobile and stationary phases
c. HPLC separation techniques: reverse-phase, normal-phase, ion exchange, ion-pair reverse-phase, ion chromatography, size exclusion chromatography
d. HPLC detectors, with emphasis on mass spectrometry detectors

e. Applications of HPLC: analysis of environmental and biological samples, applications in archaeometry and anti-doping control

Sample Preparation for Analytical Purposes

a. Dissolution of the sample to be analyzed

b. Sample preparation techniques

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Email • Department Website – Study Guide • E-Class (notes, slides, articles, assignments)
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*	
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.*	Final Course Grade Calculation The final course grade is determined based on the student's performance in the two parts of the course (Part A + Part B): • Part A is assessed through a midterm exam (1.5-hour duration) and contributes 50% to the final grade. • In the final exam, the student can choose to retain the midterm grade (Part A) and be examined only in Part B (1.5-hour duration), which also contributes 50% to the final grade. • However, if the student chooses not to keep the midterm grade or did not take the midterm, then in the final exam, they must take both Part A and Part B (3-hour duration), which together account for 100% of the final grade.

Activity	***Semester workload***
Lectures	52
Study	70
Literature project-presentation, Final examination	28
Course total	150

	Bonus Points from Assignments • Students can earn up to 2 bonus points from individual and group assignments. • The bonus points will be added to the exam grade only if the exam grade is ≥ 4.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Quantitative Chemical Analysis, Daniel C. Harris
- Analytical Chemistry 2.1, Harvey
- «Αρχές Ενόργανης Ανάλυσης», Εκδόσεις Κωσταράκη D. A. Skoog, F. J. Holler and T. A. Nieman

COURSE OUTLINE
CHEM-413 ANALYTICAL CHEMISTRY LABORATORY I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-413	**SEMESTER**	4o
COURSE TITLE	ANALYTICAL CHEMISTRY LABORATORY I		
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-experiment		4	6
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*	General background		
PREREQUISITE COURSES:	Knowledge of general chemistry topics and principles, Analytical Chemistry I		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	1) http://www.chemistry.uoc.gr/wordpress/ 2) http://eilotas.chemistry.uoc.gr/eclass 3)https://www.youtube.com/channel/UCrrDdUXUiTxyhezA140RIew		

(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*

The course gives an introduction to analytical chemistry, including basic analytical methods. The laboratory course gives the students experience with quantitative methods of analysis. At the end of the course student should be able to: - Explain the theoretical principles and important applications of classical analytical methods, as well as gravimetric and coulometric methods. Understand the theoretical principles of instrumental methods such as electroanalytical, spectrometric/spectrophotometric and mass spectrometry methods, and main components in such analytical instruments. - Explain the theoretical principles of chromatography, and typical applications of chromatographic techniques. – Be able to suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, interferences, slectivities and error sources within an analytical procedure. – Understand the fundamental statistical tools required in analytical chemistry as well as method evaluation. - Make scientific reports using this knowledge as well as the data obtained during the experiments and present the results in a scientific manner.

Students, upon successful completion of the course will:

- Possess the basic knowledge for the operation of several of the most important analytical techniques.
- Have the ability to complete instrumental chemical analysis procedures based on operating protocols.
- Have the ability to conduct data analysis, including statistical analysis, on the obtained analysis results.
- Are able to write detailed and accurate reports on the obtained results and the techniques and parameters used for each analysis.
- Understand the advantages and disadvantages of each analytical technique.
- Are familiar with a wide range of highly advanced analytical techniques.

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

Working independently *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Production of free, creative and inductive thinking

(3) COURSE CONTENT

1. Conductivity Experiment
a) Determination of cell constant
b) Titrimetric determination of BaCl2 concentration
c) Determination of CaSO4 concentration
2. Spectrophotometric Determination of the pKa of a pH indicator (bromothymol blue)
3. Potentiometric Measurement of pH
a) Determination of phosphoric acids
b) Analysis of an unknown sample.
4. Determination of Potassium Ions in Water Using Potassium-Selective Electrode.
5. Polarographic Determination of Lead and Cadmium
6. Wine Analysis (sugar content, pH, total acidity, alcohol content, free and total sulphur dioxide)
7. Analysis of Olive Oil.
a) Determination peroxide value
b) Determination of spectrophotometric K-value

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (lab)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb • e-class • youtube (channel with video)

Activity	***Semester workload***
Lectures-Experiments	52
Experiment Preparation	21
Job-Report	42
Study Of Final Test	35
Total Course	150

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.*	Greek language In each laboratory exercise, students are examined orally and 1 or 2 tests are carried out which are included in the score. Students submit a report for each exercise one week after it has been completed. The final grade of the course results from: • 11% from the oral examination and the grading of the tests • 49% from the grading of projects. reports • 40% of the final written exam, duration 3 hours A condition for a student to pass the course is to write at least the basic (5) in the final exam.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1) Quantitative Chemical analysis (Daniel C. Harris)
2) Principles of Instrumental Analysis (Skoog,Holler,Nieman)

COURSE OUTLINE
CHEM-028 BIOCHEMISTRY I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-028	**SEMESTER**	5
COURSE TITLE	BIOCHEMISTRY I		
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		4	6
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*	General background		
PREREQUISITE COURSES:	Basic knowledge of Chemistry and Biology		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	IT IS OFFERED AS A READING COURSE IN ENGLISH		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course introduces the students to the field of Biochemistry. There is an introduction to the structural and functional properties of the most important biomolecules, with emphasis on the role of proteins as biocatalysts. There is a thorough examination of the basic properties of enzymes, the enzymatic mechanisms and the regulation of activity. In addition, the students become familiar with the properties and role of biological membranes; emphasis is given on the transport of molecules through membranes. Subsequently, the students are introduced to the principles of metabolism, while there is a detailed description of the metabolism of carbohydrates. Finally, there is a detailed presentation of the two most important bioenergetic processes, oxidative phosphorylation and photosynthesis.

Students, after successfully completing the course will:

- Possess the basic knowledge of Biochemistry, that is the Chemistry of Biological systems.
- Learn the basic principles of enzymatic processes.
- Learn the principles and importance of metabolism.

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…*
	…….

- Search for analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

(1) Introduction
(2) Protein Structure and Function
(3) DNA, RNA, and the Flow of Genetic Information
(4) Myoglobin and Hemoglobin
(5) Enzymes: Basic Concepts and Kinetics
(6) Catalytic Strategies
(7) Regulation Strategies
(8) Carbohydrates
(9) Lipids and Cell Membranes
(10) Membrane Channels and Pumps
(11) Metabolism: Basic Concepts and Design
(12) Glycolysis and Gluconeogenesis
(13) The Citric Acid Cycle
(14) Oxidative Phosphorylation
(15) Photosynthesis
(16) The Calvin Cycle and the Pentose Phosphate Pathway

(17) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb, Power point presentations
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*	
	Greek language

Activity	***Semester workload***
Lectures	52
Study	90
Literature project-presentation, Final examination	8
Course total	150

	The course's grade is the result of a final written examination. The evaluation criteria are discussed with the students during the first days of the semester.

(18) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- M. Berg, J. L. Tymoczko, L. Stryer (2017), Biochemistry, Translated ΠΕΚ
- D.L. Nelson, M. M. Cox (2007) *Lehninger* Principles of Biochemistry ((2007) Translation in Greek
- Electronic form of the lectures

COURSE OUTLINE
CHEM-307 ORGANIC CHEMISTRY III

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-307	**SEMESTER**	5
COURSE TITLE	ORGANIC CHEMISTRY III		
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	4	6
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*	General background Obligatory course		
PREREQUISITE COURSES:	Basic knowledge of Organic Chemistry I and II		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (as a reading course)		
COURSE WEBSITE (URL)	https://teams.microsoft.com/l/team/19%3a5effc3238a4f499380f1a5d0267c9857%40thread.tacv2/conversations?groupId=ffe795db-7dbd-4733-923e-999e5c0f251f&tenantId=b6e0a680-49f9-4523-a06b-d5a873656d37		

(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*

The course introduces the student to the field of biomolecules with emphasis on sugars, amino acids, peptides, proteins, lipids, nucleic acids (DNA, RNA), metabolic processes in the human body, and refers to pericyclic reactions and chemistry of aliphatic and aromatic amines.

Through the course the students will acquire the basic knowledge about the biological molecules, their chemistry, and their metabolism. The course offers an extensive analysis of chemical synthesis, reactions and, in general, the latest knowledge of the chemistry of each class of compounds.

Students, after successfully completing the course will:

• Possess the basic knowledge of biomolecular chemistry.

• Be familiar with the mechanisms of pericyclic reactions.

• Be familiar with all anabolic and catabolic processes.

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…*
	…….

- 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
- Respect for the natural environment

- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

(1) Amines and heterocyclic amines
(2) Carbohydrates
(3) Anino acids, peptides, proteins
(4) Lipids
(5) Nucleic acids (DNA and RNA)
(6) Organic chemistry of metabolic processes
(7) Orbitals in organic chemistry: Pericyclic reactions

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website • Classweb • Teams
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*	
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,*	Greek language After teaching of the first 3 chapters of the syllabus (including 50% teaching of the theory and 50% problem solving), the first written examination takes place. It contains questions and problems with different degrees of difficulty (e.g. multiple choice, short-answer, simple and advanced problems). At the end of the semester the second written examination takes place for the remaining 4 chapters of the course. The exam has the same characteristics as the first one.

Activity	***Semester workload***
Lectures	52
Study for mid-term exams	42
Study for final exams	56
Course total	150

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.*	The final course grade comes from: • 43% from the first written examination • 57% from the second written examination For the students who do not attend the first written examination or failed to pass it, there is a final examination on the entire syllabus. Students who have successfully completed the first written examination but they are not very satisfied with their performance (grade), have the right to take the final examination on the entire syllabus. The evaluation criteria are explained to the students from the first lesson and repeated during the semester.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- John McMurry “Organic Chemisty” 9th edition, translated in Greek by Crete University Press under the scientific supervision of Prof. I. Smonou and Prof. M. Stratakis.
- David Klein "Organic Chemistry II" 2nd edition, translated in Greek by Utopia press, under the scientific supervision of Prof. G. Kokotos.
- Leroy G. Wade and Jan William Simek "Organic Chemistry" 9th edition, translated in Greek by Tziola press, under the scientific supervision of Prof. D. Komiotis.
- Francis A. Carey, Robert M. Giuliano, Neil T. Alison, Susan L. Bane "Organic Chemistry" translated in Greek by Kritiki press, under the scientific supervision of Prof. A. Troganis, Prof. G. Rassias and Prof. A. Tsotinis.

COURSE OUTLINE
CHEM-402 INORGANIC CHEMISTRY II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-402	**SEMESTER**	5
COURSE TITLE	INORGANIC CHEMISTRY II		
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,		4	6
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*	General background, general knowledge, skills development		
PREREQUISITE COURSES:	Basic knowledge of General Chemistry, Inorganic Chemistry, Organic Chemistry and Physical Chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/ptrikalitis/		

(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*

The course introduces the students to the field of inorganic reaction mechanisms of transition metal elements and their coordination complexes. Students gain important insight into the way in which transition metal compounds participate in reactions, including ligand substitution, redox as well as catalytic reactions such as olefin metathesis. In this context the students understand important phenomena related to the kinetics of the related reactions and how the nature of both the metal center and their substitutes control the reaction mechanism. Key phenomena that control kinetics and reactivity including the Jahn-Teller effect, chelate and macrocyclic effect and crystal-field-stabilization-energy (CFSE), are discussed and analyzed in a great detail with representative examples. In addition, students gain an in-depth knowledge of important characteristics of metal centers such as the extent of their labile nature in substitution reactions, and their hard/soft character. In particular, emphasis is given on the mechanisms of a) substitution reactions of square planar and octahedral complexes b) redox reactions and c) selected catalytic reactions.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

- Aqua-acida, hydroxo-acids, oxo-acids, Lewis bases, harda and soft acids and bases, hard and soft oxides
- Coordination compounds: nature of ligands, coordination geometries and isomers, chelate effect, polycyclic effect, Jahn-Teller effect and polymetallic complexes
- Introduction to mechanisms, kinetics and rate laws.
- Classification of inorganic reactions: i) exchange of ligands, ii) rearrangement of the coordination sphere, iii) redox processes and iv) reactions on the ligands themselves.
- Reactions of the central atom: Redox reactions, inner sphere and outer sphere mechanisms.
- Ligand substitution reactions: dissociative, associative, interchange mechanisms and their general characteristics.
- Important factors determining the mechanisms of substitution reactions: Lability-Inertness and Nucleophilicity.
- Ligand substitution in square-planar complexes. Rate laws and mechanisms. Factors affecting reactivity: cis and trans effect, trans influence, leaving and entering group effect. Stereochemistry.
- Ligand substitution reactions in octahedral (Oh) complexes: rate laws and mechanisms, importance of CFSE (CFAE), water exchange, base hydrolysis.
- Reactions of coordinated ligands.
- Oxidative addition and reductive elimination reactions.
- Insertion reactions.
- Catalysis and transition metal complexes (hydrogenation of alkenes, hydroformylation, Wacker oxidation of alkenes, alkene metathesis-Grubb's catalysts, Palladium-catalysed C-C bond forming reactions-Heck, Negishi, Suzuki)

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face (classroom)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Email
• Class website
• Departmental website-Study guide
• Classweb</td></tr>
<tr><td>TEACHING METHODS

The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and</td><td><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>52</td></tr><tr><td>Study</td><td>95</td></tr></table></td></tr>
</table>

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*	Final examination: 3 Course total: 150
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.*	Language Greek The final grade of the course comes from final written examination (duration 3 hours) (100 %)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- "Inorganic Chemistry" by Mark Weller and Tina Overton
- Powerpoint presentations and other electronic material used during lectures
- Selected scientific papers published in international peer-reviewed journals and can be found in the website of the class

COURSE OUTLINE
CHEM-411 INORGANIC CHEMISTRY LAB I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-411	**SEMESTER**	5th
COURSE TITLE	INORGANIC CHEMISTRY LAB I		
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, practical laboratory work		4	6
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*	General backgroung Laboratory Core Course of the devision of Inorganic Chemistry		
PREREQUISITE COURSES:	Basic knowledge of inorganic, general and organic chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS			
COURSE WEBSITE (URL)	https://sites.google.com/view/inorglab/		

(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*

In this laboratory course students are practiced in the synthesis of coordination compounds, the study of their properties and the identification of their structure.

Students that have successive conducted the laboratory exercises

- will be familiar with the synthesis, starting from simple reagents, of coordination compounds in which the central atom is Cu2 +, Cr3 +, Co2 +
- will be familiar with UV-vis spectroscopy and obtaining absorption spectra in solutions.
- will have understood the selection rules for electron transitions and the effect of the symmetry elements of the coordination compound on the shape and intensity of the curves.
- will recognize the implications of the electronics configuration of the metal ions and the results of the Jahn-Teller theorem.
- will be able to calculate spectroscopic constants using electron spectra
- will be familiar with infrared spectroscopy as a chemical analysis method
- will have understood the utility of the infrared spectra, the characteristic absorptions of bonds and groups, the changes in the structure of the compounds after coordination, and the effect of a symmetry change to the discrimination between the isomers of a compound
- will be familiar with the Evans method, a method of measuring magnetic susceptibility
- will be able to convert magnetic susceptibility to magnetic dipole moment and suggest central metal's electron configuration
- will recognize intramolecular interactions and how they affect magnetic properties

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	*Project planning and management* *Respect for difference and multiculturalism*

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*	*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* *……* *Others…* *…….*
Search, analyze and synthesize data and information, using the necessary technologies Teamwork Promote free, creative and inductive thinking	

(3) SYLLABUS

Safety Rules - Use MSDSH (Material Safety Data Sheets)

Synthesis of the coordination compounds

- Preparation of planar sqare complexes of copper (II)
- Preparation of octahedral complexes of chromium (III)
- Preparation of tetrahedral and octahedral complexes of cobalt (II)

Infrared spectra of the coordination compounds

- Introduction to IR spectroscopy
- Infrared spectroscopy analysis technique- spectra acquisition
- Evidence and verification of coordination and identification coordination
- Discrimination of isomers, coordination and symmetry

Electronic spectra of coordination compounds

- UV-vis Spectroscopy Analysis Technique
- Planar square and octahedral complexes of copper (II)
- Octahedral complexes of chromium (III)
- Tetrahedral and octahedral complexes of cobalt (II)

Magnetic properties of coordination compounds

- Basic principles of magnetochemistry
- Experimental methods of measuring magnetic susceptibility
- Experimental part
- Calculations-questions

Conductometry

- Conductometric study of coordination compounds

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face, Practical laboratoy work</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>E-mail, Course website, department website</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>Laboratory practical work</td><td>52</td></tr>
<tr><td>Prelab study/preparation - Laboratory report</td><td>70</td></tr>
<tr><td>Final examination</td><td>28</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
</table>
</td></tr>
<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</td><td>Language Greek

Before the laboratory experiment starts students are asked to answer a short answer- test questions about the experiment they will perform (duration 10min)

After conducting a laboratory experiment, students in groups, deliver a report according to the instructions given to them and posted on the course website

The laboratory grade is a function of lab reports scores and each student short answer- tests scores performance.

