COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΧΗΥ101 (1.1)</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>1st</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Analytical Chemistry I</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

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:
No

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:
Yes

COURSE WEBSITE (URL):
No

(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 will gain basic knowledge on analytical chemistry (Methods of Chemical Analysis. Chemical Reactions (writing and completing). Solutions and concentrations. Stoichiometric computations. Chemical equilibrium and rate of a chemical reaction. Equilibria of weak acids and bases. Water ionisation-hydrolysis-pH. Heterogeneous equilibria. Precipitation-Equilibria involving complex ions. Zwitterionic compounds and redox systems. Applications in Analytical Chemistry). They will learn how to search in literature and analyze data using new technologies. Their survey and bibliographic work will promote free, creative and inductive thinking.

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, analysis and synthesis of data and information, by using the proper technologies.
Working independently
Team work
Respect of natural environment
Promoting free, creative and inductive thinking
Understanding analytical science, demonstrate a coherent understanding of analytical chemistry
Depth and breadth of analytical chemistry knowledge
Inquiry and problem solving, critically analyse and solve problems in analytical chemistry
Personal and professional responsibility, be accountable for individual learning and scientific work in analytical chemistry

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Lectures</td>
<td>75</td>
</tr>
<tr>
<td>Not guided study</td>
<td>50</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</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

Written examination in Greek, with multiple choice questionnaires and short-answer questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

  - ΒΑΣΙΚΕΣ ΑΡΧΕΣ ΑΝΑΛΥΤΙΚΗΣ ΧΗΜΕΙΑΣ ΘΕΜΕΛΙΩΣ ΔΗΜΗΤΡΙΟΣ ΖΗΤΗ ΠΕΛΑΓΙΑ ΚΑΙ ΣΙΑ Ο.Ε.
ΧΗΜΙΚΗ ΙΣΟΡΡΟΠΙΑ ΚΑΙ ΑΝΟΡΓΑΝΗ ΠΟΙΟΤΙΚΗ ΗΜΙΜΙΚΡΟΑΝΑΛΥΣΗ
ΘΕΜΙΣΤΟΚΛΗΣ ΧΑΤΖΗΪΩΑΝΝΟΥ
ΕΛΕΝΗ ΧΑΤΖΗΪΩΑΝΝΟΥ

ΣΗΜΕΙΩΣΕΙΣ ΜΑΘ. ΑΝΑΛΥΤΙΚΗΣ ΧΗΜΕΙΑΣ Ι
Α. ΒΛΕΣΣΙΔΗΣ
Δ. ΓΚΙΩΚΑΣ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ
(ΣΗΜΕΙΩΣΕΙΣ)

• Αναλυτική Χημεία e-book, Σ. Λιοδάκης (http://www.lib.ntua.gr/ar/el_sources/ebooks/liodakis/index.htm)
• ΠΟΣΟΤΙΚΗ ΧΗΜΙΚΗ ΑΝΑΛΥΣΗ, Τόμος Α, Χανιωτάκης Νίκος, Φουσκάκη Μαρία, Πανεπιστημιακές Εκδόσεις Κρήτης, 2009

- Related academic journals:
  Journal of Chemical Education
  Analytical Chemistry
  Analytica Chimica Acta
  Talanta
INORGANIC CHEMISTRY I COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
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<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
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<tr>
<td>COURSE CODE</td>
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<td>SEMESTER</td>
<td>1st</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>INORGANIC CHEMISTRY I</td>
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</tbody>
</table>

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

FOR THE WHOLE COURSE 4 5

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Special background, specialised general knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREREQUISITE COURSES:</td>
<td>NONE</td>
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<tr>
<td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td>
<td>GREEK</td>
</tr>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>YES</td>
</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td><a href="http://ecourse.uoi.gr/course/view.php?id=756">http://ecourse.uoi.gr/course/view.php?id=756</a></td>
</tr>
</tbody>
</table>

(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 aim of the course is to teach and embody basic principles of Inorganic Chemistry that are considered necessary for both the theoretical and laboratory education of undergraduate students in this area

- Upon successful completion of the course, students should be able to:
  1. Recognize the contribution of inorganic chemistry to the development of chemistry and other related disciplines
  2. Be able to calculate (given the appropriate data) basic thermodynamic quantities, the chemical reactions equilibrium and rate constants
  3. Write down the electron configuration of any element or ion based on the building principles
  4. Be able to predict the trends of basic properties (ionization energy,
5. Identify the different types of chemical bonds and how these are formed

6. Easily use the atomic/molecular orbital theory, the valance bond theory and the VSEPR model when prediction of the geometry, bond order, hybridization, etc. of simple compounds are required

7. Know some basic properties (geometry, metal coordination modes, uses, etc.) of selected anions

8. Explain the difference in solubility of ionic compounds

9. Be able to distinguish between an acid or a base in reactions taking place in aqueous/ non-aqueous solutions. Predictions of the acidic / basic character.

10. Being in a position to easily mass-charge balancing redox reactions, predict their direction, design galvanic-electrolytic cells, use of the Nerst equation and predict the stability of a given oxidation state.

11. Be familiarized with the basic principles of coordination chemistry so that they can (a) identify a complex compound and its isomers; (b) use the relevant bond theories to predict the hybridization, thermodynamic-kinetic stability, geometry, etc.

**Knowledge**

Knowledge and understanding of the basic concepts, principles and theories related to atomic and molecular structure, periodic properties of elements, chemical bonds, chemistry in aqueous and non-aqueous solutions, redox, coordination chemistry (at the introductory level).

**Skills**

Skills in predicting basic periodic properties of elements, the geometry of small molecules, solubility and salt precipitation conditions, redox reactions direction, identification and interpretation of all types of chemical bonds, prediction of the most stable Lewis acid-base pair, kinetic-thermodynamic data in inorganic reactions.

Advanced problem solving skills through careful analysis of the provided data.

**Abilities**

Ability to apply the knowledge provided to solve an inorganic chemistry problem at the introductory level.

Ability to predict basic periodic properties of the elements, thermodynamic-kinetic data evaluation, molecules geometry, solubility in aqueous and non-aqueous solutions, redox reactions direction.

Ability to identify the bond type present in inorganic compounds, and writing down the electron configuration of an atom/ion.
Ability to accurately assess - select the data provided to solve complex problems. Ability to work independently and to interact with other students.

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...

The general competencies that the student should have acquired and to which the course is aimed are:

- Search, analyze and evaluate data-information and make decisions.
- Conversion of theory into practice.
- Promote free, creative and inductive thinking.
- Autonomous and teamwork as well.
- Acquiring the appropriate theoretical background knowledge to enable further education both at a theoretical level (advanced topics of Inorganic Chemistry) and in a laboratory.

(3) SYLLABUS

Introduction to Inorganic Chemistry, (scope, linking to other areas (Biology, Physics, Materials Science)). Atomic Structure, the hydrogen atom, the Bohr theory, atomic orbitals, s, p, d orbitals, periodic table, elements properties periodicity. Chemical bond, orbitals overlap, σ, π and δ bonds, molecular orbitals. Homo- and heteronuclear diatomic molecules. Weak interactions. The geometry of molecules, Lewis Electron-Dot Formulas, Lewis structures, the Valence-Shell Electron-Pair Repulsion (VSEPR) model. The Valence bond theory (hybridization), three centers two electrons bonds. Ionic compounds, lattice energy, Born-Habber cycle, ionic radius, simple crystal structures. Chemistry of selected anions: oxides, hydroxides, alkoxides, polyoxo anions, halides, sulfides. Protic and non-protic solvents, molten salts, acids-bases definitions, solutions, protic acids, oxoacids. Redox chemistry: Writing and balancing half reactions in acidic and basic solutions. Galvanic and electrolytic cells.


(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

- Face to face
- e-mail communication with the students
- Additional material on course website: http://ecourse.uoi.gr/course/view.php?id=756

**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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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<tbody>
<tr>
<td>lectures</td>
<td>52</td>
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<tr>
<td>Individual study, preparation</td>
<td>73</td>
</tr>
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<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

*(25 hours of workload per credit unit)*

**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.

Students are evaluated (in Greek) either with two written examinations in the middle and at the end of the semester or for those who fail by the final written examination. The exams include questions and problems (multiple choice, short response, problem solving)

**ATTACHED BIBLIOGRAPHY**

- Suggested bibliography (most in Greek):

  **ΒΑΣΙΚΗ ΑΝΟΡΓΑΝΗ ΧΗΜΕΙΑ, F. ALBERT COTTON, GEOFFERY WILKINSON, PAUL GAUS, ΠΑΡΙΣΙΑΝΟΥ Α.Ε., 2016**


Related academic journals

Inorganic Chemistry
European Journal of Inorganic Chemistry
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPARTMENT</td>
<td>CHEMISTRY</td>
</tr>
<tr>
<td>STUDY LEVEL</td>
<td>UNDERGRADUATE</td>
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<tr>
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<td>SEMESTER</td>
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<td>COURSE NAME</td>
<td>INTRODUCTORY LABORATORY OF CHEMISTRY</td>
</tr>
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</table>

### TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY LECTURE HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

*Προσθέστε σειρές αν χρειαστεί. Η οργάνωση διδασκαλίας και οι διδακτικές μέθοδοι που χρησιμοποιούνται περιγράφονται αναλυτικά στο (δ).*

### TYPE OF COURSE

- general background,
- special background,
- specialization,
- general knowledge,
- developing skills

**Scientific area / Developing skills**

### PREREQUISITE COURSES:

*There are no prerequisites.*

### LANGUAGE TEACHING and EXAMINATION:

**Greek**

### THE COURSE IS OFFERED TO ERASMUS STUDENTS

**YES**

### COURSE WEBSITE (URL)

*It does not exist*
## Learning Outcomes

The learning outcomes of the course, the specific knowledge, skills and abilities that will equip students after successful completion of the course are described.

Refer to Appendix A:
- Description of the Level of Learning Outcomes for each course according to the Qualifications Framework of the European Higher Education Area
- Indicators Descriptors Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Annex B.
- Brief writing guide of Learning Outcomes

- The aim of the course is the teaching and consolidation of the principles of chemistry (analytical, inorganic and organic) through appropriate laboratory exercises and training of students on experimental chemistry techniques.