The final grade of the laboratory course results from the average of a final written examination, (duration 3 hours) and the laboratory grade</td></tr>
</table>

work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:

- Huheey, J., (1993), Inorganic chemistry: Principles of structure and reactivity ,
- Tossidis, I., (2001), Coordination compounds chemistry. Thessaloniki: Ziti Publications
- Kesisoglou, D., Akrivos, P., (2013), Coordination Compounds Chemistry, Theory, Exercises & Experiments", Thessaloniki: Ziti Publications
- Nakamoto, K., (2009), Infrared and Raman spectra of inorganic and coordination compounds, Hoboken, N.J.: Wiley
- Laboratory guide: Vardalachaki E. and Coutsolelos, A. (2018). Inorganic chemistry i – Laboratory Exercises. Heraklion

COURSE OUTLINE
CHEM-414 ANALYTICAL CHEMISTRY II LABORATORY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-414	**SEMESTER**	6
COURSE TITLE	ANALYTICAL CHEMISTRY II LABORATORY		
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		52	
Laboratories		42	
Other		21	
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*	In laboratory (face to face)		
PREREQUISITE COURSES:	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS			
COURSE WEBSITE (URL)	1)http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/ 2) http://eilotas.chemistry.uoc.gr/eclass 3) Εργαστήρια Αναλυτικής Χημείας – YouTube		

(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*

Laboratory Course Description

This laboratory course aims to introduce students to the field of Instrumental Chemical Analysis, focusing on the proper use of advanced analytical instruments for the determination of various analytes in a wide range of samples. The course provides hands-on experience to reinforce students' existing knowledge of the fundamental operating principles of each instrumental technique. It is designed to enhance students' understanding of all topics covered in the Analytical Chemistry II course.

Learning Outcomes

Upon successful completion of this course, students will:

- Have basic knowledge of the operation of several important Instrumental Analytical techniques.
- Be able to accurately perform Instrumental Chemical Analysis procedures following operational protocols.
- Develop the ability to analyze data, including statistical analysis.
- Be capable of writing detailed and precise reports on results, techniques, and parameters used in each analysis.
- Understand the advantages and limitations of each analytical technique.
- Be familiar with a wide range of advanced Instrumental Analytical techniques.

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…*
	…….

Searching, acquiring, and analyzing data and information, using the necessary technologies

- Adaptation to new situations
- Independent work

- Teamwork
- Promotion of free, creative, and inductive thinking

(3) SYLLABUS

1. **Atomic Absorption Spectroscopy (AAS)**

The objective of this exercise is to familiarize students with atomic absorption spectroscopy techniques. The exercise is divided into two parts:

a) Preparation of standard magnesium and calcium solutions at different concentrations to generate a calibration curve for each element.

b) Determination of magnesium and calcium in an unknown sample and drinking water samples.

2. Gas Chromatography with Thermal Conductivity Detector (GC-TCD)

The objective of this exercise is to use and understand the theory of gas chromatography with a thermal conductivity detector (TCD) using an on-column sample injector and a packed column to determine key parameters of gas chromatography. The exercise is divided into two parts:

a) Calculation of the optimal mobile phase flow rate using the Van Deemter equation.

b) Qualitative identification of an unknown alcohol sample using standard solutions.

3. Gas Chromatography with Flame Ionization Detector (GC-FID)

The objective of this exercise is to use and understand the theory of gas chromatography with a flame ionization detector (FID) using a split injector and a capillary column. The exercise is divided into three parts:

a) Preparation of a known concentration alcohol solution and calculation of the Relative Response Factor (RRF).

b) Qualitative and quantitative analysis of an unknown sample.

c) Determination of methanol and ethanol in an alcoholic beverage obtained from distillation (e.g., raki).

4. Reverse Phase Liquid Chromatography (RPLC)

The objective of this exercise is to determine the partition coefficient (n-octanol/water) using the reverse-phase high-performance liquid chromatography (RPLC) method, with a focus on:

a) Understanding and using high-performance liquid chromatography (HPLC) for the determination of its key parameters.

b) Partition coefficients and lipophilicity of organic compounds.

5. Ion Chromatography (IC)

The objective of this exercise is to use and understand the theory of ion chromatography techniques. The exercise is divided into two parts:

a) Preparation of standard ion solutions at different concentrations to create a calibration curve for each cation separately.

b) Qualitative and quantitative determination of cations in an unknown sample and drinking water samples.

6. Determination of Phosphorus in Cola Beverages (UV-VIS Spectrophotometry)

The objective of this exercise is to determine the phosphorus content in cola beverages using the molybdenum blue method, while familiarizing students with spectrophotometric

techniques.

7. Determination of Relative Molecular Mass of Proteins using Electrospray Ionization – Mass Spectrometry (ESI-MS)

The objective of this exercise is to familiarize students with mass spectrometry using the electrospray ionization (ESI-MS) technique, as well as to determine the relative molecular mass of a protein sample under analysis.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Email • Department Website – Study Guide • Class Web • E-Class (notes and supplementary videos) • YouTube (channel with supplementary videos)
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 & Experiments	51
Experiment Preparation	22
Assignments & Reports	42
Final Exam Study	35
Total Course Workload	**150**

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*	Greek language

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1) Ποσοτική χημική ανάλυση (DanielC. Harris)
2) Αρχές Ενόργανης Ανάλυσης (Skoog, Holler, Nieman)
3) Χημεία 3, Εισαγωγή στην Ανόργανη Χημεία, την Οργανική Χημεία και τη Φυσικοχημεία (Burrows, Andrew)

COURSE OUTLINE
CHEM-030 BIOCHEMISTRY II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-030	**SEMESTER**	6
COURSE TITLE	BIOCHEMISTRY II		
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		4	6
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*	General background Obligatory course		
PREREQUISITE COURSES:	The course requires basic knowledge of chemistry and biology		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course introduces the student to the metabolism of biomoleculs. Through the course the students will acquire knowledge about the synthesis and degradation of different cellular biomolecules such as glucose, glycogen, fatty acids, amino acids and nucleotides. At the same time the student will know the use of these molecules in the synthesis of basic biopolymers such as glycogen, RNA, DNA, proteins and biological membranes. They will also gain insights into the relationship between catabolism and anabolism, as well as the control of various cellular processes.

Students, after successfully completing the course

• They will know the basic principles for the role of glycogen, fatty acids and amino acids in the energy metabolism of the cell.

• The role of fatty acids, nucleotides and amino acids in the formation of membrane lipids, RNA, DNA and proteins.

• The role of enzymes responsible for the degradation and synthesis of glycogen, fatty acids, RNA, DNA and proteins

• Have understanding of the regulation of various metabolic processes.

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…*
	…….

- Working independently
- Production of free, creative and inductive thinking
- Production of new research ideas
- Working in interdisciplinary environment

(3) SYLLABUS

1. The metabolism of glycogen
2. Metabolism of fatty acids
3. Degradation of amino acids and the urea cycle
4. Amino acid biosynthesis
5. Nucleotide biosynthesis
6. Membrane lipid biosynthesis
7. Biosynthesis of cholesterol and steroid hormones
8. Completion of metabolism
9. DNA replication, repair and recombination. Antibodies
10. Synthesis and splicing of RNA
11. Synthesis of proteins
12. Control of gene expression

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • OpeneClass, MS teams
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: 52 Study: 70 Examinations: 28 Course total: 150
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,*	Greek language During the semester, three test (one hour each) are given, or one final written test at the end of the semester, lasting 3 hours. The final grade of the course is derived from: • 100% of the tests Or • 100% of the final written examination

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.*	

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

- J.M. Berg, J. L. Tymoczko, G. J. Gatto & L. Stryer (2021), Biochemistry, Translated ΠΕΚ
- D.L. Nelson, M. M. Cox (2018) *Lehninger* Principles of Biochemistry (2018) Translated
- Electronic form of the lectures

COURSE OUTLINE
CHEM-405 ENVIRONMENTAL CHEMISTRY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-405	**SEMESTER**	6
COURSE TITLE	ENVIRONMENTAL 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		4	6
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*	Special background Compulsory course		
PREREQUISITE COURSES:	Basic knowledge of General, Organic and Physical Chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES under special agreement as reading course		
COURSE WEBSITE (URL)	(https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER153/)		

(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*

The course of Environmental Chemistry aims to introduce the main background concepts of the chemical processes occurring naturally in the atmosphere, the lithosphere and the hydrosphere, as well as the effects of various pollutants on the environment. In the light of Chemistry, the toxicity of the major pollutants, the treatment techniques and methods utilized, to minimize and prevent environmental pollution will also be examined.
Students, after completing the course, will familiarize themselves with the following notions:
A) The natural cycles of elements and molecules in the environment.
B) The chemical reactions related to biogeochemical cycles.
C) The chemical reactions and processes related to pollutant toxicity and wastewater treatment.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Respect for natural environment
- Production of new research ideas

(3) SYLLABUS

1. Introduction to Environmental Chemistry

1.1 Human influence on the environment

1.2 Units of geological time and the concept of «anthropocene»

1.3 Chemistry of natural processes

1.4 Chemistry of pollution processes

1.5 The importance of Environmental Chemistry

2. The fundamentals of Chemistry applied to environmental natural processes

2.1 Chemical equilibria: Distribution diagrams of chemical species

2.2 Acid-base reactions

2.3 Redox processes: Cycle and activity of electrons in the environment, pE & E, Nernst equation, diagrams pE-pH (Pourbaix), pE-pH diagram for water.

3. Complexes and complex formation

3.1 Complexes and chelate effect

3.2 Chemical kinetics of metal complexe formation

3.3 Complexes of metal ions in natural waters

4. Chemical processes in the hydrosphere

4.1 Water cycle - Residence time of water in natural reservoirs

4.2 Processes that affect water composition

4.3 Categories of natural waters and their chemical composition

4.4 Interactions of water with air and sediments: Henry law, oxygen and carbon dioxide

4.5 Processes that regulate the pH of natural waters: Alcalinity and basicity

4.6 Photosynthesis and the pH of natural waters

4.7 Calcium and other metal in natural waters

4.8 Redox reactions in natural waters

4.9 pE-pH diagrams (Pourbaix) of iron in natural waters and chlorine in drinking water

4.10 Complex formation in natural waters

4.11 Photochemical reactions in natural waters

4.12 Heterogeneous processes - Phases interactions in natural waters: I. Gas dissolution, II. Natural removal of species by physicochemical processes, III. Coloids, IV. Sorption processes

5. Biogeochemical Cycles

5.1 The water cycle

5.2 The hydrogen cycle

5.3 The carbon cycle

5.4 The oxygen cycle

5.5 The nitrogen cycle

5.6 The sulfur cycle

5.7 The phosphorus cycle

5.8 The cycle of iron

6. The Chemical Pollution

6.1 The phases of degradation of natural environment through anthropogenic activities

6.2 Sources of chemical pollution: Conventional and non-conventional pollutants

6.3 Chemical pollution from anthropogenic organic chemicals

7. Analytical Environmental Chemistry

8. Biological Treatment of Pollutants and Wastes

9. Chemical Treatment (Disinfection) of Water

10. Introduction to Environmental Organic Chemistry

11. Introduction to Toxicology and Ecotoxicology

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb
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 and exercises: 52 Study: 70 Midterm and final examination: 28 Course total: 150
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.*	Greek language The final mark for the course results as follows: 50% of the midterm exam (April) and 50% of the final exam (June). In case of failure the students will be then examined for all the course material in September

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**
  - Environmental Chemistry-Fundamentals, Ibanez, J.G., Hernandez-Esparza, M., Doria-Serrano, C., Fregoso-Infante, A., Singh, M.M., 2007, Springer (Translated in Greek, Crete University Press, 2016)

- Environmental Organic Chemistry, René P. Schwarzenbach, Philip M. Gschwend, Dieter M. Imboden, 3rd edition, ISBN: 978-1-118-76723-8, November 2016, Wiley
- Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters, Werner Stumm, James J. Morgan, 3rd Edition, ISBN: 978-0-471-51185-4, October 1995, Wiley
- Notes and ppt-slides of the course by the Tutor (E. G. Stephanou), to be uploaded from e-Class (only for students who take the course.

COURSE OUTLINE
CHEM-412 INORGANIC CHEMISTRY LABORATORY II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-412	**SEMESTER**	6
COURSE TITLE	INORGANIC CHEMISTRY LABORATORY II		
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, Conducting Laboratory Exercises		4	6
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*	Laboratory Core Course, Division of Inorganic Chemistry		
PREREQUISITE COURSES:	Basic knowledge of inorganic, general, organic and physical chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS			
COURSE WEBSITE (URL)	https://sites.google.com/view/inorglab2/		

(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*

In this laboratory course, students are practiced in the synthesis of inorganic compounds, study of their characteristic properties and understanding of structure-properties relationships. Students that have successfully completed all laboratory exercises, will be able to:

- properly use of the Material Safety Data Sheets, from which will be able to seek and obtain important chemical information
- perform properly in the laboratory according to Good Laboratory Practice (GLP)
- be familiar with the synthesis of inorganic compounds using modern methods and techniques
- identify and interpret differences in compound of elements belonging to the same Periodic Table group (group 13, 14, 17)
- distinguish the type of chemical reactions they perform and be able to propose a proper mechanism
- interpret the chemical properties of the synthesized compounds
- understood the principles of Scanning Electron Microscopy (SEM) and become familiar with its operation
- qualitatively and quantitatively determine the chemical composition of solid compounds using Energy Dispersive Spectroscopy (EDS) in SEM
- understand the basic principles of single crystal X-ray diffraction measurements and gin hands on experience in data collection using state-of-the-art instrumentation (Bruker D8 Venture)
- mount and collect single crystal X-ray diffraction data and perform data reduction towards unit cell determination and structure solution using APEX 3 suite.

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* *Respect for difference and multiculturalism* *Respect for the natural environment*

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*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
Search, analyze and synthesize data and information, using the necessary technologies Teamwork Promote free, creative and inductive thinking	

(3) SYLLABUS

Safety measures, practical rules and attitude in a chemical laboratory. Material Safety Data. Sheets Safety measures when using gases. Halogen chemistry. Interhalogens: Synthesis and study of iodine trichloride Silicone Polymers: Synthesis of "bounching Putty" Oxidative states of Tin: Synthesis characterization of SnI4, SnI2 compounds Study of SnI4, SnI2 with Scanning Electron Microscopy (SEM). Elemental analysis of SnI4, SnI2 with EDS (Energy Dispersive Spectroscopy) Spectroscopy Single crystal structure determination of SnI4, SnI2 compounds using X-ray diffraction techniques Trialkoxyboranes: Preparation of tri-n-propyloxyborane Preparation of poly (vinyl alcohol) -borate copolymer Hydrothermal synthesis and characterization of Co3(BTC)2·12H2O (BTC = 1,3,5-benzenetricarboxylic acid) a metal–organic

framework with microporous channels that are held intact via

hydrogen bonding of the coordinated water molecules.

The products are evaluated and compared using

gravimetric analysis, powder X-ray diffraction, and IR

spectroscopy. Powder X-ray diffraction is also used to monitor the

changes in structure of the framework during the partial or complete removal of the associated water molecules, as well as after reabsorption of water.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face, Practical laboratoy work</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>E-mail, Course website, department website</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>Laboratory practical work</td><td>52</td></tr>
<tr><td>Prelab study/preparation - Laboratory report</td><td>70</td></tr>
<tr><td>Final examination</td><td>28</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>Language Greek</td></tr>
</table>

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.*	Before the laboratory experiment starts students are asked to answer a short answer- test questions about the experiment they will perform (duration 10min) After conducting a laboratory experiment, students in groups, deliver a report according to the instructions given to them and posted on the course website The laboratory grade is a function of lab reports scores and each student short answer- tests scores performance. The final grade of the laboratory course results from the average of a final written examination, (duration 3 hours) and the laboratory grade

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:

- Shriver & Atkins, (2010), Inorganic Chemistry, fifth edition, Oxford University Press,
- Katakis, D., Methenitis, K., Mitsopoulos, X., Pnematikakis, G., (2002), Inorganic Chemistry. The elements, Athens, Papazisi
- Butler, Harrod, (1989), Inorganic Chmistry. Principles and applications, transl., Coutsolelos, A., Athens, Kostaraki
- Huheey, J., (1993), Inorganic chemistry: Principles of structure and reactivity
- Housecroft, C. E., Sharpe, A. G., (2012), Inorganic Chemistry, Fourth edition, Pearson Education
- King, R., B., (1995), Inorganic Chemistry of main group elements, USA VCH publishers, Inc.
- Massey, A., G., (1990), Main Group Elements, University of Leicester, Ellis Horwood
- Mark J. E., Allcock H. R., West R., (2005), Inorganic polymers, Second edition, New York, Oxford University Press
- Laboratory guide: Course website
- Hydrothermal Synthesis and Characterization of a Metal–Organic Framework by Thermogravimetric Analysis, Powder X-ray Diffraction, and Infrared Spectroscopy: An Integrative Inorganic Chemistry Experiment, Johanna L. Crane, Kelly E. Anderson, and Samantha G. Conway, J. Chem. Educ. 2015, 92, 2, 373–377, https://doi.org/10.1021/ed5000839

COURSE OUTLINE
CHEM-444 PHYSICAL CHEMISTRY LABORATORY II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-444	**SEMESTER**	6
COURSE TITLE	PHYSICAL CHEMISTRY LABORATORY II		
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		2	
Laboratories		4	
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*	General background		
PREREQUISITE COURSES:	Fundamentals concepts in Mathematics I II Physics I II and Physical Chemistry II (Thermodynamics Kinetics)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS			
COURSE WEBSITE (URL)	chemistry.uoc.gr/eclass/courses/CHEM-UNDER126/		

(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*

- Experimental study of Fundamental concepts and light properties.
- Spectroscopy, Kinetics, distribution law gases.
- Practice about Physical Chemistry Laboratory. Safety in the Lab, Lab Book Keeping.
- Error propagation in the final experimental result. Accuracy and precision. Comparison experimental results with published literatures values.
- Practice in writing a scientific paper.

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…*
	…….

- Searching analysis and synthesis data and information by contemporary technology application
- Writing creative and original lab reports
- Promote free and independ thinking about scientific data.

(3) SYLLABUS

Seminars

- Introduction
- Short course Thermodynamics I
- Short course Thermodynamics II
- Presentation Experiment Vapor pressure liquid
- Topics and comments to Vapor pressure Experiment Questions
- Presentation: Joule-Thomson effect
- Topics and comments to Joule Thomson experiment
- Short course to Statistical Thermodynamics
- Statistical Thermodynamics Introduction
- Presentation: Experiment Heat capacity solids
- Topics and comments to Heat capacity of solids.
- Presentation Gas Heat capacity
- Principle of Kinetics Experiment Viscidity liquid
- Topics and comments to Heat capacity of solids.

Electrochemistry presntationQDetermination of Faraday constant Experimens

A1 - Temperature Dependence of pure water vapor pressure
A2 - Joule-Thomson effect
A3 - Heat capacity determination of air
A3b- Determination of cp/cv ratio(γ) of a gas by the Kund's Tube
B8 - Heat capacity determination of metals
B10 –Faraday constant determination via water electrolysis
B13 –Temperature Dependence of Glycerol viscosity

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face,
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	eclass email
TEACHING METHODS	Activity: Laboratory practical work — Semester workload: 24

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*	Lectures 26 writing reports 50 Work-presentation, Final Exam 50 **Course total** **150**
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.*	Language Greek 45% Lab reports 45% Final Examination 10% Lab book

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Atkins: Physical chemistry / Peter Atkins, Julio de Paula. (gr tr)Crete University Press, 2014

- Stavros Farantos: Thermodynamics a geometric Intepretation http://tccc.iesl.forth.gr/education/local/Thermodynamics/book.pdf
- Kitsopoulos T., Rizos A., Stratigakis N.:Experiments in Physical Chemistry Iraklion 2018 el. ed.
- Garland. C., Nibler, J. and Shoemaker, D., Experiments in physical chemistry, 7th Edition (McGraw-Hill, New York, 2003
- Lide, D., Handbook of chemistry and physics, 82 ed. CRC Press, Boca Ruton, Fl 2001-02
- Dean Lange's Handbook of chemistry, 15ed, Mc Graw Hill, NY, 1999
- Perry Chilton Chemical engineers handbook, 5th ed., Mc Graw Hill, NY, 1973
- Bogosian , Chemical Thermodynamics, EAP, Patra 2008
- Mavrantzas Statistical Thermodynamics , EAP, Patra 2001
- Oikonomou Statistical Physics and Thermodynamics CUP Iraklio 2001
- ManBlundell, S. and Blundell, K., Thermal Physics,(gr,tr) CUP, Iraklio, 2017
- Mandl Statistical Physics (gr tr) Pnevmaticos ed , Athens 2013

COURSE OUTLINE
CHEM-501 BIOCHEMISTRY LABORATORY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-501	**SEMESTER**	6
COURSE TITLE	BIOCHEMISTRY LABORATORY		
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	4	6
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*	General background		
PREREQUISITE COURSES:	Courses: Biochemistry I and II		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course Biochemistry Laboratory acquaints the student with modern techniques of isolation, and analysis of biomolecules that usually are applied in biochemistry and related fields laboratories. In addition, the necessary theoretical knowledge of biochemistry techniques is acquired through introductory lectures in laboratory exercises, while experimental exercises contribute to the better consolidation of this knowledge. The course, finally, cultivates basic laboratory skills as well as scientific and critical thinking. Upon successful completion of the course the student will be able to:

• Use correctly basic laboratory equipment such as precision pipettes, pH meters, centrifuges, chromatographic columns, electrophoresis devices, photometers, etc.

• Understand and apply basic biochemistry techniques for the study of biomolecules

• Understand the process of performing an experiment (organization chart, preparation, use of indicators to compare results)

• Perform calculations and intervene, if necessary, in the various steps of an experimental process

• To process and interpret the results of the experimental exercises and to draw conclusions from them

• To apply the knowledge and skills acquired in the design of new experiments at the appropriate time and place

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently

- Team work
- Criticism and self-criticism
- Respect for the natural environment
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. Preparation of Buffer solutions
-Learn how to choose and prepare a buffer
- Response of the pH to the dilution of the buffer
- Response of buffered and unbuffered systems to addition of acids and bases

2. Isolation and characterization of bovine milk α-lactalbumin (4 lab days)
- Preparation of milk whey (casein removal)
- Affinity chromatography (separation of α-lactalbumin from β-lactoglobulin)
- Bradford protein assay in milk whey and chromatography samples
- SDS-PAGE of α-lactalbumin

3. Identification of α-lactalbumin by SDS-PAGE and Western blotting (2 lab days)
- Electroblotting
- Detection of blotted α-lactalbumin using an α-lactalbumin primary antibody conjugated with horseradish peroxidase

4. Enzyme characteristics studying using two different enzyme reactions
i) Catechol oxidase from potato extract
- Observe the action of the enzyme
- Observe the effect that phenylthiourea has in the enzymatic activity and classify the type of inhibition as competitive or noncompetitive.
- Observe the high substrate selectivity of catechol oxidase

ii) Enzyme hydrolysis of starch
- Determine the effect of amylase Concentration variation on the rate of starch digestion.
- Observe the effect of pH and Temperature variation on the enzyme activity.

5. Pigment isolation and characterization from plant leaves
- Extraction of pigments with organic solvents
- Paper chromatography and elution of pigments
- Measurement of visible absorption spectrum
- Effect of pH variation in the structure and color of water-soluble plant pigments.

6. Extraction and characterization of bacterial DNA
- Introduction to a general method for isolation and partial purification of DNA from E. coli.
- Evaluation of DNA purity using UV absorption and thermal denaturation (hyperchromic effect)

7. Enzyme kinetics of tyrosinase
-Observe and analyse the effects of changing enzyme concentration on initial reaction rates
-Observe and analyse the effects of changing substrate concentration on initial reaction rates
-Construct υ vs. [S] plots and estimate Km and Vmax
-Construct Lineweaver-Burk plots and estimate Km and Vmax
-Calculate kcat given total enzyme concentrations

8. Analysis of DNA restriction fragments

-Prepare agarose gels and load DNA samples
-Conduct restriction digestion reactions
-Analyze DNA fragments and determine their molecular weight

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Open e Class • MsTeams for communication with students, pre–lab test for students, experimental reports
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** Laboratory practice: 44 Pre lab lecture: 22 Preparation for laboratory: 22 Essay writing: 33 Preparation and Final examination: 29 Course total: 150 • Pre-lab tests and preparation of lab book before performing the experiment • Lecture /discussion before performing the experiment • Laboratory practice • Report writing
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*	Greek language Final written examination: 55% (requirement to write at least 5/10) Reports: 15% Laboratory work (preparation, examination, laboratory work etc): 30% The evaluation criteria are announced in the presentation of the course and in the laboratory experiment program and Ms Teams.

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Biochemistry Experiments Laboratory manual, Kalliopi Kavelaki and Maria Fouskaki 2018
- Modern Experimental Biochemistry-Rodney Boyer, translation in Greek Nikos Lydakis-Simantiris, Kostarakis Ed. 2018
- Experiments in Biochemistry, A Hands-on Approach, Shawn O. Farrell
- Biochemistry-Garrett and Grisham

ELECTIVE COURSES

COURSE OUTLINE

CHEM-056 CHEMISTRY OF ADVANCED MATERIALS

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-056	**SEMESTER**	7
COURSE TITLE	CHEMISTRY OF ADVANCED MATERIALS		
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		4	6
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*	Optional course General background, general knowledge, skills development		
PREREQUISITE COURSES:	Basic knowledge of General Chemistry, Inorganic Chemistry, Organic Chemistry and Physical Chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/ptrikalitis/		

(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*

The course introduces the students to the field of advanced materials chemistry. Students acquire significant knowledge on structure, crystallography and structure-property relationships. They understand structure of basic solids and their properties. The students understood that the properties of a non-molecular solid (solid having an extended structure) depend not only on its chemical composition but also on the way atoms are linked to each other. An introduction is provided to the characterization of crystalline materials using X-ray diffraction measurement from single-crystals and powders. Characteristic examples such the structure of graphite and Diamond are presented analyzed. In this context, the concept of band structure in solids is described and students understand important properties of metals, semiconductors and insulators. Emphasis is given to the elements of group 14 of the periodic table (C, Si, Ge, Sn, Pb) and their compounds. Next, an introduction is given to advanced nano-materials such as nanoparticles, quantum dots, nano-tubes and nano-wires. In this context, the basic operational principles of scanning (SEM) and transmission electron microscopes (TEM) are described, which represent the basic instruments for studying nanomaterials. Subsequently, special classes of advanced materials such as thermoelectrics and porous materials are p[resented and discusses. In particular, regarding advanced porous solids, the students are introduced into the field of MOFs (metal organic frameworks) and to their most innovative applications, including adsorption and separation of gases, as well as in biomedical sciences (immobilization of pharmaceutical compounds).

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Independent work
- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

- Introduction to solid compounds with emphasis on crystalline non-molecular solids
- Characterization of crystalline materials using X-ray diffraction experiments
- Chemistry of the group 14 elements and their compounds (C, Si, Ge, Sn)
- Metals, semiconductors, insulators
- Band theory (basic concepts)
- Advanced nano-materials:
- Nanoparticles
- Quantum dots
- Nanotubes & Nano Wires
- Scanning (SEM) and transmission electron microscopy (TEM)
- Introduction to thermoelectric materials
- Introduction to porous materials
- Classic porous solids (Zeolites, AlPO4, MCM type)
- Porous Coordination Polymers (PCPs or Metal-Organic Frameworks, MOFs)
- Determination of specific surface area and pore size distribution
- Properties and applications of advanced porous materials
- Gas adsorption and separation (H2, CO2/CH4, CO2/N2/O2)
- Bio-medical applications (Drug Delivery Systems & Gas Storage for Medical Applications)

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face (classroom)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Email
• Class website
• Departmental website-Study guide
• Classweb</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></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Study</td><td>75</td></tr>
<tr><td>Oral presentation</td><td>20</td></tr>
<tr><td>Final examination</td><td>3</td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure</td><td>Greek language

The final grade of the course comes from:</td></tr>
</table>

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.*	• Oral presentation of a special topic (20 min in the class room) (30 %) • final written examination (duration 3 hours) (70 %)

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

- Basic Solid State Chemistry" 2nd Ed. by Anthony R. West, JOHN WILEY & SONS 2002
- "Inorganic Chemistry" by Mark Weller and Tina Overton
- Powerpoint presentations and other electronic material used during lectures
- Selected scientific papers published in international peer-reviewed journals and can be found in the website of the class

COURSE OUTLINE
CHEM-057 INORGANIC BIOMATERIALS

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-057	**SEMESTER**	7
COURSE TITLE	INORGANIC BIOMATERIALS		
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		4	6
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*	Special background Elective course		
PREREQUISITE COURSES:	Basic knowledge of Inorganic Chemistry and Biochemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (selected chapters are also delivered in English)		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/demadis/home.html (follow the link “teaching”)		

(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*

The course introduces the 4th year student to the concepts of inorganic materials found in living organisms, describing their structures and functions. After the students have acquired basic knowledge in the subfields of Inorganic Chemistry and Biochemistry, they will acquire more specialized knowledge of the field of Inorganic Biomaterials. This area of chemistry is mainly concerned with inorganic materials found in living organisms and performing specific functions that support the organism's life (for example, support, movement, etc.).

Students, after successfully completing the course, will:

• Possess the basic principles of the chemistry of materials found in living organisms.

• Be familiar with the structure and operation of a large number of inorganic salts.

• They will be able to link the concepts of structure and function.

• Be familiar with the functions that require the presence of inorganic salts.

• They will comprehend the content of the theories on crystal growth.

• They will know the applications of inorganic biomaterials.

• Have knowledge of selected applications of inorganic biomaterials in biology, medicine, pharmaceutics, 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 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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new developments and technologies
- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas

- Criticism and self-criticism

(3) SYLLABUS

(1) Introduction: Inorganic structures of Life
  (a) Biomineralization: definitions, introductory remarks
  (b) Biomineralization: a new type of chemistry
(2) Biomineral types and their functions
  (a) Calcium carbonate
    (i) Shells
    (ii) Gravity sensors
    (iii) Lenses
  (b) Calcium phosphates
    (i) Bone
    (ii) Teeth
  (c) Silicon dioxide (silica)
  (d) Iron oxides
    (i) Magnetotactic bacteria
    (ii) Iron-based proteins
    (iii) Iron teeth
  (e) Metal sulfides
(3) General principles of biomineralization
  (a) Biologically-induced biomineralization
  (b) Biologically-controlled biomineralization
  (c) Biologically-influenced biomineralization
  (d) Control mechanisms
(4) Chemical control of biomineralization (Part 1)
  (a) Solubility
  (b) Solubility product
  (c) Supersaturation
  (d) Nucleation
(5) Chemical control of biomineralization (Part 2)
  (a) Crystal growth
  (b) Crystal growth inhibition
  (c) Crystal morphology
  (d) Polymorphism
  (e) Phase transformations
(6) Boundary-organized biomineralization
(a) Spatial boundaries
  (i) Phospholipids
  (ii) Ferritin
  (iii) Cellular architectures
  (iv) Macromolecular architectures
(b) Supersaturation control
(c) Ion transport
(d) Ion flux during calcification
(7) Biomineralization in organic frameworks
(a) Organic frameworks as mechanical supports
(b) Macromolecules
(c) Macromolecules in bone (collagen and other proteins)
(d) Proteins in teeth
(e) Proteins in shells

(f) Macromolecules in silica (diatoms and sponges)
(g) Nucleation induced by organic frameworks
(8) Morphogenesis
(a) Symmetry
(b) Chemical control
(c) Physical control
(d) Supramolecular structure formation
(9) Biomineral tectonics
(a) Hierarchical structures
(b) Pre-construction
(c) Higher-order formation
(d) Multilevel processing
(10)Pathological Biomineralization
(a) Osteoporosis
(b) Medical devices, tissue engineering
(c) Osteoarthritis
(d) Biomaterials in dentistry
(e) Stones (urinary, gall, etc)
(11) Biomaterials based on silicon
(a) Chemistry and biology of "Si"
(b) "Si" biotransport
(c) "Si" speciation
(d) Silica formation
(e) Control of silica fprmation
(f) Role of biopolymers
(12)Biomineral-inspired chemistry (Part 1)
(a) Synthesis in confined spaces
(b) Template synthesis
(c) Morphosynthesis and biomimetics
(d) Crystal tectonics
(13)Biomineral-inspired chemistry (Part 2)
(a) Ceramics
(b) Magnetic materials
(c) Composites
(d) Porous materials
(e) Biomedical grafts and scaffolds

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Social Media (closed group in Facebook) • Departmental website-Study guide • Classweb
TEACHING METHODS *The manner and methods of teaching are described in detail.*	***Activity*** | ***Semester workload***

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*	Lectures: 52 Study: 70 Literature project-presentation, Final examination: 28 Course total: 150
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.*	Student performance evaluation is based on two activities: (a) A compulsory written literature review (during the semester), and (b) The final exam at the end of the semester. The language of the course, as well as the evaluation process, is Greek. However, selected lectures are delivered in English, in order to familiarize the students with the English terminology. The final grade of the course is derived from: • 50 % of the written review • 50 % of the final exam of 3 hours duration. The criteria are accessible to students who become members of the closed group on Facebook.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Biomineralization: Principles and Concepts in Bioinorganic Materials Chemistry», Stephen Mann, Oxford University Press (ISBN 0-19-850882-4).
- Handbook of Biomineralization», E. Bäuerlein, Wiley-VCH, 2009
- PowerPoint presentation slides and other electronic material used during teaching in the class

COURSE OUTLINE
CHEM-058 SOFT CONDENSED MATTER

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-058	**SEMESTER**	7
COURSE TITLE	SOFT CONDENSED MATTER		
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	4	6
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*	Specialized general knowledge Elective course		
PREREQUISITE COURSES:	Basic knowledge of Physical Chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (If there are Erasmus students, it is taught in English)		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course aimed at exposing the students to the subject of soft condensed matter. Soft matter or soft condensed matter is a subfield of condensed matter comprising a variety of physical systems that are neither simple liquids nor crystalline solids of the types studied in other fields of solid state physics. Such systems include polymers, colloids, liquid crystals, amphiphilic molecules, biomolecules, etc. Many of such materials are familiar from everyday life such as plastics, glues, paints, soaps, shampoo and foams, food as well as many electronic devices. Basic common characteristic is that they can be deformed or structurally altered by thermal or mechanical stresses of the magnitude of thermal fluctuations.

The materials we discuss include colloidal dispersions, where submicrometer particles of solid or liquid are dispersed in another liquid, polymer melts and solutions, where the size and connectivity of the macromolecules lead to striking new properties (like viscoelasticity) that are very different to those of a simple liquid, and liquid crystals, where an anisotropic molecular shape leads to states with a degree of ordering intermediate between a crystalline solid and a liquid.

What is common among these systems? It is these common characteristics that allows us to consider them as a class of materials:

The importance of length scales (from ~10 nanometers to <1 micrometer) intermediate between atomic sizes and macroscopic scales

- Their basic interactions are week interactions van der Waals, which, however, can lead to phases with different symmetries and to phase transitions between those
- The importance of Browning motion and thermal fluctuations that control their behavior

The propensity of soft matter to self-assemble. This self-assembly can take place at the level of the molecules but even more complexity occurs when ordering takes place hierarchically, with molecules coming together to form supramolecular structures, which themselves order at a higher level.