After successfully completing the course, the students should:

1. Recognize the contribution of chemistry in the development of science in general.
2. Familiarize themselves with basic laboratory safety rules.
3. Familiarize themselves with the use of basic laboratory equipment.
4. Learn and understand basic principles of chemistry through the laboratory exercises.
5. Gain knowledge into basic experimental chemistry techniques.
6. Understand, through appropriate laboratory exercises, basic chemistry concepts such as solubility, redox chemistry, chemical equilibrium etc.

### Knowledge

Knowledge and understanding of basic concepts, principles and theories related to the Analytical, Inorganic and Organic chemistry.

### Skills

Development of skills on the proper use of basic laboratory equipment and basic experimental Analytical, Inorganic and Organic chemistry techniques.

Complex problem solving skills through careful analysis of the data provided.

### Capacities

- Ability to apply the knowledge provided in troubleshooting (theoretical and synthetic) relating to Analytical, Inorganic and Organic chemistry.
- Ability to work safely in a chemistry laboratory.
- Ability to use properly basic laboratory equipment.
- Ability not only to work independently but also to interact with other students on the course topics.
**General Skills**

Taking into account the general competences to be acquired by the graduate (as listed in the DS and listed below) which of these skills the course are aimed at?

| Search, analysis and synthesis of data and information, the use and the necessary technologies | Design and project management |
| Adapting to new situations | Respect for diversity and multiculturalism |
| Decision making | Respect for the natural environment |
| Autonomous work | Demonstrate social, professional and moral responsibility and sensitivity to gender issues |
| Teamwork | Criticism and self-criticism |
| Working in an international environment | Promotion of free, creative and inductive thinking |
| Work in a multidisciplinary environment | ...... |
| Generate new research ideas | Other ... |

The general skills that should be acquired by the student and in which the course aims at are:

- Search, analysis and synthesis of data and information and making decisions.
- Turning theory into practice.
- Promotion of free, creative and inductive thinking.
- Independent and teamwork.
- Acquisition of the appropriate theoretical and practical knowledge base to enable the further training both in theory (in more specific subjects of Inorganic Chemistry) and in laboratory.
(3) COURSE SYLLABUS

Introduction to the practical knowledge of Qualitative Chemical Analysis Laboratory (rules and laboratory safety measures, work planning, keeping a laboratory book, cleanliness and tidiness, laboratory apparatus, reagents, selected reactions of cations and anions with various reagents). Way of expressing concentration of solutions and preparation of them, introduction to analytical separation of cations and anions, qualitative semi-microanalytical techniques (precipitation, extraction, evaporation, centrifugation, filtration, etc.). Introduction to the practical knowledge of the Laboratory of Quantitative Chemical Analysis (laboratory rules and safety measures, work planning, keeping a laboratory book, cleanliness and tidiness, laboratory apparatus, laboratory equipment materials, calibration of volumetric utensils, reagents, analytical balance, description and operation of analytical balance, analytical standards, general rules of use of the analytical balance, weighing with an analytical balance, weighing errors). Introduction to classical quantitative analysis methods (volumetric, gravimetric analysis).

Rules and safety measures in Inorganic Chemistry. Laboratory equipment and glassware. Reminding students about basic safety rules in the laboratory and demonstration of basic laboratory equipment to be used for conducting the laboratory exercises. Weighing. Dissolution, precipitation and filtration. Reactions of ions of alkaline earth. Study of the relative solubility of the alkaline earth metal ions. Oxidation and reduction. Redox chemistry of metals and halogens. Study of the relative solubility of silver salts of halogen ions. Use of reduction potentials table. Chemical equilibrium and Le Chatelier principle. Calculation of the equilibrium constant of a chemical reaction using a UV-Vis spectrometer.


(4) ΔΙΔΑΚΤΙΚΕΣ και ΜΑΘΗΣΙΑΚΕΣ ΜΕΘΟΔΟΙ - ΑΞΙΟΛΟΓΗΣΗ

<table>
<thead>
<tr>
<th>LECTURE DELIVERY METHOD</th>
<th>Face to Face, distance learning κ.λπ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES</td>
<td>Electronic communication with students. Post-exercise additional notes etc. on the websites of teachers</td>
</tr>
<tr>
<td>ORGANIZING THE TEACHING</td>
<td>Φόρτος Εργασίας Εξετάσεων</td>
</tr>
<tr>
<td>Νομίζη</td>
<td>13</td>
</tr>
<tr>
<td>Λεσέχ</td>
<td>52</td>
</tr>
<tr>
<td>Τουτίον</td>
<td>30</td>
</tr>
</tbody>
</table>

Describe in detail the methods of teaching. Lectures, Seminars, Laboratory Exercise, Field Exercise, Study and literature analysis, Tutorial, Practice (Placement), Clinical Practice, Art Workshop, Interactive teaching, Study Visits, Study (project), Writing job / work, Artistic.
Enter the hours of study for each student learning activity and hours of Non-guided study in accordance with the principles of ECTS

<table>
<thead>
<tr>
<th>STUDENT EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation process</td>
</tr>
<tr>
<td>Assessment Language, Methods of assessment Formative or Concluding, Test Multiple Choice, Questions Short Answer, Development Questions Essays, Problem Solving, Written Work, Report / Report, Oral Examination, Public Presentation, Laboratory Work, Clinical Examination Patient Artistic Interpretation Other / other</td>
</tr>
<tr>
<td>Indicate clearly defined evaluation criteria and whether and which are accessible to students.</td>
</tr>
</tbody>
</table>

The students are graded based on their assignments in the context of the laboratory exercises, oral and / or a short written examination during the laboratory course and through written examinations at the end of the semester. Their assignments include the development of basic theory-purpose of the exercises, the experimental procedure and analysis-interpretation of results. The final exam include: Short Answer Questions, crisis, development, and problem solving

All these criteria are explained to students at the start of the course.

<table>
<thead>
<tr>
<th>SUGGESTED LITERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΕΡΓΑΣΤΗΡΙΑΚΕΣ ΑΣΚΗΣΕΙΣ ΓΕΝΙΚΗΣ ΚΑΙ ΑΝΟΡΓΑΝΗΣ ΧΗΜΕΙΑΣ, ΑΚΡΙΒΟΣ ΠΕΡΙΚΛΗΣ, ΚΑΡΑΓΙΑΝΝΙΔΗΣ ΠΕΤΡΟΣ, ΖΗΤΗ ΠΕΛΑΓΙΑ ΚΑΙ ΣΙΑ Ο.Ε. ΕΡΓΑΣΤΗΡΙΑΚΕΣ ΑΣΚΗΣΕΙΣ ΓΕΝΙΚΗΣ ΚΑΙ ΑΝΟΡΓΑΝΗΣ ΧΗΜΕΙΑΣ, ΛΑΛΙΑ - ΚΟΝΤΟΥΡΗ ΜΑΡΙΑ, ΠΑΠΑΣΤΕΦΑΝΟΥ ΣΤΕΡΓΙΟΣ, ΤΖΑΒΙΛΑ Λ.Τ., ΧΑΤΖΗΚΩΣΤΑ ΧΡ., ΖΗΤΗ ΠΕΛΑΓΙΑ ΚΑΙ ΣΙΑ Ο.Ε. ΕΡΓΑΣΤΗΡΙΑΚΕΣ ΑΣΚΗΣΕΙΣ ΓΕΝΙΚΗΣ ΚΑΙ ΑΝΟΡΓΑΝΗΣ ΧΗΜΕΙΑΣ, Μ. ΛΟΥΛΟΥΔΗ, Τ. ΤΑΣΙΟΠΟΥΛΟΣ, Σ. ΧΑΤΖΗΚΑΚΟΥ, Ν. ΧΑΤΖΗΛΙΑΔΗΣ, Σ. ΧΑΤΖΗΚΑΚΟΥ ΣΗΜΕΙΩΣΕΙΣ ΕΙΣΑΓΩΓΙΚΟΥ ΕΡΓΑΣΤΗΡΙΟΥ ΧΗΜΕΙΑΣ. Παραδόσεις και ασκήσεις αναλυτικής χημείας για το μάθημα «Εισαγωγικό Εργαστήριο Χημείας»</td>
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Συναφή επιστημονικά περιοδικά:
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
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</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
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<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
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<tr>
<td>COURSE CODE</td>
<td>ΧΗΥ 022</td>
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<tr>
<td>SEMESTER</td>
<td>2</td>
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<tr>
<td>COURSE TITLE</td>
<td>INORGANIC CHEMISTRY II</td>
</tr>
</tbody>
</table>

#### 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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

#### COURSE TYPE

Scientific Area / Special Background / Development Skills

#### PREREQUISITE COURSES:

NONE

#### LANGUAGE OF INSTRUCTION and EXAMINATIONS:

GREEK

#### IS THE COURSE OFFERED TO ERASMUS STUDENTS:

YES

#### COURSE WEBSITE (URL)

http://users.uoi.gr/jplakatu/site/ARXIKH.htm
http://users.uoi.gr/shadjika/Hadjikakou_1/Hadjikakou_08.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

After successfully completing the course, descriptive marker 6 of the European Qualifications Framework, students should be able to:

- Understand ways of interacting transition metals with ligands.
- Understand the role of coordination compounds in life and technology.
- Understand ligand exchange reactions.
- Understand the basic principles of bond theories and their application to Coordination Chemistry.
- Understand the relationship between bond theories and reactions involving metal complexes.
- Understand the spectroscopic and magnetic properties of coordination compounds.
- Understand the imperfections of some bond theories and choose the appropriate theory for use.

The second part of the course covers the part of the matter of Inorganic Chemistry referring to the chemical elements of the main groups of the periodic table and their compounds. In this lesson, young chemists meet with to the most important new developments in inorganic chemistry. The presentation of the properties of the chemical elements and their compounds is done in a systematic manner according to the groups of the periodic table. The presentation method is comparative. Each chapter develops
both the normal and the unusual behaviour of certain elements. In the manufacturing processes, the main treatments necessary for the isolation of the elements are generally reported. Along with the reference to new methods of manufacturing certain elements and their compounds, they develop their most characteristic chemical properties as well as their most important applications in other fields of science and technology. Finally, the student has the notes in a modern way of presenting the chapters to be examined.