The students, after successfully completing the course, will

- understand the basic principles of interactions, dynamics, phase transitions and supramolecular self-assembly that characterize soft condensed matter
- possess the basic knowledge for some of the basic characteristics and properties of polymers, colloids, liquid crystals, amphiphiles, biomaterials
- be exposed to issues of self-assembly and hieratchical organization in these important systems

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 *Project planning and management*

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*	*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* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Working in an interdisciplinary environment
- Production of new research ideas
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. **Introduction**
   What is soft condensed matter
2. **Forces, Energies and Timescales in Condensed Matter**
   Intermolecular forces and condensed matters; Viscous, elastic and viscoelastic behavior; Liquids and glasses
3. **Phase transitions**
   Basic principles; Liquid-liquid phase separation and phase separation kinetics; Liquid-solid phase transitions
4. **Polymers**
   Basic principles; Random walks and the dimension of polymer chains; Viscoelasticity and the reputation model
5. **Colloidal Dispersions**
   Stokes' law and the Brownian motion; Forces between colloidal particles; Stability and phase behavior of colloids
6. **Liquid Crystals**
   Liquid crystal phases; The nematic/isotropic transition; Topological defects in liquid crystals; Electrical and magnetic properties; Polymer liquid crystals
7. **Supramolecular Self-Assembly**
   Amphiphilic molecules and self-assembled phases; Self-assembly in polymers
8. **Biomolecules**
   Soft matter and nature; Nucleic acids; Proteins; Polysaccharides; Membranes
9. **Organic Electronic Materials and Devices**
   Basic principles of electronic materials; Basic semiconductor devices; Electronic devices based on organic/polymer materials

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Electronic mail
• Departmental website-Study guide</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></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Study</td><td>50</td></tr>
<tr><td>Literature project-presentation, Final examination</td><td>48</td></tr>
<tr><td>Course total</td><td>150</td></tr>
<tr><td></td><td></td></tr>
</table>
</td></tr>
<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>Greek language (English if there is an Erasmus student)

During the course, the students are responsible to prepare and present an obligatory literature project, based on a research publication or a review article on a subject that belongs to the general area of soft condensed matter. The written term paper on the paper should be less that ~10 pages (and not a translation of the article) whereas the students have to prepare and present an oral presentation utilizing PowerPoint

The final grade of the course results from:
• Written term-paper on a research publication (30% of the final grade)
• Oral presentation of the term-paper, degree of understanding the research subject and response to questions, (70% of the final grade)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

- R. A. L. Jones, “Soft Condensed Matter”, Oxford University Press, Oxford, 2002
- I. W. Hamley, “Introduction to Soft Matter”, John Willey and Sons, New York, 2000
- M. Daoud & C. E. Williams, Eds. “Soft Matter Physics”, Springer, 1999
- P. C. Hiemenz & T. P. Lodge, “Polymer Chemistry”, 2nd Edition, CRC Press, Boca Raton, 2007
- G. Strobl, “Condensed Matter Physics: Crystals, Liquids, Liquid Crystals, and Polymers”, Springer, 2004

- W. D. Callister, Jr., “Materials Science and Engineering. An Introduction”, Wiley, New York, 7th Edition, 2006
- Κ. Παναγιώτου, “Επιστήμη και Τεχνολογία Πολυμερών”, Εκδόσεις Πήγασος 2000, Θεσσαλονίκη, 1996.
- M. Doi, “Introduction to Polymer Physics”, Oxford Science Publ. Oxford, 1996.
- A. Yu Grosberg, A. R. Khokhlov, “Giant Molecules”, Academic Press, 1997
- M. Rubinstein and R. H. Colby, “Polymer Physics”, Oxford University Pres, Oxford, 2003
- D. F. Evans, H. Wennerström, “The Colloidal Domain, Where Physics, Chemistry, Biology and Technology Meet”, 2nd Edition, John Willey and Sons, New York, 1999.
- J. B. Park, R. S. Lakes, “Biomaterials: An Introduction”, Plenum Pub. Corp., 1992.
- B. D. Ratner, F. J. Schoen, A. S. Hoffman, J. E. Lemons, “Biomaterials Science: An Introduction to Materials in Medicine”, Elsevier Science & Technology Books, 2nd Edition, 2004
- S. O. Kasap, “Principles of Electronic Materials and Devices”, McGraw Hill; 2rd edition, 2002

COURSE OUTLINE
CHEM-060 ENZYME BIOTECHNOLOGY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-060	**SEMESTER**	7
COURSE TITLE	ENZYME BIOTECHNOLOGY		
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	4	6
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*	Specialised general knowledge		
PREREQUISITE COURSES:	Basic knowledge of Biology, Biochemistry and Organic Chemistry.		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

Enzyme Biotechnology is by default a multidisciplinary field that brings together Organic Chemistry, Biochemistry, Microbiology, Genetics, Molecular Biology, Chemical Engineering, Bioinformatics, Physics and other sciences.

The main purpose of the course is to educate students on enzymology and on methodology in current biotechnology, in order to be able to respond to key issues such as environmental protection and to develop new industrial (bio) processes, in line with the principles of green chemistry.

The expected learning outcomes and abilities that students will develop are as follows:

• Deepening the biochemical, microbiological and genetic fundamental understanding of biotechnological applications.
• Basic understanding of metabolic engineering and mechanical processes
• Introducing basic biotechnological methods
• Understanding the width of current biotechnological methods
• Autonomous preparation of a review for a topic
• Development of communication, organization and co-operation skills
• Developing English language skills and terminology

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking

(3) SYLLABUS

Contents of lectures:

1. Introduction to enzymology (amino acids, structure, onomatology, categories, theories on specificity etc)
2. Enzyme kinetics
3. Catalytic mechanisms
4. Regulation of enzyme activity (inhibition/activation)
5. Biocatalyst immobilization
6. Bioprocesses and bioreactor types
7. Biocatalysis in non-conventional media
8. Downstream processing
9. Biocatalytic strategies - Enzymatic cascades
10. Biocatalytic applications

Contents of seminar:

1. Introduction to the molecular biology of the recombinant DNA
2. Molecular biology methods
3. Methods of cloning
4. Genome editing methods
5. Expression systems
6. Methods of cell lysis and sterilization
7. Methods of protein purification
8. Protein Engineering Principles
9. Analytics for determination of enzymatic activity
10. Methods of structure determination

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Open eClass / Classweb • Powerpoint presentations • Poll Everywhere during lectures • Specialized softwares and databases
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*	

Activity	***Semester workload***
Lectures	26
Seminars	26
Study and preparation for seminars	70
Preparation and Final examination	28

according to the principles of the ECTS			
	Course total	150	

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.*	Greek language The students prepare in the seminars short presentations (5 min) in topics of the methodology on heterologous expression and the subsequent applications. After the preseatntations, there is a round table discussion. The final grade of the course comes from: • Oral presentation in the seminars and active participation in the round tables (30% of the final grade) • Final written examination, lasting 3 hours, (70% of the final grade)

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

- "Enzyme Biocatalysis: Principles and applications" A. Illanés. 2008, Springer Science. ISBN: 978-1-4020-8360-0
- "Biocatalysts & Enzyme Technology" K. Buchholz / V. Kasche / U.T. Bornscheuer. 2012, Wiley-VCH. ISBN: 978-3-527-32989-2
- PowerPoint presentation slides and other electronic material used during teaching in the class

COURSE OUTLINE

CHEM-109 ACADEMIC ENGLISH AND CHEMISTRY TERMINOLOGY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-109	**SEMESTER**	7
COURSE TITLE	ACADEMIC ENGLISH AND CHEMISTRY TERMINOLOGY		
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	4	4
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*	It is compulsory course that provides a general background on General Chemistry vocabulary in English and academic skills development.		
PREREQUISITE COURSES:	Basic knowledge of English (Level B1)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://chemistryenglish.wordpress.com/writing-like-a-chemist-scientific-conventions-in-chemistry-papers/ and http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course introduces the student to the field of TECHNICAL WRITING, RESEARCH WRITING AND Academic English and in particular it enhances student understanding and production of academic texts in the field of Chemistry.

Through the course the students will acquire the basic knowledge for the writing conventions prior to publication in peer-reviewed journals. They will also practice lectures in English in Chemistry and oral presentation of Chemistry subjects. It includes the presentation of specific texts and techniques that have been established in the field of Academic and Technical Writing.

The course offers extensive analysis of written and spoken language genres in General Chemistry.

Students, after successfully completing the course:

- will acquire the basic principles for writing a laboratory reference in English
- will be familiar with key chemical terms
- will have be aware of key principles of writing and oral presentation of chemistry-related topics.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas
- Critical Thinking

(3) SYLLABUS

Academic English and Chemistry Terminology

Week 1

Introduction to Presentations¨From transcript to slides, Protocells (Ted Talk)
Introduction to Academic writing features
Homework

1. Student first (three) slides and a short report on what constitutes a scientific presentation (200 words
2. Answer questions on Edpuzzle video
3. Choice of topic for presentations
4. Peer feedback (1)

Week 2

Student presentations (maximum 6) followed by peer and teacher feedback.
Video on â€œDesigning effective slides for Scientific Presentationsâ€
Types of papers, Structure of IMRD paper
Example of Organic Chemistry paper
Homework
Re-design your slides based on video input.
Give written feedback to student-presenter

Week 3

Student presentations (maximum 6) followed by peer and teacher feedback.
Chemistry Terminology Â (Amide Bond Formation) and Academic Conventions
Homework

1. Watch three videos in order to answer a quiz in class
2. Write another report on what constitutes scientific presentations based on the most recent video and class input.
3. Write a short paragraph on Edmodo stating what experimental you are planning to write as a Mock Paper and explain why (rationale).

Week 4

Class quiz on Socrative
BYOD: Design slides with WORD TABLES using information from the paper on â€œPolymer radiation and Recyclingâ€ in class (Group work)
Introduction to Methods section

Week 5

Reading, explaining and vocab tasks on Analytical Chemistry paper on Î²-carotene.
SCIENTIFIC WRITING WORKSHOPS: METHODS
HW: Prepare pair presentation of an analytical chemistry paper on â€œÎ²-caroteneâ€ using google slides.

Week 6

Student pair presentations and teacher feedback
SCIENTIFIC WRITING WORKSHOPS: RESULTS
Hand-in Methods and Results section of your mock IMRD paper and PEER review (week 7)

Week 7

Writing methods and results section (part 2)
SCIENTIFIC WRITING WORKSHOPS: DISCUSSION
HAND_IN DATE (IMRD paper part 1)
For more go to:
https://docs.google.com/document/d/1ONgMH1a0lPCZJ2I5BI3ieqifGQphQ94SBVRC0p3GGEc/edit?usp=sharing

Thu*
4th
April
SCIENTIFIC WRITING WORKSHOPS: INTRODUCTION and ABSTRACT
(Postgraduate students will also be attending)
Homework
Tue
Choose a topic for a Mock Review paper and post it on Edmodo
Thu
Hand-in discussion and introduction of Mock IMRD paper for peer review (week 9)

Week 9
Tue
Seminar of â€œHow you can paraphrase legitimatelyâ€
Thu*
11th
April
SCIENTIFIC WRITING WORKSHOPS:
Introduction to REVIEW PAPERS
(Postgraduate students will also be attending)
Homework
Tue
(-)

Thu
HAND_IN DATE (IMRD paper part 2)
Assessed
Week 10
Tue
Examining the language of critical reviews (part 2)

Thu
How to design a scientific poster
Video: Scientific Poster presentation
Homework
Tue
Hand-in student presentation (on MOCK IMRD or on MOCK REVIEW paper) for PEER-review
Peer-review is
assessed
Thu
Hand-in student mock REVIEW paper for PEER-review

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Electronic mail Departmental website-Study guide Edmodo and Course site

<table>
<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</td><td>30</td></tr>
<tr><td>Study</td><td>20</td></tr>
<tr><td>Literature project-presentation</td><td>12</td></tr>
<tr><td>Final examination</td><td>8</td></tr>
<tr><td>Course total</td><td>80</td></tr>
</table>
</td>
</tr>
<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>English language

During the last period of the teaching activity a personalised obligatory literature project is given to each student, in order to prepare an oral presentation and submit a mock Chemistry paper (IMRD and/or Review paper)

The specific subject related to the content of the course comes from the scientific literature, usually peer-reviewed international journals.

The final grade of the course comes from:
• 40% Class Attendance and contribution, peer-review and follow-up revisions
• 60% 10 pieces of coursework (presentations, part of an IMRD paper scientific poster and part of a review paper)</td>
</tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Robinson M. S. et al. Write like a Chemist; Oxford University Press: Oxford; 2008.
- Weissberg and Buker. Writing up Research; Experimental Research report writing for students of English. Prentice Hall Regents. 1990.

COURSE OUTLINE
CHEM-120 ADVANCED BIOCHEMISTRY LABORATORY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-120	**SEMESTER**	7
COURSE TITLE	ADVANCED BIOCHEMISTRY LABORATORY		
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	4	6
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*	Specialised general knowledge and skills developmenrt		
PREREQUISITE COURSES:	Courses: Biochemistry I and II Lab courses: Biochemistry laboratory		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The main learning objectives of biochemistry laboratories are summarized below:

1. Skill development and training on modern biochemistry techniques.

The skills developed include the correct use of precision pipettes, proper use of pH meters, proper balancing for centrifugation, filling column chromatography, setting up an electrophoresis device, etc. These skills will be used timely in the respective specific experiments.

2. Scientific thinking development.

This includes, among other things, the ability to perform calculations at the various stages of the experimental process and design the process of the experiment (organization chart, use of result comparison indicators), ability to process the results and extract productive conclusions from them.

3. Learning and understanding the corresponding theory behind the experiments.

Basic knowledge of biochemistry and related topics is obtained through the lectures in the respective lessons, but no doubt the experience gained from the application of this knowledge in a biochemistry workshop contributes greatly to their better embedding. As the lab does not go hand in hand with the lectures for all students, all necessary theoretical background is introduced at the beginning of each experiment. A deep understanding of the theory behind the techniques is necessary so that the student has the ability to apply techniques he has learned in new situations when it is time to design his own experiments from the beginning.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Criticism and self-criticism
- Respect for the natural environment
- Production of free, creative and inductive thinking

(3) SYLLABUS

In advanced biochemistry laboratories, experiments have been selected in such a way that students further expand their understanding and the toolbox of techniques they have been familiarized with in previous laboratories. Specifically:
1. Separation and amino acid identification: A solution of various amino acids is analysed using a cation exchange column and then identified by TLC. The isoelectric point of amino acid glycine is also determined by baseline titration at 2 laboratory days.
2. Isoelectric focusing and 2D-electrophoresis: Separation of a protein mixture initially based on their isoelectric point and then based on their molecular weight-2 laboratory days.
3. Photon-induced transport of protons to chloroplast membranes: In this experiment, spatula chloroplasts are irradiated, and using a pH meter, students can detect the formation of proton gradients across the membrane.
4. Redox reaction in biological samples: In vitro study of compounds of biological interest (vitamin C and redox systems of Photosystems I and II) using redox reactions.
5. Qualitative and Quantitative determination of carbohydrates: Qualitative (Benedict reagent, blue bottle experiment) and Quantitative (DNAS Method) determination of carbohydrates.
6. Activity and thermal stability of gel-immobilized peroxidase: Students trap molecules of the enzyme horse radish peroxidase within polyacrylamide gel matrix. The reaction kinetics and thermal stability of the immobilized peroxidase is measured and compared to those of the free enzyme.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face (classroom)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Open eClass</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,</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Laboratory practice</td><td>32</td></tr>
<tr><td>Preparation for laboratory</td><td>40</td></tr>
<tr><td>Essay writing</td><td>40</td></tr>
</table>
</td></tr>
</table>

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*	Preparation and Final examination: 38 Course total: 150 • Pre-lab tests and preparation of lab book before performing the experiment • Lecture /discussion before performing the experiment • Laboratory practice • Report writing
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.*	Greek language Final written examination: 50% (requirement to write at least 5/10) Reports: 15% Laboratory work (preparation, examination, laboratory work etc): 35% The evaluation criteria are announced in the presentation of the course and in the laboratory experiment program and e class.

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

- Biochemistry Advanced Experiments Laboratory manual, Kalliopi Kavelaki 2018
- Modern Experimental Biochemistry-Rodney Boyer
- Experiments in Biochemistry, A Hands-on Approach, Shawn O. Farrell
- Biochemistry-Garrett and Grisham

COURSE OUTLINE
CHEM-160 CHEMISTRY AND CURRENT TOPICS IN NUTRITION

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-160	**SEMESTER**	7
COURSE TITLE	CHEMISTRY AND CURRENT TOPICS IN NUTRITION		
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		4	6
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*	Specialised general knowledge Selective course		
PREREQUISITE COURSES:	Basic knowledge of Organic Chemistry, Biochemistry and Physical Chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/biopolymers/GX/info.htm		

(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*

During the last few years there has been an increased interest regarding the relation between diet and health. This is due to the important role nutrition plays throughout our lifetime, since this role affects the growth of our body during childhood, the risk for acute and chronic diseases as well as the maintenance of physiological biological processes. An important goal of this course is to help inform and clarify the knowledge about the relationship between our diet and the molecular processes that involve the food we eat. The course also includes the investigation of a series of political, social and economic choices that affect the diffusion and implementation of scientific conclusions on nutrition and how the various organizations (countries, European Union, international humanitarian organizations, scientific organizations) are tackling the solution of nutritional problems. This course provides a new depth of objective information on increasingly salient issues and is essential for all those interested in the relationship between diet and our health.

Completion of the course is achieved by

(a) The consolidation of the principles of healthy eating.

(b) Understanding the role of food for the long-term preservation of health and longevity and its importance for the prevention and treatment of chronic diseases.

(c) Obtaining the ability to interpret and critically review information relating to healthy eating.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

1. Introduction

2. Food categories
2.1 Carbohydrates
2.2 Lipids
2.3 Proteins, Enzymes, Hormones
2.4 Water soluble Vitamins
2.5 Fat soluble Vitamins
2.6 Minerals: Major and Trace Elements – for Life

3. Physicochemical and biochemical changes of food nutrients
3.1 The chemistry of trans fats - Hydrogenation
3.2 Oxidation of Foods - Auto-oxidation of Lipids
3.3 Physical and chemical changes of oil during deep-fat frying
3.4 Health implications

4. Food additives of color or taste
4.1 Natural antioxidants
4.2 Synthetic antioxidants
4.3 Applications of Antioxidants to Foods
4.4 Health implications

5. Connection between diet and our physiology in different diseases
5.1 Endocrine Disrupting Chemicals and implications on health
5.2 Fatty acids and implications on health
5.3 Carbohydrates and implications on health
5.4 Herbs and implications on health

6. Current nutritional topics
6.1 Functional foods
6.2 Diet foods
6.3 Genetically modified foods
6.2 Nanotechnology applications in food items

Purpose of the Course

During the last few years there has been an increased interest regarding the relation between diet and health. This is due to the important role nutrition plays throughout our lifetime, since this role affects the growth of our body during childhood, the risk for acute and chronic diseases as well as the maintenance of physiological biological processes. An important goal of this course is to help inform and clarify the knowledge about the relationship between our diet and the molecular processes that involve the food we eat. This course provides a new depth of objective information on increasingly salient issues and is essential for all those interested in the relationship between diet and our health.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face (classroom)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Electronic mail
• Departmental website-Study guide
• Classweb</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></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Study</td><td>70</td></tr>
<tr><td>Literature project-presentation, Final examination</td><td>28</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<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>Greek and English language

During the last period of the teaching activity a personalized project is given to each student, in order to prepare an oral presentation by searching the international scientific literature.