**Knowledge**
- Knowledge and understanding of basic and advanced principles of coordination chemistry.
- Knowledge and understanding of all bond theories applied to complexes.
- Knowledge and understanding of the evolution of bond theories, and their imperfections.
- Knowledge and understanding of complex formation and substitution reactions.
- Knowledge and understanding of the relationships between structure and reactivity of the complexes.
- Knowledge and understanding of spectroscopic and magnetic properties of coordination compounds.
- Knowledge of structure and properties of various compounds containing metals.
- Knowledge of the most important new developments in inorganic chemistry.
- Knowledge of the properties of the chemical elements and their compounds.
- Knowledge of both the normal and unusual behaviour of certain elements.
- Knowledge of the manufacturing processes, the main treatments necessary to isolate the elements.

**Skills**
- Skills to solve problems related to coordination chemistry.
- Skills to solve problems related to structural coordination chemistry.
- Skills to solve problems related to the reactivity of complex compounds.
- Skills to solve problems associated with spectroscopy and magnetism in complexes.

**Abilities**
- Ability to apply their knowledge in addressing issues related to coordination chemistry.
- Ability to combine bibliographic / experimental data and provide for chemical reaction products containing complexes.
- Ability to interact with other students or researchers in the field of coordination chemistry and transition metals.
- Ability to select and apply relevant methodology for solving a particular spectroscopic and/or magnetochemical problems involving a metal center.

**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 |
| Decision-making | Respect for difference and multiculturalism |
| 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 | ...... |

The general competencies that the student should have acquired and to which the course is aimed are:
- Theoretical thinking and ability to translate theory into practice.
- Ability to apply knowledge acquired during the study period and related courses of the curriculum of the Department of Chemistry.
- Ability to search, analyze and synthesize data and information from international literature and use the necessary technologies related to the presentation of research results.
- Acquiring the appropriate theoretical and practical knowledge base to allow further education at the postgraduate level of specialization and doctorate.
- Working in an interdisciplinary environment.
Ability to work together at team level to achieve these goals.

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND</td>
<td>e-mail, Powerpoint</td>
</tr>
<tr>
<td>COMMUNICATIONS TECHNOLOGY</td>
<td></td>
</tr>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td>Lectures, tutoring</td>
<td>52</td>
</tr>
<tr>
<td>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>Study, preparation</td>
<td>73</td>
</tr>
</tbody>
</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. | |

Student evaluation is made through progress exams during the course and written final examination (evaluation) in Greek which includes:

- Theoretical questions
- Multiple choice questions
- Responses to questions of judgement
- Problem solving.
(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**
- **Related academic journals:**

3. INORGANIC CHEMISTRY (IN GREEK), C. E. HOUSECROFT, A. G. SHARPE,
5. Chemistry Principles, Nick Hadjiliadis

**Related Journals**
ACS: JACS, Inorganic Chemistry
Wiley: European Journal of Inorganic Chemistry
# COURSE OUTLINE

## (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
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</tr>
<tr>
<td>COURSE CODE</td>
<td>ΦΘΧ7</td>
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<tr>
<td>SEMESTER</td>
<td>B</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>PHYSICAL CHEMISTRY OF POLYMERS</td>
</tr>
</tbody>
</table>

### 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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

### COURSE TYPE

**Special Background**

### PREREQUISITE COURSES:

There are not prerequisite courses in the Chemistry Department.

### LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek (There is a possibility of teaching in English depending on the audience)

### IS THE COURSE OFFERED TO ERASMUS STUDENTS

Yes (In English)

### 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

After successful completion of the course, students should be able to:

Understand the basic principles of modelling of a single polymer chain by coarse graining and atomistic models.

To understand the achievements and limitations of Flory theory for polymer melts and blends.

To understand the principles of light scattering

**Knowledge of:**

- what is the Kuhn length
- what is the C infinity
- what is the radii of gyration and the end-to-end square distance
- what is probability distribution function
- what is the scaling law
What is the stability condition in polymer blends
What is the glass transition temperature

**Skills:**
To use the experimental data in order to extract the necessary parameters for polymer modelling.
To apply previous knowledge from mathematics in the study of real systems

**Abilities:**
- Ability to calculate the number of segments of real polymers from experimental data.
- Ability to calculate the radius of gyration of polymers with complex architecture with the random walk model.
- Ability to use the equations of states.

### 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 | ...... |

The course aims students to acquire special knowledge in physical chemistry of polymers necessary to cope with the latest developments in chemical science. It also aims to develop critical thinking and familiarization of students with contemporary subjects in the theoretical and experimental fields of science.

- Advance collaboration between students to understand each subject and discover ways to cope with,
- Search for complementary solutions and evaluate critical thinking for a proper choice between available “tools” and
- Plan and deal with a sufficient number of problems to better gain self-reliance and confidence with the "modern" way of thinking.
(3) SYLLABUS

1) Polymer chain conformation: Basic principles, Simple models of flexible chains, the Gaussian chain, Kuhn length, excluded volume, dilute solutions, Two parameters theory, renormalization group theory, scaling laws in polymer physics, virial coefficients, Radius of gyration, Effects of architecture of polymer chain, Hydrodynamic theories of dilute solutions, viscosity.

2) Introduction to the rotational isomeric state model.

3) Light Scattering

4) Flory lattice theory, Phases equilibrium , Various equations of states

5) Solid state properties of polymers

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Power point presentations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>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>
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<table>
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<th>Activity</th>
<th>Semester workload</th>
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<td>Teaching</td>
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<tr>
<td>Individual study</td>
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<td>Assignments</td>
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Course total 150
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<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
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<tr>
<td>Description of the evaluation procedure</td>
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<tr>
<td>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>
</tr>
<tr>
<td>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
</tr>
</tbody>
</table>

Evaluation will be by final written examination, which will cover all the semester's work (60% of the final grade) and the assignments during the course (40% of the final grade). The passing grade for the course is 50%.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:

*Iwao Teraoka* Polymer Solutions. An Introduction to Physical Properties. Wiley-Interscience

*Paul Hiemenz & Timothy Lodge* Polymer Chemistry. CRC Press

*M. Rubinstein & Ralph H. Colby* Polymer Physics. Oxford University Press
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
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<td>LEVEL OF STUDIES</td>
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<td>Β’</td>
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<td>COURSE TITLE</td>
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</table>

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

<table>
<thead>
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<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tr>
<td>LECTURES</td>
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</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE
Background knowledge

PREREQUISITE COURSES:
According to the curriculum of the Department of Chemistry there are no prerequisites.

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

After successfully completing the course, level descriptor 6 of the European Qualifications Framework, students should be able to:

• Understand the basic principles of the hybridization of carbon and, more generally, heteroatoms and the molecular structure of organic molecules.
• Understand the concepts of covalent, polar and semi-polar bond.
• To understand the basics of the resonance theory and the theory of molecular orbitals.
• Understand the concept of electronegativity and dipole moment.
• Understand the concept of electronic phenomena (inductive, conjugation, hyperconjugation) and be able to distinguish them.
• Understand the concept of steric phenomena.
• Understand the concept of the stereogenic center and consequently the concept of the configuration and the stereochemical representation of the molecules (stereochemistry).
• Understand the concept of acidity and basicity in organic molecules.
• Understand the meaning of the strength of the chemical bond and its dissociation energy.
• Understanding the substitution-elimination reactions and the factors affecting them.
(substrate, temperature, nucleophile, etc.). The nature of the transition state in combination with their kinetics.

- Understand the characteristics of the functional groups (alkenes-alkyne-dienes) and the type of reactions they give. Their thermochemical stability. The concept of regioselectivity and stereochemistry in their reactions, based on the established mechanisms of the basic reactions.

**Knowledge**

- Knowledge and understanding of basic concepts of hybridization, atomic and molecular orbitals of the carbon atom and heteroatoms of interest in Organic Chemistry.
- Knowledge of different categories of chemical bonds.
- Elementary knowledge of resonance theory and molecular orbital theory.
- Knowledge of electronic phenomena (inductive, conjugation, hyperconjugation) and steric phenomena.
- Knowledge of the concepts of acidity and basicity as applied to organic compounds.
- Knowledge and understanding of the concept of stereochemistry of organic molecules [Chirality, optical activity, enantiomers, diastereomers, meso-compounds, racemic mixtures. stereo display, Fischer projection, nomenclature (R / S)].
- Knowledge of nomenclature, synthetic routes, basic chemical reactions and mechanisms of alkenes, alkynes, dienes, as well as, the Substitution- Elimination reactions.

**Skills**

- Skills in predicting structures of organic compounds.
- Skills in predicting the formation and stereochemistry of organic compounds.
- Skills in the distinction and prediction of electronic phenomena.
- Skills in prediction of acidity-basicity properties of organic compounds.
- Skills to predict the mechanism of substitution, addition reactions, and expected reaction products.

**Competences**

- Ability to predict and interpret structures of organic compounds.
- Ability to predict and interpret electronic phenomena of importance in organic compounds.
- Ability to predict and interpret the acidity and basicity properties of organic compounds.
- Ability to predict and interpret the mechanisms of substitution, addition, and elimination 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
- 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...

The general competences that the student should have acquired and to which the course is aimed are:

- Ability to apply the knowledge acquired during the study period in other related courses of the curriculum of the Department of Chemistry.

(3) SYLLABUS

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of Technologies of Information and communications in teaching and communication with students.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td><strong>Activity</strong></td>
</tr>
<tr>
<td>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.</td>
<td>Lectures</td>
</tr>
<tr>
<td></td>
<td>Written assignment</td>
</tr>
<tr>
<td></td>
<td>Individual study, preparation</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Course total</td>
</tr>
</tbody>
</table>

(5) ATTACHED BIBLIOGRAPHY
Books:

Proposed Electronic Bibliography:
- http://chemwiki.ucdavis.edu/Wikitexts/Purdue/Purdue%3A_Chem_26505/Chapter_3_Stereochemistry
- http://chemwiki.ucdavis.edu/Wikitexts/Purdue/Purdue%3A_Chem_26505/Chapter_8_Acid-Base_Reactions
- http://nsmn1.uh.edu/miljanic/lec6.swf
- http://handbook.free.fr/telechargement/cours/cyclohexane.swf
- http://sitemaker.umich.edu/medchemlibrary/files/stereochemistry_calm_module_johnz.swf
- https://www.youtube.com/watch?v=I665n1HC7tY

Scientific Journals:
- Journal of Chemical Education
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
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<tr>
<td>COURSE CODE</td>
<td>ΧΗΥ 201 (2.1)</td>
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<tr>
<td>SEMESTER</td>
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</table>

COURSE TITLE: Analytical Chemistry II

<table>
<thead>
<tr>
<th>INDEPENDENT TEACHING ACTIVITIES</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE: General background, specialization, skills development

PREREQUISITE COURSES: No

LANGUAGE OF INSTRUCTION and EXAMINATIONS: Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS: Yes

COURSE WEBSITE (URL): No

(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 will gain basic knowledge on analytical chemistry topics relevant to the analytical process, measurements, apparatus and unit operations of analytical chemistry, experimental errors in chemical analysis, statistical data treatment and evaluation, introduction to analytical separations, gravimetric methods of analysis, titrimetric methods, precipitation titrimetry, principles of neutralization titrations, titrations curves of complex acid/base systems, applications of neutralization titrations, complexation reactions and titrations. They will learn how to search in literature and analyze data using new technologies. Their survey and bibliographic work will promote free, creative and inductive thinking.

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
<table>
<thead>
<tr>
<th>Working in an international environment</th>
<th>Production of free, creative and inductive thinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>......</td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td>Others...</td>
</tr>
</tbody>
</table>

Search, analysis and synthesis of data and information, by using the proper technologies.
Working independently
Team work
Respect of natural environment
Promoting free, creative and inductive thinking
Understanding analytical science, demonstrate a coherent understanding of analytical chemistry
Depth and breadth of analytical chemistry knowledge
Inquiry and problem solving, critically analyse and solve problems in analytical chemistry
Personal and professional responsibility, be accountable for individual learning and scientific work in analytical chemistry

(3) SYLLABUS

The analytical process, measurements, apparatus and unit operations of analytical chemistry, experimental errors in chemical analysis, statistical data treatment and evaluation, introduction to analytical separations, gravimetric methods of analysis, titrimetric methods, precipitation titrimetry, principles of neutralization titrations, titrations curves of complex acid/base systems, applications of neutralization titrations, complexation reactions and titrations

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
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<td></td>
<td>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>
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</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
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<tr>
<td>Written assignment</td>
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<tr>
<td>Not guided study</td>
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Course total 125

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

Written examination (80%) in Greek.
Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography: :
<table>
<thead>
<tr>
<th>ΠΟΣΟΤΙΚΗ ΑΝΑΛΥΣΗ</th>
<th>Θ.Π. ΧΑΤΖΗΪΩΑΝΝΟΥ, Α.ΚΑΛΟΚΑΙΡΙΝΟΣ, Μ. ΤΙΜΟΘΕΟΥ-ΠΟΤΑΜΙΑ</th>
<th>ΕΛΕΝΗ ΧΑΤΖΗΪΩΑΝΝΟΥ</th>
</tr>
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<tbody>
<tr>
<td>ΣΗΜΕΙΩΣΕΙΣ ΜΑΘ. ΠΟΣΟΤΙΚΗΣ ΧΗΜΙΚΗΣ ΑΝΑΛΥΣΗΣ</td>
<td>Α. ΒΛΕΣΣΙΔΗΣ</td>
<td>ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ (ΣΗΜΕΙΩΣΕΙΣ)</td>
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<td>ΣΤΡΑΤΗΣ ΙΩΑΝΝΗΣ, ΖΑΧΑΡΙΑΔΗΣ ΓΕΩΡΓΙΟΣ, Α. ΒΟΥΛΓΑΡΟΠΟΥΛΟΣ</td>
<td>ΖΗΤΗ ΠΕΛΑΓΙΑ ΚΑΙ ΣΙΑ Ο.Ε.</td>
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<td>ΣΗΜΕΙΩΣΕΙΣ ΜΑΘ. ΠΟΣΟΤΙΚΗΣ ΧΗΜΙΚΗΣ ΑΝΑΛΥΣΗΣ</td>
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</tbody>
</table>


- Related academic journals:
  1) Analytical Chemistry
  2) Journal of Chromatography
  3) Analytica Chimica Acta
  4) Talanta
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
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<tr>
<td>LEVEL OF STUDIES</td>
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<td>SEMESTER</td>
<td>2</td>
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<tr>
<td>COURSE TITLE</td>
<td>INORGANIC CHEMISTRY II</td>
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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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tr>
<td>4</td>
<td>5</td>
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Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE
Scientific Area / Special Background / Development Skills

PREREQUISITE COURSES:
NONE

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS:
YES

COURSE WEBSITE (URL)
http://users.uoi.gr/jiplakatu/site/ARXIKH.htm
http://users.uoi.gr/shadjika/Hadjikakou_1/Hadjikakou_08.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

After successfully completing the course, descriptive marker 6 of the European Qualifications Framework, students should be able to:
- Understand ways of interacting transition metals with ligands.
- Understand the role of coordination compounds in life and technology.
- Understand ligand exchange reactions.
- Understand the basic principles of bond theories and their application to Coordination Chemistry.
- Understand the relationship between bond theories and reactions involving metal complexes.
- Understand the spectroscopic and magnetic properties of coordination compounds.
- Understand the imperfections of some bond theories and choose the appropriate theory for use.
- The second part of the course covers the part of the matter of Inorganic Chemistry referring to the chemical elements of the main groups of the periodic table and their compounds. In this lesson, young chemists meet with to the most important new developments in inorganic chemistry. The presentation of the properties of the chemical elements and their compounds is done in a systematic manner according to the groups of the periodic table. The presentation method is comparative. Each chapter develops
both the normal and the unusual behaviour of certain elements. In the manufacturing processes, the main treatments necessary for the isolation of the elements are generally reported. Along with the reference to new methods of manufacturing certain elements and their compounds, they develop their most characteristic chemical properties as well as their most important applications in other fields of science and technology. Finally, the student has the notes in a modern way of presenting the chapters to be examined

Knowledge
- Knowledge and understanding of basic and advanced principles of coordination chemistry.
- Knowledge and understanding of all bond theories applied to complexes.
- Knowledge and understanding of the evolution of bond theories, and their imperfections.
- Knowledge and understanding of complex formation and substitution reactions.
- Knowledge and understanding of the relationships between structure and reactivity of the complexes.
- Knowledge and understanding of spectroscopic and magnetic properties of coordination compounds.
- Knowledge of structure and properties of various compounds containing metals.
- Knowledge of the most important new developments in inorganic chemistry.
- Knowledge of the properties of the chemical elements and their compounds.
- Knowledge of both the normal and unusual behaviour of certain elements.
- Knowledge of the manufacturing processes, the main treatments necessary to isolate the elements.

Skills
- Skills to solve problems related to coordination chemistry.
- Skills to solve problems related to structural coordination chemistry.
- Skills to solve problems related to the reactivity of complex compounds.
- Skills to solve problems associated with spectroscopy and magnetism in complexes.

Abilities
- Ability to apply their knowledge in addressing issues related to coordination chemistry.
- Ability to combine bibliographic / experimental data and provide for chemical reaction products containing complexes.
- Ability to interact with other students or researchers in the field of coordination chemistry and transition metals.
- Ability to select and apply relevant methodology for solving a particular spectroscopic and / or magnetochemical problems involving a metal center.

General Competences

<table>
<thead>
<tr>
<th>General Competence</th>
<th>Project planning and management</th>
<th>Respect for difference and multiculturalism</th>
<th>Showing social, professional and ethical responsibility and sensitivity to gender issues</th>
<th>Criticism and self-criticism</th>
<th>Production of free, creative and inductive thinking</th>
<th>Others...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for, analysis and synthesis of data and information, with the use of the necessary technology</td>
<td>Team work</td>
<td>Working in an international environment</td>
<td>Working in an interdisciplinary environment</td>
<td>Production of new research ideas</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The general competencies that the student should have acquired and to which the course is aimed are:
- Theoretical thinking and ability to translate theory into practice.
- Ability to apply knowledge acquired during the study period and related courses of the curriculum of the Department of Chemistry.
- Ability to search, analyze and synthesize data and information from international literature and use the necessary technologies related to the presentation of research results.
- Acquiring the appropriate theoretical and practical knowledge base to allow further education at the postgraduate level of specialization and doctorate.
- Working in an interdisciplinary environment.
• Ability to work together at team level to achieve these goals.

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Classroom</th>
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</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td>e-mail, Powerpoint</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>The manner and methods of teaching are described in detail.</td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>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>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</td>
</tr>
<tr>
<td>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>
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<tr>
<td>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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<tbody>
<tr>
<td>Lectures, tutoring</td>
<td>52</td>
</tr>
<tr>
<td>Study, preparation</td>
<td>73</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

Student evaluation is made through progress exams during the course and written final examination (evaluation) in Greek which includes:
- Theoretical questions
- Multiple choice questions
- Responses to questions of judgement
- Problem solving.
(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:

3. INORGANIC CHEMISTRY (IN GREEK), C. E. HOUSECROFT, A. G. SHARPE,
5. Chemistry Principles, Nick Hadjiliadis

Related Journals
ACS: JACS, Inorganic Chemistry
Wiley: European Journal of Inorganic Chemistry
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
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</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
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<tr>
<td>LEVEL OF STUDIES</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
<td>LABORATORY OF INORGANIC CHEMISTRY I</td>
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</table>

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.