The final grade of the course comes from:
• Class participation (10% of the final grade)
• Personalized project (30% of the final grade)
• Final written examination, (60% of the final grade)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Διατροφή και Χημεία Τροφίμων στη Δημόσια Υγεία των Κοτροκόη Κ.,Παπαδογιαννάκη Ε.., (BROKEN HILL PUBLISHERS LTD)
- «Χημεία Τροφίμων», Δ. Μπόσκου (ΓΑΡΤΑΓΑΝΗΣ ΑΓΙΣ-ΣΑΒΒΑΣ).
- "Food Chemistry", H.-D. Belitz, W. Grosch, P. Schieberle (Εκδόσεις Τζιόλα)
- PowerPoint presentation slides

COURSE OUTLINE
CHEM-161 COMPUTATIONAL CHEMISTRY WITH APPLICATIONS TO MOLECULES, MATERIALS AND THE ENVIRONMENT –I

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-161	**SEMESTER**	7
COURSE TITLE	COMPUTATIONAL CHEMISTRY WITH APPLICATIONS TO MOLECULES, MATERIALS AND THE ENVIRONMENT –I		
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 laboratory exercises	4	6
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*	Special background Selective course		
PREREQUISITE COURSES:	Basic knowledge of computers		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course aims to introduce the student to numerical programming in order to use it for physical-chemical calculations of varying complexity and application.

Students, after successfully completing the course:
• will possess the basic principles for communicating with computers running Linux
• will have learnt using the vi editor
• will have been introduced into the programming language fortran.

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…*
	…….

- Search, analyze and synthesize data and information, using the necessary technologies
- Adapt to new situations
- Autonomous work
- Teamwork

(3) SYLLABUS

1. Introduction to Computational Chemistry with application examples in the field of new materials, molecules and environment. The basic concepts of molecular simulations are developed.
2. Introduction to the operating system linux, the editor vi and creating scripts in bash (basic commands and programming exercises for the consolidation of knowledge)
3. Introduction to programming with fortran, basic commands and programming exercises for the consolidation of knowledge.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>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>• Electronic mail
• Departmental website-Study guide
• Laboratory education
• Classweb</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, laboratory practice</td><td>52</td></tr>
<tr><td>Study</td><td>90</td></tr>
<tr><td>Course personal Assignment, Oral presentation of results</td><td>8</td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure</td><td>Student’s performance is evaluated based on:

1. Programming exercises during the semester
2. A programming project and examination during its presentation to the teacher at the end of the semester. The exercise will lead to a numerical model that will be</td></tr>
</table>

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.*	written during the examination in the computer laboratory and will be presented to the teacher. The final grade of the course comes by: • 50% from the grade of the personalized project and • 50% the performance of the student in laboratory exercises during the course.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Summary notes by the teachers and e-books on linux and fortran available on the internet.

http://www.linux.org/forums/beginner-tutorials.53/

http://www.yolinux.com/TUTORIALS/LinuxTutorialHardware.html

http://www.pcc.qub.ac.uk/tec/courses/f90/stu-notes/F90_notesMIF_2.html

- Related academic journals:

COURSE OUTLINE

CHEM-404 ENVIRONMENTAL CHEMISTRY II (ATMOSPHERIC CHEMISTRY)

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-404	**SEMESTER**	7
COURSE TITLE	ENVIRONMENTAL CHEMISTRY II (ATMOSPHERIC 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, exercises	4	6
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*	Specialised general knowledge Selective course		
PREREQUISITE COURSES:	Basic knowledge on chemical kinetics and organic chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/ eclass web page https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER157/		

(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*

The course introduces the students to the basics of atmospheric chemistry, the chemical and physical processes that cause air pollution and to its effects. Through this course the students will acquire the basic knowledge about the chemistry and physics of the atmosphere, the sources of gaseous and particulate pollutants and the chemical reactions taking place in the atmosphere. The students will be also informed on the impacts of air pollution on climate, human health and ecosystems, which are of major societal concern and have led to the adoption of directives for air pollution abatement by the European Union and International Organizations.

With the successful completion of the course, the students
• will have acquire the basic principles for understanding atmospheric pollution incidences and the chemical reactions involved
• will be acquainted with the causes and impacts of the main environmental problems related to the atmospheric environment
• will have learned the methodology for understanding and investigating ways to cope with air pollution
• will be aware of environmental issues

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*
	Production of free, creative and inductive thinking

Working in an international environment *Working in an interdisciplinary environment* *Production of new research ideas*	…… *Others…* …….
• 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 interdisciplinary environment • Respect for the natural environment • Production of free, creative and inductive thinking • Production of new research ideas	

(3) SYLLABUS

The course will provide basic knowledge on the following topics and concepts:

- Structure and composition of the atmosphere.
- Greenhouse effect and climate change (energy balance, greenhouse gases, climatic role of greenhouse gases and aerosols, atmospheric emissions of carbon dioxide)
- Photochemistry in the atmosphere-endothermic and exothermic reactions in the environment- lifetime of air pollutants.
- Tropospheric ozone and physico-chemical processes of its formation and destruction, photochemical smog, urban pollution.
- Stratospheric ozone and physico-chemical processes of its formation and destruction. Impact of halogens on stratospheric ozone, ozone hole.
- Volatile organic compounds, nitrogen and sulfur compounds in the atmosphere.
- Particulate matter in the atmosphere, characterization, sources and removal form the atmosphere, impacts, acid rain.

For each module, 1-2 hours (depending on the length of the section) are dedicated to exercises.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	

<table>
<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, exercises</td><td>52</td></tr>
<tr><td>Study</td><td>80</td></tr>
<tr><td>Literature project-presentation, Final examination</td><td>28</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>160</td></tr>
</table>
</td>
</tr>
<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>Greek language (or English when it concerns Erasmus student).

During teaching activity a personalized optional literature project is given to each student, in order to prepare an oral presentation of 15 min in the form of a powerpoint.

Success of the examination requires the success to the written test of the course, of duration of 3 hours.

The final grade of the course comes from:

oral presentation of personalized project (50% of the final grade)

Final written examination, lasting 3 hours, (50% of the final grade)</td>
</tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Notes from the lecturers on the eclass webpage

https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER157/

and literature available at the library or the internet:

Graedel and Crutzen (1933) Atmospheric Change An Earth perspective, Freeman eds

Richard Wayne (1993) Chemistry of Atmospheres, Oxford Univ., Clarendon Press.

Seinfeld & Pandis (2006) Atmospheric Chemistry and Physics, From air pollution to Global Change, John Wiley & Sons.

Jacobson M.Z. (1999) Fundamentals of Atmospheric Modeling, Cambridge Univ. Press.

Atkinson R. (2004) Evaluated kinetic and photochemical data for atmospheric chemistry: Volume I – gas phase reactions of Ox, HOx, NOx and SOx species, Atmos. Chem. Phys., 4, 1461–1738.

Jacob D. (2000) Introduction to Atmospheric Chemistry, Princeton University Press.

Spyro, Th G, & Stigliani W. M. (2003) Chemistry of the Environment, Prentice Hall, Pearson Education LTD.

- Related academic journals:

Nature, Nature Geoscience, Atmospheric Chemistry and Physics, Science, Proceedings of the National Academy of Science (PNAS), Atmospheric Environment, Environmental Science and Technology

COURSE OUTLINE
CHEM-421 BIOINORGANIC CHEMISTRY

1. GENERAL

ΣΧΟΛΗ	SCHOOL OF SCIENCES AND ENGINEERING		
ΤΜΗΜΑ	DEPARTMENT OF CHEMISTRY		
ΕΠΙΠΕΔΟ ΣΠΟΥΔΩΝ	UNDERGRADUATE		
ΚΩΔΙΚΟΣ ΜΑΘΗΜΑΤΟΣ	CHEM-421	**ΕΞΑΜΗΝΟ ΣΠΟΥΔΩΝ**	$5^{ο}$ & $7^{ο}$
ΤΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ	BIOINORGANIC CHEMISTRY		

ΑΥΤΟΤΕΛΕΙΣ ΔΙΔΑΚΤΙΚΕΣ ΔΡΑΣΤΗΡΙΟΤΗΤΕΣ	**ΕΒΔΟΜΑΔΙΑΙΕΣ ΩΡΕΣ ΔΙΔΑΣΚΑΛΙΑΣ**	**ΠΙΣΤΩΤΙΚΕΣ ΜΟΝΑΔΕΣ**
Lectures	4	6

ΤΥΠΟΣ ΜΑΘΗΜΑΤΟΣ *γενικού υποβάθρου, ειδικού υποβάθρου, ειδίκευσης* *γενικών γνώσεων, ανάπτυξης δεξιοτήτων*	Ειδικού υποβάθρου Μάθημα Επιλογής
ΠΡΟΑΠΑΙΤΟΥΜΕΝΑ ΜΑΘΗΜΑΤΑ:	Το μάθημα προϋποθέτει βασικές γνώσεις Οργανικής Χημείας, Βιοχημείας και Στερεοχημείας-
ΓΛΩΣΣΑ ΔΙΔΑΣΚΑΛΙΑΣ και ΕΞΕΤΑΣΕΩΝ:	Ελληνική.
ΤΟ ΜΑΘΗΜΑ ΠΡΟΣΦΕΡΕΤΑΙ ΣΕ ΦΟΙΤΗΤΕΣ ERASMUS	ΟΧΙ
ΗΛΕΚΤΡΟΝΙΚΗ ΣΕΛΙΔΑ ΜΑΘΗΜΑΤΟΣ (URL)	http://www.chemistry.uoc.gr/xhm420/index.htm

2. ΜΑΘΗΣΙΑΚΑ ΑΠΟΤΕΛΕΣΜΑΤΑ

Μαθησιακά Αποτελέσματα

Περιγράφονται τα μαθησιακά αποτελέσματα του μαθήματος οι συγκεκριμένες γνώσεις, δεξιότητες και ικανότητες καταλλήλου επιπέδου που θα αποκτήσουν οι φοιτητές μετά την επιτυχή ολοκλήρωση του μαθήματος.

Συμβουλευτείτε το Παράρτημα Α

- *Περιγραφή του Επιπέδου των Μαθησιακών Αποτελεσμάτων για κάθε ένα κύκλο σπουδών σύμφωνα με το Πλαίσιο Προσόντων του Ευρωπαϊκού Χώρου Ανώτατης Εκπαίδευσης*
- *Περιγραφικοί Δείκτες Επιπέδων 6, 7 & 8 του Ευρωπαϊκού Πλαισίου Προσόντων Διά Βίου Μάθησης και το Παράρτημα Β*
- *Περιληπτικός Οδηγός συγγραφής Μαθησιακών Αποτελεσμάτων*

Η αναφορά στο ρόλο των μεταλλικών στοιχείων στην βιοχημεία, βιολογία, ιατρική παρουσιάζεται με τέτοιο τρόπο ώστε να μπορούμε να κατανοήσουμε τη χημική δράση τους σε βιολογικά συστήματα. Αυτό μας θα μας βοηθήσει να δώσουμε απαντήσεις και λύσεις σε κοινά "προβλήματα" με τη βοήθεια της Χημείας, του Χημικού αλλά στην ουσία με την ... έννοια του χημικού δεσμού.! Μετά την περιγραφή των διαδικασιών που εμπλέκονται τα επιλεγμένα στοιχεία, εξηγείται ο ρόλος-μηχανισμός που λαμβάνει χώρα. Περιγράφεται η σύνθεση ενώσεων μοντέλων με στόχο την κατανόηση της λειτουργίας των φυσικών ενεργών κέντρων, ή την μίμηση της λειτουργίας των. Ο προβληματισμός των φοιτητών μας σε πεδία αιχμής, όπως αυτό του μαθήματος, τους δίνει την δυνατότητα να κατανοήσουν την διεπιστημονικότητα της ειδικότητας των και τους ανοίγει ένα από τα παράθυρα στο μέλλον της χημείας, μιας επιστήμης που εξελίσσεται αλλά και ... μεταλλάσσεται διαρκώς.!

Γενικές Ικανότητες

Λαμβάνοντας υπόψη τις γενικές ικανότητες που πρέπει να έχει αποκτήσει ο πτυχιούχος (όπως αυτές αναγράφονται στο Παράρτημα Διπλώματος και παρατίθενται ακολούθως) σε ποια / ποιες από αυτές αποσκοπεί το μάθημα;.

Αναζήτηση, ανάλυση και σύνθεση δεδομένων και πληροφοριών, με τη χρήση και των απαραίτητων τεχνολογιών	*Σχεδιασμός και διαχείριση έργων*
Προσαρμογή σε νέες καταστάσεις	*Σεβασμός στη διαφορετικότητα και στην πολυπολιτισμικότητα*
Λήψη αποφάσεων	*Σεβασμός στο φυσικό περιβάλλον*
Αυτόνομη εργασία	*Επίδειξη κοινωνικής, επαγγελματικής και ηθικής υπευθυνότητας και ευαισθησίας σε θέματα φύλου*
Ομαδική εργασία	*Άσκηση κριτικής και αυτοκριτικής*
Εργασία σε διεθνές περιβάλλον	*Προαγωγή της ελεύθερης, δημιουργικής και επαγωγικής σκέψης*
Εργασία σε διεπιστημονικό περιβάλλον	

Παράγωγή νέων ερευνητικών ιδεών	*……* *Άλλες*

- Αναζήτηση, ανάλυση και σύνθεση δεδομένων και πληροφοριών, με τη χρήση και των απαραίτητων φασματοσκοπικών μεθόδων
- Προσαρμογή σε νέες καταστάσεις
- Αυτόνομη εργασία – Προφορική παρουσίαση άρθρου σχετικά με την ύλη του μαθήματος
- Προαγωγή της ελεύθερης, δημιουργικής και επαγωγικής σκέψης
- Παραγωγή νέων ερευνητικών ιδεών

3. ΠΕΡΙΕΧΟΜΕΝΟ ΜΑΘΗΜΑΤΟΣ

- **ΕΙΣΑΓΩΓΗ ΣΤΗΝ ΒΙΟΑΝΟΡΓΑΝΗ ΧΗΜΕΙΑ**
- **ΤΑ ΙΧΝΟΣΤΟΙΧΕΙΑ IN VIVO**
- **ΣΥΜΠΛΟΚΕΣ ΕΝΩΣΕΙΣ IN VIVO**
- **Ο ΣΙΔΗΡΟΣ IN VIVO**
  - Γενικά για τις σιδηροπρωτεΐνες μεταφοράς ηλεκτρονίων
  - Σιδηροπορφυρίνες μεταφοράς ηλεκτρονίων με πορφυρινικό σύστημα
  - Πρωτεΐνες σιδήρου θείου
  - Σιδηροπρωτεΐνες μεταφοράς οξυγόνου
  - Πρωτεΐνες μεταφοράς και αποθήκευσης σιδήρου
- **ΤΟ ΜΟΛΥΒΔΕΝΙΟ IN VIVO**
  - Οξειδάση και αφυδρογονάση της ξανθίνης
  - Δέσμευση του αζώτου και κύκλος του αζώτου
- **Ο ΨΕΥΔΑΡΓΥΡΟΣ IN VIVO**
  - Γενικά για τον ψευδάργυρο
  - Ο ψευδάργυρος σαν ιχνοστοιχείο
  - Η τοξικότητα του Ψευδαργύρου
  - Βιολογική αξιοποίηση του Ψευδαργύρου
  - Ο δομικός του ρόλος
  - Γενικά για τα ένζυμα του Ψευδαργύρου
  - Καρβοξυπεπτιδάση-Μηχανισμός δράσης της-Μοντέλλα
  - Καρβονική ανυδράση-Πρότυπα
  - Αλκοολικές αφυδρογονάσες

- **Ο ΧΑΛΚΟΣ IN VIVO**
  - Γενικά για τον χαλκό
  - Ο χαλκός σαν ιχνοστοιχείο
  - Χαλκοπρωτείνες
  - Ο χαλκός ως φάρμακο
  - Τα σύμπλοκα του χαλκού ως παράγοντες ραδιοπροστασίας
- **ΤΟ ΧΡΩΜΙΟ IN VIVO**
- **ΤΟ ΒΑΝΑΔΙΟ IN VIVO**
  - Θαλάσσιοι οργανισμοί και ιχνοστοιχεία (marine organisms and trace metals)
  - Βιορυκτοποίηση (biomineralization)