<table>
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<tr>
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<tbody>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Scientific Area / Special Background / Development Skills

PREREQUISITE COURSES

NONE

LANGUAGE OF INSTRUCTION and EXAMINATIONS

GREEK

IS THE COURSE OFFERED TO ERASMUS STUDENTS

YES

COURSE WEBSITE (URL)

NONE

(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 aim of the course is to teach and consolidate basic principles of inorganic chemistry through appropriate laboratory exercises and to teach students synthetic and characterization techniques of inorganic compounds.
- After successful completion of the course, students should be able to:
  1. Recognize the contribution of inorganic chemistry to the development of chemistry and other related disciplines.
  2. Be able to prepare coordination compounds using appropriate synthetic methods.
  3. Be able to isolate coordination compounds in pure form using appropriate purification methods.
  4. Know some characteristic properties (geometry, coordination, etc.) of different metal ions.
  5. Understand geometric isomerism (e.g., cis, trans) in coordination compounds.
  6. Know basic principles (stability of oxidative states, kinetics, etc.) regarding transition metal coordination chemistry such as Cu²⁺, Co²⁺/³⁺.
  7. Identify different ways of ligands (monodentate, chelate, bridging etc).
  8. Explain basic infrared and UV/visible spectroscopic data of inorganic compounds and lead to conclusions on the way ligands are coordinated, geometry, isomerism, symmetry, crystal field splitting, etc.
  9. Be able to calculate the yield of reactions involving the synthesis of coordination compounds.
  10. Understand basic principles of magnetochemistry of coordination compounds, be able to
perform magnetic susceptibility measurements at room temperature, calculate the effective magnetic moment and thus be able to draw conclusions about oxidation state of metal ions and discrimination in low-high spin compounds. 

11. Be aware of the basic principles of coordination chemistry so that (a) can easily draw a complex compound and its isomers; (b) use relevant bond theories to predict the hybridization, thermodynamic-kinetic stability geometry, etc. for certain complexes

**Knowledge**

Knowledge and understanding of the basic concepts, principles and theories related to the composition and physico-chemical characterization of coordination compounds.

**Skills**

Skills in the synthesis and purification of coordination compounds, use of spectrometers and magnetic balances, interpretation of infrared and visible-ultraviolet spectra, processing of magnetic susceptibility data at room temperature.

Advanced problem solving skills through careful analysis of the provided data.

**Abilities**

Ability to apply the knowledge provided in solving problems (theoretical and synthetic) related to Inorganic Chemistry.

Ability to synthesize coordination compounds in pure form.

Ability to use spectrometers and magnetic scales.

Ability to interpret spectroscopic data.

Ability to work independently and to interact with other students on the subject.

**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
- Decision-making
- Respect for difference and multiculturalism
- Working independently
- 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...

The general competencies that the student should have acquired and to which the course is aimed are:

Search, analyze and synthesize data and information and make decisions.

Conversion of theory into practice.

Promote free, creative and inductive thinking.

Autonomous but also teamwork.

Acquiring the appropriate theoretical and practical knowledge base to enable further education both at a theoretical level (in more specific topics of Inorganic Chemistry) and in a laboratory.

**SYLLABUS**

Introduction to the Lab. Safety measures. Demonstration of glassware and instruments.


In particular, the course consists of the following subjects:

1. INTRODUCTION TO THE LABORATORY

To educate students on the basic safety rules in the laboratory and to demonstrate the basic laboratory equipment to be used for the laboratory exercises. Lab book.

2. INTRODUCTION TO THE BASIC PRINCIPLES OF SPECTROSCOPY and MAGNETOCHEMISTRY

Basic principles of infrared and visible spectroscopy are presented, as well as principles of magnetocochemistry of coordination compounds. Examples are given regarding the use of the above techniques in inorganic chemistry.

3. CHELATED COMPLEXES. SYNTHESIS OF M(acac)₃ (M = Mn, Cr, Al) (4 Laboratory exercises).

The purpose of the experiment is to synthesize and characterize the Mn(acac)₃ and Cr(acac)₃.
The experiment intends in particular to demonstrate
(a). The use of basic laboratory techniques.
(B). The use of chelating ligands in complexes.
(C). The slow kinetics of Cr(III) reactions and the particularities in the use of basic reagents. Use of urea for ammonia production.
(C) Different starting materials in manganese chemistry. Preparing Mn(III) by the reaction of Mn(II) and Mn(VII).
(E) The composition of Al(acac)₃ is at the initiative of the students. Use of knowledge gained from previous experiments.
(G) Characterization by infrared spectroscopy. Characteristic peaks, similarities to spectral differences. Relative strength of M-O and C-O bonds
4. THE CHEMISTRY OF Ni(II) ION. COORDINATION GEOMETRIES and MAGNETIC CHARACTERISTICS (4 laboratory exercises).
The purpose of the laboratory exercises is the synthesis and characterization of three Nickel complexes with 3 different geometries: octahedral, tetrahedral and square planar. Yield calculation. Use of dehydrating agents in reaction systems.
Then study their magnetic properties. Measure their magnetic susceptibility and calculate their magnetic moment. Conclusions about their electronic structures from their magnetic properties
5. SYNTHESIS of SnI₄. REFLUX. (1 laboratory exercise)
The subject of this laboratory exercise is the synthesis of SnI₄. Utilization of a condenser for the first time. Different solvents in synthesis and their effect.
Yield calculation and recrystallization.
6. SYNTHESIS of [CoCl₂(qui)₂]. Qui = 8-hydroxyquinoline (2 laboratory exercises)
Use of reflux for the synthesis. Study of the equilibrium of tetrahedral-octahedral complex with electronic spectroscopy. Solid state and solution. First contact with Orgel and Tanabe-Sugano charts.
7. SYNTHESIS OF GROUP 2 HYDRATED OXALATES. THERMAL ANALYSIS OF THE PRODUCTS. (3 laboratory exercises)
The aim of the laboratory exercise is the synthesis and characterization of the complexes M(ox).xH₂O (M = Mg, Ca, Sr and ox = C₂O₄²⁻) The influence of the size of the metal product on the properties of the complex Thermogravimetric analysis and thermal decomposition of complexes

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>e-mail, Powerpoint, additional notes on tutors and/or demonstrator's web pages</td>
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<tr>
<td>TEACHING METHODS</td>
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</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
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<td>Lectures</td>
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<td>Laboratory Practice</td>
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<td>Study</td>
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<td>Course total</td>
<td>125</td>
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</table>

STUDENT PERFORMANCE EVALUATION

Assessment of the students is done through laboratory exercises, oral and / or short written examinations during the workshop and written examinations at the end of the semester. Reports include the basic theoretical purpose of the
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.

exercises, the experimental part and the analysis-interpretation of the results. Final exams include: Short answer, judgment, development and problem-solving questions

All the above evaluation criteria are explained to the students at the beginning of the workshop.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Κεσίσογλου Δημήτρης, Ακρίβος Περικλής, Ασλανίδης Παρασκευάς, Καραφίλογλου Παντελής, Δενδρινού - Σαμαρά Αικατερίνη, «Βιοσυναρμοστική χημεία, Τόμος 2: Σύνθεση και Μελέτη Ενώσεων Συναρμογής, Εκδόσεις Ζήτη, Θεσ/νικη 2006.
2. Ακρίβος Περικλής Δ., Ασλανίδης Παρασκευάς, Καραγιαννίδης Πέτρος, «Σύνθεση και μελέτη σύμπλοκων ενώσεων, Εκδόσεις Ζήτη, Θεσ/νικη 1999.

OTHER

7. http://riodb01.ibase.aist.go.jp/sdbs/cgi-bin/direct_frame_top.cgi

-- Related academic journals:
Inorganic Chemistry
European Journal of Inorganic Chemistry
Journal of Chemical education
Polyhedron
Inorganic Synthesis
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
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<td>COURSE TITLE</td>
<td>Organic Chemistry II</td>
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</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>Laboratory Experiments</td>
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</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE
| Specialised General Knowledge/Skills Development |

PREREQUISITE COURSES:
For a better understanding of this course basic knowledge of Organic Chemistry is required, such as the course Organic Chemistry I

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
Greek
All curriculum has been filmed and offered to the interested students as Online Service of the University of Ioannina at the link: E-Course / Asynchronous Tele-Education System

IS THE COURSE OFFERED TO ERASMUS STUDENTS
YES

COURSE WEBSITE (URL)
http://ecourse.uoi.gr/course/view.php?id=991

(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

Knowledge
- Understanding basic concepts of organic chemistry, physical and chemical properties of certain classes of organic compounds in relation to functional groups and their general structure
- Understanding the relationship of structure and chemical behavior of specific classes of organic compounds
- Understanding specific mechanisms of organic reactions

Skills
- Enlargement of the scientific horizon, better understanding of matter and deepening.
- The application of concepts, reactions and mechanisms to simple or complex associations and the logical handling of synthetic problems

**Abilities**

- Ability to apply his knowledge in dealing with synthetic problems of organic chemistry.
- Ability to approach synthetic problems and to suggest the most appropriate synthetic course of a composition.
- Ability to investigate international bibliography and gather information to solve complex synthetic 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 | Others... |
| Production of new research ideas | ...... |

The general competences that the student should have acquired and to which the course is aimed are:

- Theoretical training and acquisition of skills for approaching multidisciplinary issues and problems.
- Ability to search scientific information from international literature, understanding and presentation.
- Teamwork and work in an international interdisciplinary environment.

(3) **SYLLABUS**

The course Organic Chemistry II refers to important classes of organic compounds (amines, phenols, carbonyl compounds, aromatic and heterocyclic compounds, see contents). Their physical and chemical properties are studied, their composition, the mechanisms of the various transformations and their general significance, such as their connection with life and biological processes, as bioactive molecules occurring in nature.

The lesson consists of the following individual subject areas:

1. **Benzene and aromaticity**

   **Thematic unit description:** Nomenclature of aromatic compounds, structure and stability of benzene, description of this on the basis of coordination and molecular orbitals, Hückel rule, aromatic ions, heterocyclic and polycyclic aromatic compounds.

   **Keywords:** Aromaticity, aromatic compounds.

2. **Chemistry of benzene**

   **Thematic unit description:** Electrophilic aromatic substitution mechanism (chlorination, bromination, alkylation and Friedel-Crafts acylation), interpretation of the effect of substituents on aromatic rings, polyunsaturated benzenes and additive phenomena of the groups. Nuclear aromatic substitution - mechanisms (addition / elimination, elimination / addition), benzene.

   **Key words:** Electronophilic and nucleophilic reagent, aromatic substitution, elimination, addition.

3. **Aliphatic amines**
Thematic unit description: Nomenclature, structure and amine stereochemistry, physical and chemical properties of amines - basicity, synthesis and reaction of amines.

Key words: Basicity, elimination, rearrangement.

4. Arylamines and phenols
Thematic unit description: Properties of arylamines-basicity, preparations and their reactions, properties of phenols – acidity, preparations and reactions of phenols.

Key words: Acidity, electrophilic aromatic substitution, mechanism.

5. Heterocyclic compounds
Thematic unit description: Heterocyclic compounds with five-membered and six-membered ring-nomenclature, condensed ring heterocyclic compounds, electrophilic and nucleophilic substitution reactions.

Key words: Aromaticity, heterocyclic aromatic rings.

6. Aldehydes and ketones
Thematic unit description: Nomenclature, structure, synthesis, physical and chemical properties of aldehydes and ketones.

Key words: Nucleophilic reagent-nucleophilic addition, acidity H in α-position, enol, enol ions, tautomerism, condensation, isomerism.

7. Aldehydes and ketones - nucleophilic addition
Thematic unit description: Nucleophilic addition to the carbonyl of aldehydes and ketones-mechanism.

Key words: Nucleophilic reagent-nucleophilic addition, acidity H in α-position, enol, enol ions, tautomerism, condensation, isomerism.

8. Aldehydes and ketones - α-position acidity and condensations
Thematic unit description: Acidity of H in α-position to C = O, explanation, consequences, enol anions. Enol-ketone tautomerism, reactions (alkylation, halogenation, acylation, aldol condensation, etc.), isomerism, α,β−unsaturated carbonyl compounds, reactions thereof.

Key words: Nucleophilic reagent-nucleophilic addition, acidity H in α-position, enol, enol ions, tautomerism, condensation, isomerism.

9. Carboxylic acids
Thematic unit description: Nomenclature, structure, synthesis, properties of carboxylic acids, their acidity - effect of substituents - comparison with other acidic organic compounds, reactions - comparison with aldehydes and ketones.

Key words: Acidity of carboxylic acids.

10. Carboxylic acid derivatives
Thematic unit description: Acid derivatives: halides, anhydrides, esters, amides and nitriles, nomenclature, physical and chemical properties, synthesis of derivatives, relative activity, nucleophilic substitution reactions, mechanisms.
11. Carboxylic acid derivatives - α-position acidity, concentrations

Thematic unit description: α-position acidity of carboxylic acid derivatives, Claisen and Dieckmann condensations, Michael reaction, malonate synthesis and ethyl acetoacetate synthesis.

Key words: Reactivity, nucleophilic acyl substitution, derivative transformations, α-position acidity, condensations, mechanisms, syntheses.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>e-Electronic communication with students.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
</tr>
<tr>
<td>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></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures-Suggestions</td>
<td>50</td>
</tr>
<tr>
<td>Individual study, preparation</td>
<td>50</td>
</tr>
<tr>
<td>Course total</td>
<td>100</td>
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</tbody>
</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, etc.

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

The evaluation of the students is done by written final examination (evaluation) in Greek which includes:

I. Written / oral final examination including:
   o the development of topics
   o short answer questions
   o answers to crisis questions problem solving

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Organic Chemistry, David R. Klein, UTOPIA Εκδόσεις ΕΠΕ
2. Organic Chemistry volume B’, VOLLLHARDT PETER, SCHORE NEIL.
   (translation Spyroudis Spyros, Rodios Nestor, Malamidou-Xenikaki Elisavet),
   Publishing Company Kyriakidis Bros.
3. Organic Chemistry John McMurry
4. L.G. Wade
5. Organic Chemistry, R.T. Morisson και R.N. Boyd,
### COURSE OUTLINE

#### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
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<td>COURSE CODE</td>
<td>XHY 033</td>
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<tr>
<td>SEMESTER</td>
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<td>PHYSICAL CHEMISTRY II</td>
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</table>

#### INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

#### COURSE TYPE

General background

#### PREREQUISITE COURSES:

The Department’s curriculum does not require any prerequisite courses. However, the essential attendance and participation in the course lectures presupposes the assimilation of basic mathematical and thermodynamics coursework knowledge taught in the first year of studies (Calculus I & II and Physical Chemistry I) of the Chemistry Department.

#### LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

#### IS THE COURSE OFFERED TO ERASMUS STUDENTS

Yes (in English)

#### COURSE WEBSITE (URL)

http://users.uoi.gr/melissas/notes/lecture%20notes.htm
The Physical Chemistry II compulsory course aims to introduce students in the concepts of chemical kinetics and quantum mechanics.

The course material aims at introducing students to the following subjects:
- perception of the importance of time in chemical reactions,
- writing equations describing the time evolution of a chemical reaction,
- the proposal of chemical reaction mechanisms compatible with experimental data,
- understanding parameters affecting chemical reactions rates,
- the embedding of the wave-particle duality of light and matter,
- familiarization with Schrödinger equation and its statistical interpretation,
- the emergence of the uncertainty principle in the physical properties assessment,
- the utilization of square potential wells in the interpretation of chemical reactions,
- the necessity of the harmonic oscillator approach and
- the completeness of the hydrogen atom eigenstates.

After successful completion of the course, students should be able to:
- realize the evolution of time in chemical and physical phenomena,
- write correctly equations describing the time evolution of a chemical system,
- propose chemical reaction mechanisms compatible with experimental data,
- understand parameters affecting chemical reactions rates,
- accept the duality of wave and particle-like nature for particles and electromagnetic radiation,
- establish and solve Schrödinger equation for a series of problems,
- easily use operators' tools for physical properties visualization purposes,
- clearly describe simple particle problems in square potential wells,
- easily handle the harmonic oscillator approach and
- solve for the eigenstates of hydrogen atom.

Knowledge of:
- to acquire knowledge on basic concepts and theories of chemical kinetics,
- basic knowledge of reaction mechanisms and their correlation with chemical kinetics,
- assimilation of the wavelength-particle duality for radiation and matter,
- complete knowledge of the prerequisite mathematical background, which includes manipulation of operators, solving partial differential equations, introductory concepts of statistics, solving definite integrals,
- application of the Schrödinger equation in discrete and continuous eigenvalue potential wells,
- in-depth knowledge of the harmonic oscillator application in a variety of problems and
- thorough and detailed knowledge of the complete hydrogen atom problem.
**Skills:**
- in applying basic concepts and theories of chemical kinetics,
- in identifying reaction mechanisms and matching their correlation with chemical kinetics,
- in assimilating the wavelength-particle duality for radiation and matter,
- in acquiring the prerequisite mathematical background, which includes manipulation of operators, solving partial differential equations, introductory concepts of statistics, solving definite integrals,
- in applying the Schrödinger equation in discrete and continuous eigenvalue potential wells,
- in applying the harmonic oscillator approximation in a variety of problems and
- in solving the complete hydrogen atom problem.

**Abilities:**
- to understand basic concepts and theories of chemical kinetics,
- to apply reaction mechanisms and denote their correlation with chemical kinetics,
- to assimilate the wavelength-particle duality for radiation and matter,
- to acquire the prerequisite mathematical background, which includes manipulation of operators, solving partial differential equations, introductory concepts of statistics, solving definite integrals,
- to apply the Schrödinger equation in discrete and continuous eigenvalue potential wells,
- to practice the harmonic oscillator application in a variety of problems and
- to solve the hydrogen atom problem.
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 |
| Production of new research ideas | Others... |

The course aims at acquiring basic knowledge of physical chemistry, necessary for the understanding of the wider field of chemical science. It also aims at developing critical thinking, which is tragically absent amongst high school graduates. In particular, the areas of focus and understanding of the above concepts are aimed at developing the following basic abilities:

- discarding the image of classical particles for leptons and hadrons and adopting the correct quantum-mechanical image of the "material wave",
- reevaluating the offered mathematical "tools" and thorough understanding of their application,
- recognizing the origin of the Schrödinger equation and its applicability to all queries regarding a particle’s life,
- identifying the restrictive terms of each particle and exploiting their definition,
- enhancing cooperation between students to realize the physical chemistry concepts and figure out how to deal with them,
- seeking complementary solutions and applying critical thinking in the choice of available “tools” and designing and managing a thorough number of problems to gain self-confidence and self-reliance about the "new" way of thinking.
- Chemical reactions rates: experimental rate law.
- Reaction rates and rate laws.
- Effect of temperature and Arrhenius equation.
- Determination of the reaction mechanism through the reaction rate law.
- II: Reactions approaching equilibrium. Homogeneous catalysis, enzymatic kinetics.

- The wave-particle dualism of light and matter.
- Schrödinger equation and its statistical interpretation.
- The uncertainty principle.
- Potential wells I: discrete/quantized solutions.
- Potential wells II: continuous energies.
- The harmonic oscillator.
- Hydrogen atom I: spherically symmetric solutions.
- Hydrogen atom II: solutions with angular dependence (angular momentum).
- Atom in a magnetic field and the emergence of spin.
DELIVERY

Face-to-face, Distance learning, etc.

In class lecturing, encouraging students to participate with comments and questions.

A significant part of the course is being taught within the “Physical Chemistry Lab II” framework.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Use of ICT in teaching, laboratory education, communication with students

Support of the learning process through the e-course platform, a variety of short explanatory video projections and the use of specialized web pages.

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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>52</td>
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<tr>
<td>Series of problems focusing on the application of methodologies and the enhancement of cooperation between students</td>
<td>32</td>
</tr>
<tr>
<td>Interactive teaching</td>
<td>10</td>
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<tr>
<td>Independent Study</td>
<td>31</td>
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<tr>
<td>Course total</td>
<td>125</td>
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</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.