4. ΔΙΔΑΚΤΙΚΕΣ και ΜΑΘΗΣΙΑΚΕΣ ΜΕΘΟΔΟΙ - ΑΞΙΟΛΟΓΗΣΗ

ΤΡΟΠΟΣ ΠΑΡΑΔΟΣΗΣ *Πρόσωπο με πρόσωπο, Εξ αποστάσεως εκπαίδευση κ.λπ.*	Πρόσωπο με πρόσωπο (αίθουσα διδασκαλίας)
ΧΡΗΣΗ ΤΕΧΝΟΛΟΓΙΩΝ ΠΛΗΡΟΦΟΡΙΑΣ ΚΑΙ ΕΠΙΚΟΙΝΩΝΙΩΝ *Χρήση Τ.Π.Ε. στη Διδασκαλία, στην Εργαστηριακή Εκπαίδευση, στην Επικοινωνία με τους φοιτητές*	• Ηλεκτρονικό ταχυδρομείο, facebook, skype για επικοινωνία • Ιστοσελίδα τμήματος-Οδηγός σπουδών
ΟΡΓΑΝΩΣΗ ΔΙΔΑΣΚΑΛΙΑΣ *Περιγράφονται αναλυτικά ο τρόπος και μέθοδοι διδασκαλίας.* *Διαλέξεις, Σεμινάρια, Εργαστηριακή Άσκηση, Άσκηση Πεδίου, Μελέτη & ανάλυση βιβλιογραφίας, Φροντιστήριο, Πρακτική (Τοποθέτηση), Κλινική Άσκηση, Καλλιτεχνικό Εργαστήριο, Διαδραστική διδασκαλία, Εκπαιδευτικές επισκέψεις, Εκπόνηση μελέτης (project), Συγγραφή εργασίας / εργασιών, Καλλιτεχνική δημιουργία, κ.λπ.* *Αναγράφονται οι ώρες μελέτης του φοιτητή για κάθε μαθησιακή*	

Δραστηριότητα	*Φόρτος Εργασίας Εξαμήνου*
Διαλέξεις	52
Μελέτη	70
Εργασία-παρουσίαση, Τελικό Διαγώνισμα	28
Σύνολο Μαθήματος	150

δραστηριότητα καθώς και οι ώρες μη καθοδηγούμενης μελέτης σύμφωνα με τις αρχές του ECTS	
ΑΞΙΟΛΟΓΗΣΗ ΦΟΙΤΗΤΩΝ *Περιγραφή της διαδικασίας αξιολόγησης* *Γλώσσα Αξιολόγησης, Μέθοδοι αξιολόγησης, Διαμορφωτική ή Συμπερασματική, Δοκιμασία Πολλαπλής Επιλογής, Ερωτήσεις Σύντομης Απάντησης, Ερωτήσεις Ανάπτυξης Δοκιμίων, Επίλυση Προβλημάτων, Γραπτή Εργασία, Έκθεση / Αναφορά, Προφορική Εξέταση, Δημόσια Παρουσίαση, Εργαστηριακή Εργασία, Κλινική Εξέταση Ασθενούς, Καλλιτεχνική Ερμηνεία, Άλλη / Άλλες* *Αναφέρονται ρητά προσδιορισμένα κριτήρια αξιολόγησης και εάν και που είναι προσβάσιμα από τους φοιτητές.*	Γλώσσα ελληνική Κατά τη διάρκεια του μαθήματος δίδεται μία υποχρεωτική εργασία, με στόχο 15λεπτη προφορική παρουσίαση κάποιου σχετικού με το μάθημα επιστημονικού άρθρου με μορφή powerpoint. Ο τελικός βαθμός του μαθήματος προκύπτει από: • 50% από την Τελική γραπτή εξέταση με ερωτήσεις πολλαπλών επιλογών, διάρκεια 1 ώρα (ποσοστό) αλλά και την • 50% από την Προφορική εξέταση (ανά 4 άτομα) • Bonus έως 30% από την βαθμολόγηση της «εξατομικευμένης» εργασίας 10/10, στον τελικό βαθμό της γραπτής-προφορικής εξέτασης.

5. ΣΥΝΙΣΤΩΜΕΝΗ-ΒΙΒΛΙΟΓΡΑΦΙΑ

- **Προτεινόμενη Βιβλιογραφία:**

- Βιοανόργανη Χημεία (Γ. Μανουσάκη, Δ. Κεσσίσογλου)
- Τα Ιχνοστοιχεία στην Υγεία του Ανθρώπου (Γ. Μανουσάκη)
- Βιο-Ανόργανη Χημεία (Robert W. Hay) ελληνική μετάφραση
- Bioinorganic Chemistry (Bertini, Gray, Lippard, Valantine)
- Principles of Bioinorganic Chemistry (Lippard, Berg)
- Metals in Biological Systems (Kendrick, May, Plishka, Robinson)
- Inorganic Biochemistry, An Introduction (J.A. Cowan)

COURSE OUTLINE
CHEM-068 FOOD ANALYSIS TECHNIQUES

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-068	**SEMESTER**	8
COURSE TITLE	FOOD ANALYSIS TECHNIQUES		
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	4	6
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*	General background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/aspyros/spyweb/FoodAnal.html		

(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*

After successfully concluding the course, the learning outcomes the students will have accomplished are as follows:

- A deep understanding the main categories of chemical components of foods (lipids, proteins, carbohydrates, etc.) and their physical and chemical properties.
- Recognition of the wide array of chemical analytical problems involved in food analysis and guidance for the selection of the most suitable methodological analytical approach for tackling them.
- Familiarization with the theory and practical application of established analytical methods of food analysis and novel spectroscopic/chromatographic analytical techniques used in food quality control (NMR, MS, IR-Raman, UV-Vis, GC-MS, LC-MS, HPLC, etc.).
- Understanding the scientific duties and role of food chemists through visits to established state and food industry quality control laboratories.

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
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Decision-making • Working independently • Working in an interdisciplinary environment • Production of free, creative and inductive thinking

(3) SYLLABUS

The course describes current analytical methodologies that are used in the characterization and quality control of foods, with emphasis being given to modern spectroscopic and chromatographic techniques.
The course consists of the following chapters: Introduction, Lipids, Lipid analysis, NMR spectroscopy in lipid analysis, Proteins, Proteins analysis, Carbohydrates, Carbohydrate analysis, Taste and smell, Volatiles analysis, Water, Water determination, Vitamins, Colours, Food additives, Minerals, Food hazards, Food Toxicology.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Course website • E-class • Public databases of food composition

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.

Activity	***Semester workload***
Lectures	54
Tutorial	8
Unguided study	56
Educational visits	8
Work/presentation preparation	24
Course total	**150**

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	
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.*	The evaluation procedure is in the Greek or English language Student evaluation is shaped as follows: - Written examination, 3h, that includes multiple choice questions, short-answer questions and problem solving (50% or 60% of the final mark, depending on choice of presentation or written essay. - Public presentation on a subject that deals with the food analysis methodology for a specific food, a subject of interest in food analysis or a scientific publication from the field of food analysis (50%) -or- - Written essay on a subject that deals with the food analysis methodology for a specific food, a subject of interest in food analysis (40%) Public presentations/written essays are evaluated based on scientific accuracy, coverage of the field and comprehensibility of the material provided, while self-evaluation by the student audience is also included for the public presentations. Evaluation criteria are accessible to students from the semester start in the course website.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Food analysis, N. K. Andrikopoulos
- Food analysis, A. Polychroniadou-Alitanidou
- Current Protocols in Food Analytical Chemistry, John Whitaker, 2001, John Wiley & Sons, Inc.
- PowerPoint presentation slides and other electronic material used during teaching in the class

Related academic journals::
Journal of Agricultural & Food Chemistry, Journal of Food Composition & Analysis, Food Chemistry

COURSE OUTLINE

CHEM-109 ACADEMIC ENGLISH AND CHEMISTRY TERMINOLOGY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-109	**SEMESTER**	8
COURSE TITLE	ACADEMIC ENGLISH AND CHEMISTRY TERMINOLOGY		
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	4	4
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*	It is compulsory course that provides a general background on General Chemistry vocabulary in English and academic skills development.		
PREREQUISITE COURSES:	Basic knowledge of English (Level B1)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://chemistryenglish.wordpress.com/writing-like-a-chemist-scientific-conventions-in-chemistry-papers/ and http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course introduces the student to the field of TECHNICAL WRITING, RESEARCH WRITING AND Academic English and in particular it enhances student understanding and production of academic texts in the field of Chemistry.

Through the course the students will acquire the basic knowledge for the writing conventions prior to publication in peer-reviewed journals. They will also practice lectures in English in Chemistry and oral presentation of Chemistry subjects. It includes the presentation of specific texts and techniques that have been established in the field of Academic and Technical Writing.

The course offers extensive analysis of written and spoken language genres in General Chemistry.

Students, after successfully completing the course:

- will acquire the basic principles for writing a laboratory reference in English
- will be familiar with key chemical terms
- will have be aware of key principles of writing and oral presentation of chemistry-related topics.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas
- Critical Thinking

(3) SYLLABUS

Academic English and Chemistry Terminology

Week 1

Introduction to Presentations¨From transcript to slides, Protocells (Ted Talk)
Introduction to Academic writing features
Homework

4. Student first (three) slides and a short report on what constitutes a scientific presentation (200 words
5. Answer questions on Edpuzzle video
6. Choice of topic for presentations
7. Peer feedback (1)

Week 2

Student presentations (maximum 6) followed by peer and teacher feedback.
Video on â€œDesigning effective slides for Scientific Presentationsâ€
Types of papers, Structure of IMRD paper
Example of Organic Chemistry paper
Homework
Re-design your slides based on video input.
Give written feedback to student-presenter

Week 3

Student presentations (maximum 6) followed by peer and teacher feedback.
Chemistry Terminology Â (Amide Bond Formation) and Academic Conventions
Homework

8. Watch three videos in order to answer a quiz in class
9. Write another report on what constitutes scientific presentations based on the most recent video and class input.
10. Write a short paragraph on Edmodo stating what experimental you are planning to write as a Mock Paper and explain why (rationale).

Week 4

Class quiz on Socrative
BYOD: Design slides with WORD TABLES using information from the paper on â€œPolymer radiation and Recyclingâ€ in class (Group work)
Introduction to Methods section

Week 5

Reading, explaining and vocab tasks on Analytical Chemistry paper on Î²-carotene.
SCIENTIFIC WRITING WORKSHOPS: METHODS
HW: Prepare pair presentation of an analytical chemistry paper on â€œÎ²-caroteneâ€ using google slides.

Week 6

Student pair presentations and teacher feedback
SCIENTIFIC WRITING WORKSHOPS: RESULTS
Hand-in Methods and Results section of your mock IMRD paper and PEER review (week 7)

Week 7

Writing methods and results section (part 2)
SCIENTIFIC WRITING WORKSHOPS: DISCUSSION
HAND_IN DATE (IMRD paper part 1)
For more go to:
https://docs.google.com/document/d/1ONgMH1a0lPCZJ2I5BI3ieqifGQphQ94SBVRC0p3GGEc/edit?usp=sharing

Thu*
4th
April
SCIENTIFIC WRITING WORKSHOPS: INTRODUCTION and ABSTRACT
(Postgraduate students will also be attending)
Homework
Tue
Choose a topic for a Mock Review paper and post it on Edmodo
Thu
Hand-in discussion and introduction of Mock IMRD paper for peer review (week 9)

Week 9
Tue
Seminar of â€œHow you can paraphrase legitimatelyâ€
Thu*
11th
April
SCIENTIFIC WRITING WORKSHOPS:
Introduction to REVIEW PAPERS
(Postgraduate students will also be attending)
Homework
Tue
(-)

Thu
HAND_IN DATE (IMRD paper part 2)
Assessed
Week 10
Tue
Examining the language of critical reviews (part 2)

Thu
How to design a scientific poster
Video: Scientific Poster presentation
Homework
Tue
Hand-in student presentation (on MOCK IMRD or on MOCK REVIEW paper) for PEER-review
Peer-review is
assessed
Thu
Hand-in student mock REVIEW paper for PEER-review

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Electronic mail Departmental website-Study guide Edmodo and Course site

<table>
<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</td><td>30</td></tr>
<tr><td>Study</td><td>20</td></tr>
<tr><td>Literature project-presentation</td><td>12</td></tr>
<tr><td>Final examination</td><td>8</td></tr>
<tr><td>Course total</td><td>80</td></tr>
</table>
</td>
</tr>
<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>English language

During the last period of the teaching activity a personalised obligatory literature project is given to each student, in order to prepare an oral presentation and submit a mock Chemistry paper (IMRD and/or Review paper)

The specific subject related to the content of the course comes from the scientific literature, usually peer-reviewed international journals.

The final grade of the course comes from:
• 40% Class Attendance and contribution, peer-review and follow-up revisions
• 60% 10 pieces of coursework (presentations, part of an IMRD paper scientific poster and part of a review paper)</td>
</tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Robinson M. S. et al. Write like a Chemist; Oxford University Press: Oxford; 2008.
- Weissberg and Buker. Writing up Research; Experimental Research report writing for students of English. Prentice Hall Regents. 1990.

COURSE OUTLINE
CHEM-121 POLYMER SCIENCE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-121	**SEMESTER**	8
COURSE TITLE	POLYMER SCIENCE		
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	4	6
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*	Specialized general knowledge Elective course		
PREREQUISITE COURSES:	Basic knowledge of Physical Chemistry (Thermodynamics) and general chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (If there are Erasmus students, it is taught in English)		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

I am inclined to think that the development of polymerization is perhaps the biggest thing chemistry has done, where it has had the biggest impact on everyday life". This assessment of the significance of polymer chemistry to modern society was offered twenty-five years ago by Lord Todd (President of the Royal Society and 1957 Nobel Laureate in Chemistry), and subsequent developments have only reinforced this sentiment. There is hardly an area of modern life in which polymer materials do not play an important role. Applications span the range from the mundane (e.g., packaging, toys, fabrics, diapers, non-stick cookware, pressure sensitive adhesives…) to demanding specialty uses (e.g., bullet-proof vests, stealth aircraft, artificial hip joints, …). In many instances polymers are the main ingredients, and the ingredients whose characteristic properties are essential to the success of a particular technology: rubber tires, foam cushions and insulation, high-performance athletic shoes, clothing, and equipment are good examples. In other cases, polymers are used as additives at the level of a few percent by volume, but which nevertheless play a crucial role in the properties of the final material; illustrations of this can be found in asphalt (to suppress brittle fracture at low temperature and flow at high temperature), shampoo and other cosmetics (to impart "body"), automobile windshields (to prevent shattering), and motor oil (to reduce the dependence of viscosity on temperature and to suppress crystallization).

The students, after successfully completing the course, will:

- Understand the basic principles of polymer classification, polymerization reactions, polymer chain conformations
- possess the basic knowledge on the thermodynamics of polymers solution and polymer blends as well as block copolymers, the phase equilibria and the kinetics of phase separation
- be exposed to issues of polymer dynamics and polymer viscoelasticity in melt and in solution, polymer crystallization, thermal and mechanical properties of polymers

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* *Respect for difference and multiculturalism* *Respect for the natural environment*

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*	*Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Working in an interdisciplinary environment
- Production of new research ideas
- Production of free, creative and inductive thinking

(3) SYLLABUS

- Introduction
  How big is big?
- Polymer Classification
  Linear and branched polymers; Homopolymers and copolymers; Addition polymers, condensation polymers and natural polymers; Polymer nomeclature
- Polymerization Reactions
  Step-growth polymerization; Chain polymerization; Controlled polymerization; Copolymerization
- Molecular Weight Distribution
  Number, weight and z-average molecular weights; Polydispersity index and standard deviation; measurement of molecular weights
- Conformation of Polymer Chains
  Average end-to-end distance for model chains; Characteristic ratio; Semiflexible chains and persistence length; Radius of gyration
- Polymer Solutions
  Regular solution theory; Flory-Huggins theory
- Thermodynamics of Polymer Solutions
  Dilute, semidilute and concentrated polymer solutions; Static and dynamic light scattering
- Phase Equilibria
  Phase behavior of polymer solutions; Phase diagram from Flory-Huggins theory
- Polymer Properties
  Thermal and mechanical properties
- Viscoelasticity
  Basic principles; Response of the Maxwell and Voigt elements; Boltzmann superposition principle; Phenomenology of entanglements; The reputation model
- Polymer Dynamics

Glass transition; Characteristic relaxation times; Time-temperature superposition; Temperature dependence

- Polymer Crystallization
  Introduction; Thermodynamics of crystallization; Structure and melting of lamellae; Kinetics of nucleation and growth; Kinetics of bulk crystallization
- Polymer Blends and Block Copolymers
  Thermodynamics of polymer mixtures; Phase equilibria; Phase diagram; Copolymer thermodynamics; Order-disorder transition
- Polymer Composites and Nanocomposites
  Dispersion of inorganic particles in polymer matrices; Properties

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face (classroom)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Electronic mail
• Departmental website-Study guide</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</td><td>52</td></tr>
<tr><td>Study</td><td>50</td></tr>
<tr><td>Literature project-presentation, Final examination</td><td>48</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>Greek language (English if there is an Erasmus student)

During the course, the students are responsible to prepare and present an obligatory literature project, based on a research publication or a review article on a subject that</td></tr>
</table>

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.*	belongs to the general area of polymer science and technology. The written term paper on the paper should be less that ~10 pages (and not a translation of the article) whereas the students have to prepare and present an oral presentation utilizing PowerPoint. The final grade of the course results from: • Written term-paper on a research publication (30% of the final grade) • Oral presentation of the term-paper, degree of understanding the research subject and response to questions, (70% of the final grade)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- P. C. Hiemenz & T. P. Lodge, "Polymer Chemistry", 2nd Edition, CRC Press, Boca Raton, 2007 [Also in Greek translation, Edited by S. H. Anastasiadis, Crete University Press, Heraklion 2014]
- P. C. Painter, M. M. Coleman, Polymer Science and Engineering, DEStech Publications, Inc. 2009.
- Flory, P.J. Principles of Polymer Chemistry, Cornell University Press New York 1953.
- de Gennes, P.-G. Scaling Concepts in Polymer Physics. Cornell University Press, 1979.
- M. Rubinstein, R. H. Colby. Polymer Physics. Oxford University Press, New York, 2003.
- G. Strobl. The Physics of Polymers. Springer-Verlag Berlin Heidelberg 2007.
- M. Doi. Introduction to Polymer Physics. Oxford University Press, New York, 1995.
- A. Yu. Grosberg, A. R. Khokhlov. Giant Molecules. Academic Press, 1997.