Chemical Kinetics: Students are required to either participate in two midterm exams or a final exam. Exams mainly focus on problem solving.

Quantum mechanics: Two choices are offered:

a) three quick exams (~20 minutes each) without any prior notification (50% of the grade), the one with the lowest grade is being rejected, and a final quick exam at the end of the semester (25% of the grade). 10 homework sets gain an extra 25% of the final grade.

b) a final three-hour exam at the end of the semester.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - Related academic journals:

  ΚΒΑΝΤΟΜΗΧΑΝΙΚΗ ΤΟΜΟΣ Ι
  ΤΡΑΧΑΝΑΣ ΣΤΕΦΑΝΟΣ
  ΣΤΕΦΑΝΟΣ ΤΡΑΧΑΝΑΣ
  ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ
  CRETAN UNIVERSITY PRESS

  ΚΒΑΝΤΟΜΗΧΑΝΙΚΗ ΤΟΜΟΣ II
  ΤΡΑΧΑΝΑΣ ΣΤΕΦΑΝΟΣ
  ΣΤΕΦΑΝΟΣ ΤΡΑΧΑΝΑΣ
  ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ
  CRETAN UNIVERSITY PRESS

  Ο ΧΗΜΙΚΟΣ ΔΕΣΜΟΣ
  ΤΗΕ CHEMICAL BOND
  MURELL J.N., KETTLE S.A., TEDDER J.N.
  ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ
  CRETAN UNIVERSITY PRESS
| ΕΙΣΑΓΩΓΗ ΣΤΗΝ | ΤΣΙΠΗΣ ΚΩΝ/ΝΟΣ | ΖΗΤΗ ΠΕΛΑΓΙΑ  
| ΚΒΑΝΤΙΚΗ ΧΗΜΕΙΑ | CONSTANTINOS TSIPIS | ΚΑΙ ΣΙΑ Ο.Ε.  
| INTRODUCTION TO | | ΖΙΤΙ ΠΕΛΑΓΙΑ LTD  
| QUANTUM CHEMISTRY | | |
| ΜΟΡΙΑΚΗ | ATKINS PETER WILLIAM | ΕΚΔΟΣΕΙΣ ΠΑΠΑΖΗΣΗ  
| ΚΒΑΝΤΙΚΗ ΜΗΧΑΝΙΚΗ | | ΡΑΡΑΖΗΣΙΣ PRESS  
| MOLECULAR QUANTUM | | |
| MECHANICS | | |

-Συναφή επιστημονικά περιοδικά:
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
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<td>COURSE TITLE</td>
<td>PHYSICAL CHEMISTRY LABORATORY I</td>
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<table>
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<tr>
<th>INDEPENDENT TEACHING ACTIVITIES</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>GENERAL BACKGROUND</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>PREREQUISITE COURSES:</th>
<th>There are not prerequisite courses in the Chemistry Department</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</th>
<th>GREEK</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>IS THE COURSE OFFERED TO ERASMUS STUDENTS</th>
<th>YES</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>COURSE WEBSITE (URL)</th>
<th>Video tutorials and presentations can be found in <a href="http://ecourse.uoi.gr/">http://ecourse.uoi.gr/</a></th>
</tr>
</thead>
</table>

(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 successful completion of the course, students should be able to:

- Understand physicochemical processes related to Chemical Thermodynamics
- Carry out a physicochemical determination experiment.
- Prepare a work in which physicochemical calculations are performed on the experimental results and diagrams from which the desired physicochemical quantities are determined
- Improve the presentations of projects

Knowledge

- Knowledge and understanding of the basic concepts, principles and theories related to the physicochemical field of Chemical Thermodynamics.
- Knowledge of the use of physicochemical data from the international literature.
**Skills**

- Skills to perform a demanding experiment with precision.
- Use of appropriate mathematical and computational techniques to solve complex physicochemical problems.
- Complex problem-solving skills through data analysis of international literature.

**Abilities**

- Ability to apply his / her knowledge in dealing with problems related to physical chemistry issues and especially Chemical Thermodynamics.
- Ability to perform complex calculations and identify different physicochemical parameters.
- Develop critical competence through the interpretation of the result.
- Ability to interact with other students or researchers in Chemical Thermodynamics.
- Ability to select and apply the most appropriate physicochemical methods and relevant methodology to solve a specific research problem.
- Ability to work in a team.

---

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

---

- Ability to convert the knowledge of theory into solving and finding experimental parameters.
- Ability to apply knowledge from related courses
- Ability to search, analyze data and information from international literature and use the necessary technologies related to the presentation of research results.
- Acquiring the appropriate practical knowledge to allow further education at postgraduate level.
- Working in an interdisciplinary environment.
- Ability to work together at team level to achieve these goals.
(3) SYLLABUS

- Introduction to the laboratory: Thermochemistry, Computer software, safety in the laboratory.
- Determination of salt solution enthalpy
- Deferential Scanning Calorimetry: Phase diagram of Urea-hexadecane mixture
- Determination of combustion enthalpy of organic compounds.
- Evaporation Enthalpy of water
- Zeseseoscopy: Determination of molecular weight of organic compound
- Partially miscible binary blends: Phase diagram
- Ternary blends: Phase diagram
- gass-liquid phase diagram of binary mixtures
- Determination of Partial molar volume in binary mixtures
- Determination of surface tension of solutions with the Du Nouy ring tensiometer
- X-ray determination of structure of crystal compounds

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td></td>
<td>Use of internet for search of values of physical chemistry parameters.</td>
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</table>

<table>
<thead>
<tr>
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</thead>
<tbody>
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</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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<tbody>
<tr>
<td>Laboratory practice</td>
<td>50</td>
</tr>
<tr>
<td>Post processing of experimental data and report</td>
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<tr>
<td>lectures</td>
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<tr>
<td>Individual work</td>
<td>10</td>
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</table>
directed study according to the principles of the ECTS

<table>
<thead>
<tr>
<th>Project (in some cases)</th>
<th>15</th>
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</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.

Evaluation will be by final oral or written examination, which will cover all the semester’s work (50% of the final grade) and the laboratory reports during the course (50% of the final grade).

The passing grade for the course is 50%.

---

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:
  - Peter Atkins and Julio de Paula Physical Chemistry Oxford University Press
  - Physical chemistry laboratory S. Skoulika and A Michaelides University of Ioannina
  - Physical chemistry laboratory notes C. Vlahos, V. Melissas, T. Lazaridis and A. Tampaki University of Ioannina
# COURSE OUTLINE

## (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
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<tr>
<td>Lectures</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

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:
The Department’s curriculum does not require any prerequisite courses. However, the essential attendance and participation in the course lectures presupposes the assimilation of basic mathematical and thermodynamics coursework knowledge taught in the first year of studies (Calculus I & II and Physical Chemistry I) of the Chemistry Department.

## LANGUAGE OF INSTRUCTION and EXAMINATIONS:
- Greek

## IS THE COURSE OFFERED TO ERASMUS STUDENTS
- Yes (in English)

## COURSE WEBSITE (URL)
http://users.uoi.gr/melissas/notes/lecture%20notes.htm
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 Physical Chemistry II compulsory course aims to introduce students in the concepts of chemical kinetics and quantum mechanics.

The course material aims at introducing students to the following subjects:
- perception of the importance of time in chemical reactions,
- writing equations describing the time evolution of a chemical reaction,
- the proposal of chemical reaction mechanisms compatible with experimental data,
- understanding parameters affecting chemical reactions rates,
- the embedding of the wave-particle duality of light and matter,
- familiarization with Schrödinger equation and its statistical interpretation,
- the emergence of the uncertainty principle in the physical properties assessment,
- the utilization of square potential wells in the interpretation of chemical reactions,
- the necessity of the harmonic oscillator approach and
- the completeness of the hydrogen atom eigenstates.

After successful completion of the course, students should be able to:
- realize the evolution of time in chemical and physical phenomena,
- write correctly equations describing the time evolution of a chemical system,
- propose chemical reaction mechanisms compatible with experimental data,
- understand parameters affecting chemical reactions rates,
- accept the duality of wave and particle-like nature for particles and electromagnetic radiation,
- establish and solve Schrödinger equation for a series of problems,
- easily use operators' tools for physical properties visualization purposes,
- clearly describe simple particle problems in square potential wells,
- easily handle the harmonic oscillator approach and
- solve for the eigenstates of hydrogen atom.

Knowledge of:
- to acquire knowledge on basic concepts and theories of chemical kinetics,
- basic knowledge of reaction mechanisms and their correlation with chemical kinetics,
- assimilation of the wavelength-particle duality for radiation and matter,
- complete knowledge of the prerequisite mathematical background, which includes manipulation of operators, solving partial differential equations, introductory concepts of statistics, solving definite integrals,
- application of the Schrödinger equation in discrete and continuous eigenvalue potential wells,
- in-depth knowledge of the harmonic oscillator application in a variety of problems and
- thorough and detailed knowledge of the complete hydrogen atom problem.
Skills:
- in applying basic concepts and theories of chemical kinetics,
- in identifying reaction mechanisms and matching their correlation with chemical kinetics,
- in assimilating the wavelength-particle duality for radiation and matter,
- in acquiring the prerequisite mathematical background, which includes manipulation of operators, solving partial differential equations, introductory concepts of statistics, solving definite integrals,
- in applying the Schrödinger equation in discrete and continuous eigenvalue potential wells,
- in applying the harmonic oscillator approximation in a variety of problems and
- in solving the complete hydrogen atom problem.

Abilities:
- to understand basic concepts and theories of chemical kinetics,
- to apply reaction mechanisms and denote their correlation with chemical kinetics,
- to assimilate the wavelength-particle duality for radiation and matter,
- to acquire the prerequisite mathematical background, which includes manipulation of operators, solving partial differential equations, introductory concepts of statistics, solving definite integrals,
- to apply the Schrödinger equation in discrete and continuous eigenvalue potential wells,
- to practice the harmonic oscillator application in a variety of problems and
- to solve the hydrogen atom problem.
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...