COURSE OUTLINE

CHEM-151 BIOCATALYSIS IN ORGANIC SYNTHESIS

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-151	**SEMESTER**	7
COURSE TITLE	BIOCATALYSIS IN ORGANIC SYNTHESIS		
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	4	6	
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*	Special background Selective course		
PREREQUISITE COURSES:	Basic knowledge of Organic Chemistry, Biochemistry and Stereochemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course introduces the student to the field of Biocatalysis, the use of biocatalysts for chemical transformations in non-natural organic compounds and its applications. Through this course the students will acquire the basic knowledge about Biocatalysis, which is now established as an alternative, often complementary to the methodology of classical organic synthesis. It includes the presentation of specific biocatalytic processes established in organic synthesis. The course offers extensive analysis on stereoselective reactions catalyzed mainly by hydrolytic or redox enzymes. Examples are presented from the chemical and pharmaceutical industry, where biocatalytic methods are applied in the synthesis of high added value products.

Students, after successfully completing the course

• Possess the basic principles for the use of enzymes in organic transformations.

• Become familiar with the main types of biocatalytic processes which combine particularly mild reaction conditions with excellent stereoselectivity, benefits that have made them very useful at both laboratory and industrial scale.

• Have learned the basic principles of Biocatalysis in accordance with the principles of Green Chemistry and its main applications in organic synthesis.

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*
	Production of free, creative and inductive thinking

Working in an international environment *Working in an interdisciplinary environment* *Production of new research ideas*	…… *Others…* …….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

1. Introduction and Background Information

1.1 Common Prejudices Against Enzymes
1.2 Advantages and Disadvantages of Biocatalysts
1.3 Mechanistic Aspects of Enzyme-Catalyzed Reactions
1.4 Michaelis-Menten kinetics
1.5 Enzyme Inhibition
1.6 Substrate Specificity
1.7 Classification of Enzymes-Nomenclature
1.8 Βελτίωση ή μεταβολή ενζυμικής ειδικότητας
1.9 Kinetic Reasons for Enzyme Selectivity
1.10 Immobilization of Enzymes
1.11 Recycling of Cofactors
1.12 Enzymes in Organic Solvents
1.13 Design of New Biocatalysts-Modified Enzymes

2. Contribution of Biocatalysis in Asymmetric Organic Synthesis

2.1 Enantiomer Differentiation
2.2 Kinetic Resolution
2.3 Deracemization Strategies: Enantioconvergent Processes, Dymanic Kinetic Resolution, Stereoinversion
2.4 Enantiotops Differentiation
2.5 Enantioface Differentiation

3. Biocatalytic Applications

3.1 Hydrolytic Reactions

3.1.1 Esterases and Proteases
3.1.2 Lipases
3.1.3 Structure and Enzyme Mechanism
3.1.4 Hydrolysis of Nitriles- Nitrilases
3.1.5 Hydrolysis of Phosphate Esters- Phosphatases
3.1.6 Hydrolysis of Epoxides- Epoxide Hydrolases

3.2 Reduction Reactions
3.2.1 NAD(P)+- Dependent Oxidoreductions
3.2.2 Recycling of Coenzymes
3.2.3 Stereospecificity of Alcohol Dehydrogenases
3.2.4 Reduction of Aldehydes and Ketones Using Isolated Enzymes or Whole Cells
3.2.5 Reduction of C=C Bonds Using Whole Cells
3.3 Oxidation Reactions
3.3.1 Oxidation of Alcohols
3.3.2 Oxidation of Alkanes
3.3.3 Hydroxylation of Aromatic Compounds
3.3.4 Oxidation of Alkenes
3.3.5 Oxidation of aldehydes and ketones-Bayer-Villiger Reactions
3.4 Formation of Carbon-Nitrogen Bonds
3.4.1 Transaminases
4. Applications of Biocatalysis in Chemical Industry
5. Applications of Biocatalysis in Pharmaceutical Industry

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb
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	52
Study	70
Literature project-presentation, Final examination	28
Course total	**150**

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.*	Greek language During the last period of the teaching activity a personalized obligatory literature project is given to each student, in order to prepare an oral presentation. The specific subject related to the content of the course comes from the scientific literature, usually international journals. The final grade of the course comes from: • Oral presentation of personalized project (40% of the final grade) • Final written examination, lasting 3 hours, (60% of the final grade)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

•Kurt Faber, (2004) “Biotransformations in Organic Chemistry” A Textbook, Springer

•Nicholas J. Turner and Luke Humphreys, (2018) “Biocatalysis in Organic Synthesis-The Retrosynthesis Approach” Royal Society of Chemistry

•U.T. Bornscheuer, R. J. Kazlauskas (1999) “Hydrolases in Organic Synthesis- Regio- and Stereoselective Biotransformations”, WILEY-VCH

•V. Gotor, I. Alfonso, E. Garcia-Urdiales (2008) “Asymmetric Organic Synthesis with Enzymes”, WILEY-VCH

•PowerPoint presentation slides and other electronic material used during teaching in the class

COURSE OUTLINE
CHEM-160 CHEMISTRY AND CURRENT TOPICS IN NUTRITION

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-160	**SEMESTER**	8
COURSE TITLE	CHEMISTRY AND CURRENT TOPICS IN NUTRITION		
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		4	6
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*	Specialised general knowledge Selective course		
PREREQUISITE COURSES:	Basic knowledge of Organic Chemistry, Biochemistry and Physical Chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/biopolymers/GX/info.htm		

(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*

During the last few years there has been an increased interest regarding the relation between diet and health. This is due to the important role nutrition plays throughout our lifetime, since this role affects the growth of our body during childhood, the risk for acute and chronic diseases as well as the maintenance of physiological biological processes. An important goal of this course is to help inform and clarify the knowledge about the relationship between our diet and the molecular processes that involve the food we eat. The course also includes the investigation of a series of political, social and economic choices that affect the diffusion and implementation of scientific conclusions on nutrition and how the various organizations (countries, European Union, international humanitarian organizations, scientific organizations) are tackling the solution of nutritional problems. This course provides a new depth of objective information on increasingly salient issues and is essential for all those interested in the relationship between diet and our health.

Completion of the course is achieved by

(a) The consolidation of the principles of healthy eating.

(b) Understanding the role of food for the long-term preservation of health and longevity and its importance for the prevention and treatment of chronic diseases.

(c) Obtaining the ability to interpret and critically review information relating to healthy eating.

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…*
	…….

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

1. Introduction

2. Food categories
2.1 Carbohydrates
2.2 Lipids
2.3 Proteins, Enzymes, Hormones
2.4 Water soluble Vitamins
2.5 Fat soluble Vitamins
2.6 Minerals: Major and Trace Elements – for Life

3. Physicochemical and biochemical changes of food nutrients
3.1 The chemistry of trans fats - Hydrogenation
3.2 Oxidation of Foods - Auto-oxidation of Lipids
3.3 Physical and chemical changes of oil during deep-fat frying
3.4 Health implications

4. Food additives of color or taste
4.1 Natural antioxidants
4.2 Synthetic antioxidants
4.3 Applications of Antioxidants to Foods
4.4 Health implications

5. Connection between diet and our physiology in different diseases
5.1 Endocrine Disrupting Chemicals and implications on health
5.2 Fatty acids and implications on health
5.3 Carbohydrates and implications on health
5.4 Herbs and implications on health

6. Current nutritional topics
6.1 Functional foods
6.2 Diet foods
6.3 Genetically modified foods
6.2 Nanotechnology applications in food items

Purpose of the Course

During the last few years there has been an increased interest regarding the relation between diet and health. This is due to the important role nutrition plays throughout our lifetime, since this role affects the growth of our body during childhood, the risk for acute and chronic diseases as well as the maintenance of physiological biological processes. An important goal of this course is to help inform and clarify the knowledge about the relationship between our diet and the molecular processes that involve the food we eat. This course provides a new depth of objective information on increasingly salient issues and is essential for all those interested in the relationship between diet and our health.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb
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*	
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.*	Greek and English language During the last period of the teaching activity a personalized project is given to each student, in order to prepare an oral presentation by searching the international scientific literature. The final grade of the course comes from: • Class participation (10% of the final grade) • Personalized project (30% of the final grade) • Final written examination, (60% of the final grade)

Activity	***Semester workload***
Lectures	52
Study	70
Literature project-presentation, Final examination	28
Course total	150

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Διατροφή και Χημεία Τροφίμων στη Δημόσια Υγεία των Κοτροκόη Κ.,Παπαδογιαννάκη Ε.., (BROKEN HILL PUBLISHERS LTD)
- «Χημεία Τροφίμων», Δ. Μπόσκου (ΓΑΡΤΑΓΑΝΗΣ ΑΓΙΣ-ΣΑΒΒΑΣ).
- "Food Chemistry", H.-D. Belitz, W. Grosch, P. Schieberle (Εκδόσεις Τζιόλα)
- PowerPoint presentation slides

COURSE OUTLINE
CHEM-162 METAL IONS IN MEDICINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-162	**SEMESTER**	8
COURSE TITLE	METAL IONS IN MEDICINE		
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	4	6
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*	Special background		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The main goals of the course are:

a) understanding the basic principles of Medicinal Chemistry,
b) getting familiar with the use of inorganic compounds and complexes in therapeutic and diagnostic medicine,
c) understanding the mechanisms of actions of various metal-based drugs,
d) understanding the principles of Magnetic Resonance Imaging.

The students upon successful completion of the course:

- will know the basic principles of Medicinal Chemistry.
- will be familiar with the mechanisms of actions of various metal-based drugs, as well as with the challenges of the modern medicinal chemistry with respect to metal-based drugs
- will comprehend the basic principles of Magnetic Resonance Imaging.

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

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

……

Others…

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Working independently
- Team work
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

The use of metallic inorganic compounds in various fields of Medicine. Metallodrugs in Therapeutic and Diagnostic Medicine.
Introduction: general aspects for drugs and historical review of metallic compounds as therapeutic agents.
. Treatment
- Li compounds against manic depression/bipolar disorders.
-Anticancer Pt, Ru, Au and Cu complexes: Mechanisms of actions.
- Manganese complexes as SOD (SuperOxidaseDismutase) mimics.
- Vanadium compounds as insulin regulators.
-Gold anti-arthritic compounds
-Radiotherapy.
- Bismuth anti-ulcer drugs.
. Diagnosis
Magnetic Resonance Imaging, MRI
Introduction, Historical review, Advantages of using MRI. Basic Principles of NMR and MRI: spin physics, nuclei with spins, energy levels, transitions, Larmor frequency, CW-NMR, Boltzman statistics. T1 and T2 relaxation time, Spin relaxation. Basics of Imaging. Paramagnetic complexes in MRI: i) Magnetic relaxation of paramagnetic complexes, ii) Mechanisms of action, iii) Inner Sphere relaxivity, Solomon-Bloembergen equations, iii) Outer Sphere relaxivity. Improving magnetic relaxation of paramagnetic complexes for MRI agents. Stability and toxicity of MRI agents. Examples of MRI agents.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb
TEACHING METHODS *The manner and methods of teaching are described in detail.*	

Activity	***Semester workload***
Lectures	52
Study	70

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*	<table><tr><td>Final Exam</td><td>28</td></tr><tr><td>Course total</td><td>150</td></tr></table>
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.*	Greek language The final grade of the course comes from: • Final written examination, lasting 3 hours, (100% of the final grade)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

• Chris Jones, John Thornback, “Medicinal Applications of Coordination Chemistry”, RSC Publishing, Cambridge, 2007.
• “Uses of Inorganic Chemistry in Medicine”, Ed: Nicholas P. Farell, RSC Publishing, Cambridge, 1999.
• PowerPoint presentation slides and other electronic material used during teaching in the class

COURSE OUTLINE
CHEM-164 COMPUTATIONAL CHEMISTRY WITH APPLICATIONS TO MOLECULES, MATERIALS AND THE ENVIRONMENT –II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-164	**SEMESTER**	8
COURSE TITLE	COMPUTATIONAL CHEMISTRY WITH APPLICATIONS TO MOLECULES, MATERIALS AND THE ENVIRONMENT –II		
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 laboratory exercises		4	6
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*	Special background Selective course		
PREREQUISITE COURSES:	Basic knowledge of physical and organic chemistry and of numerical modeling		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The course aims to introduce the student to numerical programming for carrying out physical-chemical calculations of varying complexity and application.

Students, after successfully completing the course, will possess the basic principles for numerical modeling of molecular dynamics, ab-initio and Gaussian calculations and for simple environmental problems.

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…*
	…….

- Search, analyze and synthesize data and information, using the necessary technologies
- Adapt to new situations
- Autonomous work
- Teamwork

(3) SYLLABUS

1. Molecular Dynamics : Computation of free energy differences of ions in water solution via molecular simulations. Introduction to Molecular Dynamics programs of TINKER and molecular graphics via VMD.

2. Molecules & Materials : Introduction to Ab-initio methods and applications with the program package Gaussian (Molecular Orbital theory, Born-Oppenhimer approximation, Hartree-Fock theory, basis sets)

3. Environment : Short revision of the main commands of fortran and its use in a linux environment and of the editor vi. Numerical programming exercises (hands-on) in fortran for the computation of the lifetimes of compounds in the environment, the photodissociation rates in the atmosphere, the rate constant of reactions using structure-activity relationship.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Laboratory education • Classweb
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, laboratory practice	52
Study	50
Course personal Assignment, Oral presentation of results	48
Course total	150

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.*	Student's performance is evaluated based on 1) Programming exercises during the semester 2) A programming project and examination during its presentation to the teacher at the end of the semester. The exercise will lead to a numerical model that will be written during the examination in the computer laboratory and will be presented to the teacher. The final grade of the course comes by 1) 50% from the grade of the personalized project and 2) 50% the performance of the student in laboratory exercises during the course.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Summary notes by the teachers and e-books on linux and fortran available on the internet.

http://www.linux.org/forums/beginner-tutorials.53/

http://www.yolinux.com/TUTORIALS/LinuxTutorialHardware.html

http://www.pcc.qub.ac.uk/tec/courses/f90/stu-notes/F90_notesMIF_2.html

- Related academic journals:

COURSE OUTLINE

CHEM-416 COMPUTATIONAL ENVIRONMENTAL CHEMISTRY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-416	**SEMESTER**	8
COURSE TITLE	COMPUTATIONAL ENVIRONMENTAL 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 laboratory exercises	4	6
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*	Special background Selective course
PREREQUISITE COURSES:	Basic knowledge of chemistry and computers
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/

(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*

The purpose of the course is to introduce the student to the environmental computer simulations and the possibilities given by the development and use of numerical models for the understanding of chemical physical and biological processes that occur in the environment. Additionally the introduction of the student to programming of physicochemical calculations of varying complexity with applications in the environment.
Throughout the course, students will be briefed on current developments in environmental, climate and chemistry transfer and the Earth system models, developed internationally. They will be introduced to linux computing and the FORTRAN programming language with embedded exercises. The course gives general rational directions for the development of algorithms suitable for solving specific problems. Students will be able to understand how to think about the computer and acquire basic knowledge to develop computational programs to solve environmental problems.

Students, after successfully completing the course
• will have the basic principles for the development of numerical models in general,and in particular for environmental applications.
• be familiar with basic environmental concepts such as the importance of life time for the effect of a compound on the environment, but also how the abundance of a compound changes in the natural environment, given the time perspective and the dynamic balance of chemical compounds.
• will have learned how to develop the methodology for understanding and exploring environmental issues and ways of dealing with anthropogenic pollution

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*
	Respect for the natural environment
	Showing social, professional and ethical

Decision-making *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

- Search, analyze and synthesize data and information, using the necessary technologies
- Adapt to new situations
- Decision making
- Autonomous work
- Teamwork
- Working in an interdisciplinary environment
- Respect for the natural environment
- Promoting free, creative and inductive thinking

(3) SYLLABUS

The lesson offers knowledge in the following areas and concepts:

- Basic commands for communication with Linux computing systems and introduction to editor vi.
- Basic principles of algorithm creation
- Fundamentals and programming commands in Fortran

Once basic knowledge and skills on programming have been established the following exercises are

1. Radiation propagation patterns in the atmosphere and calculation of photodissociation rates of chemical compounds

2. Lifetime of a compound in the environment and how it varies within the earth system

3. Calculation of the daily variation of tropospheric ozone and how it is affected by its precursors (nitrogen oxides and organic volatile compounds) considering an equilibrium state.

4. Exchanges between surface water and atmosphere and what parameters affect them.

5. Models for calculating reaction rates using structure-activity relationship apporximation.

6. Models for calculating secondary formation of aerosol particles particles in the atmosphere

7. Calculation of the hygroscopicity of atmospheric aerosol particles and their conversion to cloud condensation nuclei.

Each lesson module includes a presentation of the theoretical framework and its implementation for the creation of a suitable computer program followed by a discussion of the environmental significance of the results.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face (classroom and computer lab)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Electronic mail
• Departmental website-Study guide
• Classweb</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, laboratory practice</td><td>52</td></tr><tr><td>Study</td><td>90</td></tr><tr><td>Course personal Assignment, Oral presentation of results</td><td>8</td></tr><tr><td>Course total</td><td>150</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>At the end of the semester, a compulsory personal assignment/exercise is given, aiming to evaluate the student. The given exercise must be converted into a numerical model during a 4-hour laboratory examination</td></tr>
</table>

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.*	and then presented to the instructor. The final grade of the course is derived from: • 60% of the rating of personal assignment/exercise • 40% of evaluation of the student's performance in laboratory exercises during the course.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Course handbook form the teachers.

Jacob D., Introduction to Atmospheric Chemistry, Princeton University Press, 2000.

Jacobson, M., Fundamentals of Atmospheric Modeling. Cambridge: Cambridge University Press. doi:10.1017/CBO9781139165389, 2005.

Freely available online material:

http://www.linux.org/forums/beginner-tutorials.53/

http://www.yolinux.com/TUTORIALS/LinuxTutorialHardware.html

http://www.pcc.qub.ac.uk/tec/courses/f90/stu-notes/F90_notesMIF_2.html

Additional material from online sources and the University of Crete Library.

- Related academic journals:

Atmospheric Chemistry and Physics, Proceedings of the National Academy of Science (PNAS), Atmospheric Environment, Environmental Science and Technology, Nature, Nature Geoscience, Science

COURSE OUTLINE

CHEM-425 LASER LABORATORY APPLICATIONS IN CHEMISTRY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-425	**SEMESTER**	8
COURSE TITLE	LASER LABORATORY APPLICATIONS IN 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 or Laboratory sessions		4	6
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*	Special background Specialised general knowledge		
PREREQUISITE COURSES:	Successful performance in the following courses is required: Physical Chemistry-I (XHM-048), Analytical Chemistry I and II (XHM-301, -408), Physical Chemistry Laboratory-I and II (XHM-311, -444) and Analytical Chemistry Laboratory-II (XHM-414).		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (English foe ERASMUS)		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	e-class: https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER127/ (lecture ppt slides, problem sets, worked problems)		

(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*

The course is addressed to senior students (4th year) of the Chemistry Department.

Its main objective is to present, in the context of lectures and advanced laboratory experiments, the use of modern laser methods in the study of atoms, molecules and materials and applications of these techniques in cutting-edge science and technology with examples drawn from the fields of nanotechnology, biology, environmental monitoring, space research and heritage science.

The course expands on concepts developed at in introductory level in Physical Chemistry-I (XHM-048) and the corresponding laboratory course (XHM-311). Main subjects introduced include:

- Basic principles of modern laser technology.

- Basic principles and applications of photoelectron spectroscopy in the study of atoms, molecules and materials.

- Fluorescence spectroscopy methods and their use in the study of molecules, biomolecules and materials.

- Laser spectroscopy methods for monitoring ultrafast processes.

- Non-linear optics and multi-photon processes.

- Basic principles and applications of laser light scattering in the study of macromolecules.

Lectures are combined with specialized laboratory experiments performed in advanced research labs and familiarize students with modern laser and spectroscopy instrumentation.

After successfully attending the class students are expected to:

- Have understood in a theoretical and practical context aspects related to applications of laser-based in the study of atoms, molecules and materials.
- Know basic laser spectroscopy techniques used in materials analysis and characterization.
- Have a basic understanding of non-linear interactions of high intensity electromagnetic radiation (light) with matter and the study of ultrafast phenomena in atoms, molecules and materials.
- Have a good overview of research in Physical Chemistry (with emphasis on laser spectroscopy) that will help in further graduate studies and their potential professional or research career.

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

Working independently *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Criticism and self-criticism* *Production of free, creative and inductive thinking* *Others…….*
• Search for, analysis and synthesis of data and information, with the use of the necessary technology • Adapting to new situations • Working independently • Team work • Production of free, creative and inductive thinking • Working in an interdisciplinary environment	

(3) SYLLABUS

LECTURES

1. Review of atomic and molecular spectroscopy
2. Photoelectron spectroscopy
3. Lasers: Basic principles and types of lasers. Laser safety.
4. Fluorescence spectroscopy
5. Laser spectroscopic techniques. Study of dynamic phenomena.
6. Laser light scattering techniques in the study of macromolecules
7. Applications of lasers in Chemistry

LABORATORY EXPERIMENTS

1. Optics and Lasers
2. Photoelectron spectroscopy and imaging. Chemical Dynamics (Vacuum systems)
3. Time-resolved fluorescence spectrometry
4. Non-linear laser spectroscopy
5. Laser-induced plasma spectroscopy (atomic, molecular emission)
6. Raman microscopy
7. Dynamic light scattering

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom) Remote teaching (MS Teams platform) if needed
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• E-class – course website (lecture ppt slides, problem sets, literature papers) • MS Teams – course website (lecture ppt slides, problem sets, worked problems) • E-mail
TEACHING METHODS *The manner and methods of teaching are described in detail.*	

Activity	***Semester workload***
Lectures	36

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*	<table><tr><td>Laboratory experiments</td><td>16</td></tr><tr><td>Presentation</td><td>20</td></tr><tr><td>Study</td><td>52</td></tr><tr><td>Final exam</td><td>26</td></tr><tr><td>Course total</td><td>150</td></tr></table>
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.*	Greek language **Attendance of lectures (L)** **Problem sets (P)** (4 sets during the semester) **Laboratory experiments and reports (E)** (4-5 experiments, 3 reports) **Oral presentation (O)** (Topic selected from recent literature) **Final exam** (F) (Written cumulative exam, Critical questions and calculations, Open book/notes exam) Overall grade **G (scale 0-10) = 0,1*L + 0,15*P + 0,3*E + 0,15*O + 0,3*F** The evaluation procedures and criteria are presented in the introductory lecture (and reminded often during the semester). Model exam questions are handed out.

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

1. **P. W. Atkins, 'Molecular Quantum Mechanics', (Papazisis Editions, 1999) [ΕΥΔΟΞΟΣ]**
2. **M. Young, 'Οπτική και Λέιζερ', (NTUA University Press, Athens, 2008) [ΕΥΔΟΞΟΣ]**
3. **J. Wilson, J. Hawkes, 'Optoelectronics' (NTUA University Press, Athens,, 2007) [ΕΥΔΟΞΟΣ]**
4. W. Demtröder, 'Laser Spectroscopy : Basic concepts and instrumentation' (Springer, Berlin 2003)
5. P.W. Atkins 'Physical Chemistry' (Crete University Press, Heraklion 2014)
6. D.C. Harris, M.D. Bertolucci, '*Symmetry and Spectroscopy*' (Dover, NY 1978)
7. J.M. Hollas, '*Modern Spectroscopy*' (John-Wiley & Sons, NY 1996)
8. C. N. Banwell, E.M. McCash, '*Fundamentals of Molecular Spectroscopy*' (McGraw Hill, 1999)
9. C.S. Johnson, D.A. Gabriel "Laser Light Scattering" [Dover, 1994]

- Relevant literature and review articles
- Lecture ppt slides

COURSE OUTLINE
CHEM-515 FOOD CHEMISTRY

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-515	**SEMESTER**	8
COURSE TITLE	FOOD 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		4	6
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*	Special background, soft skills development		
PREREQUISITE COURSES:	Basic knowledge of Biology, Biochemistry and/or Organic chemistry		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://www.chemistry.uoc.gr/wordpress/σπουδές/προπτυχιακές-σπουδές/οδηγός-σπουδών/		

(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*

The "Food Chemistry" CHEM-515 course focuses on the study of the physical and chemical characteristics of the main nutrients of foods such as water, proteins, carbohydrates, lipids as well as the secondary natural food ingredients or additives including vitamins, minerals, colorants, flavorings. Lectures describe the basic chemical reactions / alterations that occur during the technological processing and storage of food.
Expected learning outcomes and skills upon completion of the course are:

From the course lectures, the students are expected to:

- Understand the different chemical structures of key ingredients and their role / properties in food.
- Acquire knowledge on the basic chemical and physical changes that occur during food processing and storage and their impact on food quality and safety.
- Become familiar with the structure and basic properties of secondary food ingredients.

From the exercises / questions during the lectures (Food for Thought), the students are expected to:

- Develop their critical thinking as well as communication and collaboration skills (team work).
- Grow their scientific thinking (data analysis, brainstorming, troubleshooting)

From the optional Journal Club projects, the students are expected to:

- Familiarize themselves with the structure of scientific articles (mainly review papers) and develop skills in reading and understanding scientific terminology related to Food Science in English.
- Develop skills in literature search and in writing a mini review in English.
- Develop communication, organization, collaboration and time management skills.
- Develop skills in preparing and presenting a scientific topic PowerPoint (either as slide or poster presentation) in English language.

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*
	Production of free, creative and inductive thinking

Working in an international environment *Working in an interdisciplinary environment* *Production of new research ideas*	*……* *Others…* *…….*

- Working independently
- Team work
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Working in an interdisciplinary environment
- Search for, analysis and synthesis of data and information, with the use of the necessary technology

(3) SYLLABUS

Lecture Modules:

1. Introduction to Food Chemistry (course objectives, evaluation, nutrients-categories)
2. Water: properties and structure of water/ice in food, pH, water activity, adsorption isotherms, drying techniques - lyophilisation.
3. Carbohydrates: categories, basic properties & reactions, modifications during heat treatment or storage (starch gelatinization, caramelization, browning reactions - Maillard), sweeteners.
4. Proteins: amino acids, peptides and proteins, physicochemical properties, functional properties in foods (gelatinization, foaming, etc.), important proteins in food - changes during food processing.
5. Lipids: edible fats / oils, lipid classification and structure - essential fatty acids, natural and chemical properties of fatty acids (melting point ect), fat and oil treatments (refining, hydrogenation, transesterification), lipid oxidation reactions in foods.
6. Food additives (categories, applications)
7. Vitamins and minerals (categories, biological role, food sources, functionality in foods)
8. Food flavorings

Journal Club Projects & Seminars (optional):
Each student group (2-3 students) is assigned a review scientific paper in the area of Food Science. Students are required to study, understand and present the topic of the review paper as a PowerPoint slide or poster presentation in class (15 minutes), in English language. They are also required to write a short review (report – in English) based on the topic of the assigned paper, adding their own literature search.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• PowerPoint lecture presentations • Explanation of topics via online educational videos • Course team on the MSTeams platform • Course information & slides in e-class
TEACHING METHODS *The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and*	

Activity	***Semester workload***
Lectures	44

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*	Study of lecture material – quiz preparation: 88 Preparation and Final examination: 28 Journal Club (optional): 20 Course total: 160 (180)
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.*	Greek language Evaluation method: 1. Journal Club (optional): report and presentation. 2. Quiz (optional): midterm short assessment with multiple choice questions. The final grade of the course is calculated based on: • Midterm quiz (15% of the final grade) • Final written examination - 3 hours (85% of the final grade) • Up to 2 points are added to the final grade (bonus) based on Journal Club evaluation. The final examination grade must be at least five (5) in order to successfully pass the class. The grade of the final exam is also the final grade of the course if the student does not opt for the quiz or Journal Club.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Damodaran S, Parkin K, Fennema OR, Fennema's Food Chemistry (4th Edition), CRC, 2007
- PowerPoint presentation slides and other electronic material used during teaching in the class

COURSE OUTLINE
CHEM-516 STRUCTURAL ELUCIDATION OF ORGANIC COMPOUNDS FROM SPECTRA

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-516	**SEMESTER**	8
COURSE TITLE	STRUCTURAL ELUCIDATION OF ORGANIC COMPOUNDS FROM SPECTRA		
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		4	6
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*	Special background Optional course for skills development		
PREREQUISITE COURSES:	Basic knowledge of Organic Chemistry I and II courses		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (as a reading course)		
COURSE WEBSITE (URL)	https://teams.microsoft.com/l/team/19%3a5e0a6b03841f423aa80178eb05242be0%40thread.tacv2/conversations?groupId=59168cec-aeb7-4463-87e3-3e5958835eeb&tenantId=b6e0a680-49f9-4523-a06b-d5a873656d37		

(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*

The course teaches UV, IR, 1D-NMR and 2D-NMR spectroscopy at a high level, as well as, mass spectrometry. Special attention is given to 2D-NMR spectroscopy which is a subject that the undergraduate student has not been exposed to in the other main undergraduate courses. The main learning outcome and skill that the students will acquire from this course is the capability to extract information fast and effectively from the spectroscopic data and elucidate the structure of the organic compound being analyzed. For the successful teaching of this skill, the students will have been exposed to many examples throughout the course; starting from simple organic compounds without the use of 2D-NMR and finishing with difficult organic structures that require the use of 2D-NMR.

After the successful completion of the course the students should:

• Possess high level knowledge of UV, IR, 1D-NMR and 2D-NMR spectroscopy, as well as mass, spectrometry.

• Become familiar with the fast and effective extraction of important information from the spectroscopic data.

• Be able to combine all this information in order to elucidate the structure of the organic compound being analyzed.

• Be able to confirm the proposed structure from extra information that exists in the given spectra, but which was not used in the previous steps.

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…*
	…….

- 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
- Production of free, creative and inductive thinking
- Production of new research ideas

(3) SYLLABUS

1. Introduction and Background Information
   - 1.1 General principles of absorption spectroscopy
   - 1.2 Chromophores
   - 1.3 Degree of unsaturation
   - 1.4 Connectivity
2. Ultraviolet spectroscopy (UV)
   - 2.1 Nature of ultraviolet spectroscopy
   - 2.2 Absorption bands in UV and special terms
   - 2.3 Important UV chromophores and the influence of solvents
3. Infrared spectroscopy (IR)
   - 3.1 Nature of IR absorption
   - 3.2 General characteristics of IR spectra
   - 3.3 Important IR chromophores
4. Mass spectrometry (MS)
   - 4.1 Different ionization methods
   - 4.2 Mass spectrometry data
   - 4.3 Common fragmentation paths
5. One dimension nuclear magnetic resonance spectroscopy (1D-NMR)
   - 5.1 Nature of NMR spectroscopy
   - 5.2 Chemical shifts in 1H-NMR
   - 5.3 Spin-spin coupling in 1H-NMR and correlation of coupling constants with structure
   - 5.4 1H-NMR analysis and second order spectra
   - 5.5 The Overhauser effect and decoupling in 13C-NMR
   - 5.6 The determination of multiplicity in 13C-NMR with DEPT experiments
   - 5.7 Chemical shifts in 13C-NMR
   - 5.8 19F, 31P and 15N NMR spectroscopy
6. Two dimensions nuclear magnetic resonance spectroscopy (2D-NMR)
   - 6.1 General principles
   - 6.2 1H-1H interactions
   - 6.3 13C-13C interactions
   - 6.4 Heteronuclear 2D-NMR experiments
7. Elucidation of the structure of a lot of organic compounds using spectroscopic data
   - 7.1 Solving the problems in the class under the guidance of the teacher
   - 7.2 Solving the problems in the class with less involvement of the teacher

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face (classroom)
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Electronic mail • Departmental website-Study guide • Classweb • Teams

<table>
<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></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Study</td><td>70</td></tr>
<tr><td>Presentation in the class and final examination</td><td>28</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td>
</tr>
<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>Greek language

Usually, 3 sets of spectroscopic data are given to the students (different for each student). After studying this data, the student presents to the class the analysis of all these spectroscopic data and proposes possible organic structures.

The final grade of the course comes from:

• Oral presentation of personalized project (50% of the final grade)

• Final written examination, lasting 3 hours, (50% of the final grade)

The evaluation criteria are explained to the student from the first lesson and repeated during the semester.</td>
</tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- L. D. Field, S. Sternhell and J. R. Kalman “Organic Structures from Spectra”. A textbook from WILEY-VCH.
- L. D. Field, H. L. Li and A. M. Magill “Organic Structures from 2D NMR Spectra”. A textbook from WILEY-VCH.
- Both books have been translated in Greek by D. Georgiadis, G. Kokotos, V. Konstantinou and E. Mikros in one book titled: "Structural elucidation of organic compounds by spectroscopic methods", Utopia pres.

COURSE OUTLINE

CHEM-517 DRUG DESIGN AND DEVELOPMENT

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	CHEM-517	**SEMESTER**	8
COURSE TITLE	DRUG DESIGN AND DEVELOPMENT		
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			52
Laboratories			70
Other			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*			
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes 1		
COURSE WEBSITE (URL)	https://www.chemistry.uoc.gr/eclass/courses/CHEM-UNDER159/		

(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*

The familiarization of students with the principles of Pharmaceutical Chemistry, with a particular emphasis on the design, synthesis, and overall development of active pharmaceutical ingredients. Applications of fundamental knowledge in organic chemistry and biochemistry will be analyzed.

Upon successful completion of the course, students will:

- Acquire the fundamental knowledge of Pharmaceutical Chemistry.
- Become familiar with drug targets, basic protein functions, and nucleic acids (Receptors, Agonists, Drug Competition, Receptor Characterization).
- Understand drug metabolism and pharmacokinetics (Metabolic pathways - Drug metabolism sites).
- Learn the fundamental principles of drug design and discovery: Rational approaches to drug discovery, Drug Design and Synthesis, Structural Modifications of Lead Compounds, Identification of Active Functional Groups and Recognition of the Pharmacophore.
- Be introduced to modern methods in combinatorial and parallel synthesis, as well as computational pharmaceutical chemistry.
- Learn about specific drugs and the approaches taken in their development.

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…*
	…….

- Search, analysis, and synthesis of data and information, utilizing the necessary technologies
- Decision-making
- Independent work
- Generation of new research ideas
- Promotion of free, creative, and inductive thinking

(3) SYLLABUS

A. Introduction: What is a drug?

B. Drug Targets

1. Protein structure and function
2. Enzymes: Structure and function
3. Enzymes as drug targets
4. Receptors: Structure and function
5. Receptors as drug targets
6. Receptors and signal transduction
7. Nucleic acids: Structure and function
8. Nucleic acids as drug targets
9. Pharmacokinetics and related topics

C. Drug Discovery and Development

1. Identification of the lead compound
2. Optimization of target interactions
3. Optimization of target accessibility
4. The path to drug approval

D. Tools for Drug Discovery and Design

1. Combinatorial and parallel synthesis
2. Computational pharmaceutical chemistry

E. Selected Topics in Pharmaceutical Chemistry

1. Antibacterial drugs
2. Antiviral drugs
3. Anticancer drugs
4. Opioid analgesics
5. Other drugs

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Power Point Presentation Open e-class
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,*	

Activity	***Semester workload***
Lectures	52
Study	70

<table>
<tr>
<td>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><td>Course Work</td><td>20</td></tr>
<tr><td>Final Competition</td><td>8</td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td>
</tr>
<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>Language: Greek/English

The final assessment is conducted through written exams covering the entirety of the material taught, with an emphasis on critical thinking questions.

There is an opportunity for a bonus (1 point, 10%) through the submission of a written assignment on topics related to drug discovery from contemporary literature.

All lecture notes for each chapter taught are posted in advance on the open e-class platform.</td>
</tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Medicinal Chemistry, GRAHAM L. PATRICK, (κωδικός Εύδοξος: 102071627)
- R. B. Silverman, The Organic chemistry of Drug Design and Drug Action Elsevier, New York, 2004