The course aims at acquiring basic knowledge of physical chemistry, necessary for the understanding of the wider field of chemical science. It also aims at developing critical thinking, which is tragically absent amongst high school graduates.

In particular, the areas of focus and understanding of the above concepts are aimed at developing the following basic abilities:

- discarding the image of classical particles for leptons and hadrons and adopting the correct quantum-mechanical image of the "material wave",
- reevaluating the offered mathematical "tools" and thorough understanding of their application,
- recognizing the origin of the Schrödinger equation and its applicability to all queries regarding a particle’s life,
- identifying the restrictive terms of each particle and exploiting their definition,
- enhancing cooperation between students to realize the physical chemistry concepts and figure out how to deal with them,
- seeking complementary solutions and applying critical thinking in the choice of available “tools” and designing and managing a thorough number of problems to gain self-confidence and self-reliance about the "new" way of thinking.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical reactions rates: experimental rate law.</td>
<td></td>
</tr>
<tr>
<td>Reaction rates and rate laws.</td>
<td></td>
</tr>
<tr>
<td>Effect of temperature and Arrhenius equation.</td>
<td></td>
</tr>
<tr>
<td>Determination of the reaction mechanism through the reaction rate law.</td>
<td></td>
</tr>
<tr>
<td>II: Reactions approaching equilibrium. Homogeneous catalysis, enzymatic kinetics.</td>
<td></td>
</tr>
<tr>
<td>The wave-particle dualism of light and matter.</td>
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<tr>
<td>Schrödinger equation and its statistical interpretation.</td>
<td></td>
</tr>
<tr>
<td>The uncertainty principle.</td>
<td></td>
</tr>
<tr>
<td>Potential wells I: discrete/quantized solutions.</td>
<td></td>
</tr>
<tr>
<td>Potential wells II: continuous energies.</td>
<td></td>
</tr>
<tr>
<td>The harmonic oscillator.</td>
<td></td>
</tr>
<tr>
<td>Hydrogen atom I: spherically symmetric solutions.</td>
<td></td>
</tr>
<tr>
<td>Hydrogen atom II: solutions with angular dependence (angular momentum).</td>
<td></td>
</tr>
<tr>
<td>Atom in a magnetic field and the emergence of spin.</td>
<td></td>
</tr>
</tbody>
</table>
TEACHING and LEARNING METHODS - EVALUATION

DELIVERY
Face-to-face, Distance learning, etc.

In class lecturing, encouraging students to participate with comments and questions.

A significant part of the course is being taught within the “Physical Chemistry Lab II” framework.

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students

Support of the learning process through the e-course platform, a variety of short explanatory video projections and the use of specialized web pages.

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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>Series of problems focusing on the application of methodologies and the enhancement of cooperation between students</td>
<td>32</td>
</tr>
<tr>
<td>Interactive teaching</td>
<td>10</td>
</tr>
<tr>
<td>Independent Study</td>
<td>31</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</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.

Chemical Kinetics: Students are required to either participate in two midterm exams or a final exam. Exams mainly focus on problem solving.

Quantum mechanics: Two choices are offered:

a) three quick exams (~20 minutes each) without any prior notification (50 % of the grade), the one with the lowest grade is being rejected, and a final quick exam at the end of the semester (25 % of the grade). 10 homework sets gain an extra 25 % of the final grade.

b) a final three-hour exam at the end of the semester.

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:

<table>
<thead>
<tr>
<th>ΚΒΑΝΤΟΜΗΧΑΝΙΚΗ ΤΟΜΟΣ I</th>
<th>ΤΡΑΧΑΝΑΣ ΣΤΕΦΑΝΟΣ STEFANOS TRACHANAS</th>
<th>ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ CRETAN UNIVERSITY PRESS</th>
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<td>ΤΡΑΧΑΝΑΣ ΣΤΕΦΑΝΟΣ STEFANOS TRACHANAS</td>
<td>ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ CRETAN UNIVERSITY PRESS</td>
</tr>
<tr>
<td>Ο ΧΗΜΙΚΟΣ ΔΕΣΜΟΣ</td>
<td>MURELL J.N., KETTLE S.A., TEDDER J.N.</td>
<td>ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ CRETAN UNIVERSITY PRESS</td>
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<td>ΕΙΣΑΓΩΓΗ ΣΤΗΝ ΚΒΑΝΤΙΚΗ ΧΗΜΕΙΑ</td>
<td>ΣΥΝΑΦΗ ΕΠΙΣΤΗΜΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ:</td>
<td></td>
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<tr>
<td>-----------------------------</td>
<td>---------------------------------</td>
<td></td>
</tr>
<tr>
<td>INTRODUCTION TO QUANTUM CHEMISTRY</td>
<td>ΤΣΙΠΗ ΠΕΛΑΓΙΑ ΚΑΙ ΣΙΑ Ο.Ε.</td>
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</tr>
<tr>
<td>CONSTANTINOS TSIPIΣ</td>
<td>ZITI PELAGIA LTD</td>
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<tr>
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<td>ΕΚΔΟΣΕΙΣ ΠΑΠΑΖΗΣΗ</td>
<td></td>
</tr>
<tr>
<td>MOLECULAR QUANTUM MECHANICS</td>
<td>PAPAZISIS PRESS</td>
<td></td>
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<tr>
<td>ATKINS PETER WILLIAM</td>
<td>———</td>
<td></td>
</tr>
</tbody>
</table>

- Συναφή επιστημονικά περιοδικά:
# COURSE OUTLINE

## (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΧΗΥ 301 (3.1)</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>3rd</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Analytical Chemistry III</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

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:**

No. According to the curriculum of the Department of Chemistry there are no prerequisites, but its attendance is not effective without the required knowledge of the courses of Analytical Chemistry I and Analytical Chemistry II

**LANGUAGE OF INSTRUCTION and EXAMINATIONS:**

Greek

**IS THE COURSE OFFERED TO ERASMUS STUDENTS**

Yes

**COURSE WEBSITE (URL)**

No

## (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 will gain basic knowledge on instrumental analytical chemistry, Electroanalytical Techniques, Potentiometry, Coulometry, Electrogravimetric Analysis, Polarography, Voltammetry, Introduction to Biosensors, Introduction to Spectrochemical Methods, Instrumentation for Optical Spectrometry, Molecular Absorption Spectrometry, Molecular Fluorescence Spectroscopy, Atomic Spectroscopy, Analytical Separations, Gas Chromatography, High-Performance Liquid Chromatography

**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?

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

- Search, analysis and synthesis of data and information, by using the proper technologies.
- Working independently
- Team work
- Respect of natural environment
- Promoting free, creative and inductive thinking
- Understanding analytical science, demonstrate a coherent understanding of instrumental analytical chemistry
- Depth and breadth of analytical chemistry knowledge
- Inquiry and problem solving, critically analyse and solve problems in instrumental analytical chemistry
- Personal and professional responsibility, be accountable for individual learning and scientific work in (instrumental) analytical chemistry

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>Not guided study</td>
<td>30</td>
</tr>
<tr>
<td>Homework and preparation</td>
<td>43</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

- Written examination in Greek, with multiple choice questionnaires and short-answer questions.

(5) ATTACHED BIBLIOGRAPHY
### Suggested bibliography:

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
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<tbody>
<tr>
<td>ΑΡΧΕΣ ΑΝΑΛΥΤΙΚΗΣ ΧΗΜΕΙΑΣ</td>
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<td>ΕΝΟΡΓΑΝΗ ΑΝΑΛΥΣΗ</td>
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<td>SKOOG ΚΩΣΤΑΡΑΚΗΣ Α.Ε.</td>
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</tbody>
</table>

### Related Scientific Journals:

- Journal of Chemical Education
- Analytical Chemistry
- Analytica Chimica Acta
- Talanta
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
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</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
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<tr>
<td>COURSE CODE</td>
<td>ΧΗΕ 503</td>
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<tr>
<td>SEMESTER</td>
<td>3</td>
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<tr>
<td>COURSE TITLE</td>
<td>Environmental Chemistry</td>
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</table>

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.

<table>
<thead>
<tr>
<th>WEEKLY</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEACHING HOURS</td>
<td></td>
</tr>
<tr>
<td>LECTURES</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>general background, special background, specialised general knowledge, skills development</td>
<td></td>
</tr>
</tbody>
</table>

PREREQUISITE COURSES:
No

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:
No

COURSE WEBSITE (URL):
No

(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
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• Guidelines for writing Learning Outcomes

Students will gain basic knowledge on Environmental chemistry, will be introduced to the principles and factual basis of chemistry in an environmental context, will gain an appreciation of the scientific methodology in environmental chemistry, and will develop problem-solving and critical-thinking skills that are necessary to analyse and discuss chemical and physical phenomena in the environment.

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...

This Course aims to promote:
• free, creative and inductive thinking
• understanding science, demonstrate a coherent understanding of environmental science
• scientific knowledge, exhibit depth and breadth of environmental science knowledge
• inquiry and problem solving, critically analyse and solve problems in environmental science
• communication, be an effective communicator of environmental science
• personal and professional responsibility, be accountable for individual learning and scientific work in environmental science

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
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</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
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</tr>
<tr>
<td>Study and analysis of bibliography</td>
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</tr>
<tr>
<td>Not guided study</td>
<td>43</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</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.

Written examination with multiple choice questionnaires and short-answer questions and essay/report (100%) in Greek.
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:

- Related academic journals:
  1) Journal of Chemical Education (American Chemical Society)
  2) Environmental Science and Technology (American Chemical Society)
  3) The Science of the Total Environment (Elsevier)
  4) Environmental Pollution (Elsevier)
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
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<tr>
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<td>Department of Chemistry</td>
</tr>
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INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE
knowledge, skills development

PREREQUISITE COURSES:
No

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:
Yes

COURSE WEBSITE (URL):
No

(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

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- Guidelines for writing Learning Outcomes

After the successful completion of this course, according to the Descriptors for Levels 6 of the European Qualifications Framework for Lifelong Learning, students should be able to:

- To understand of the basic principles of Analytical Chemistry and its applications.
- Knowledge and good apprehension of the basic principles, theory and concepts of chemical analysis and data treatment.
- Knowledge and good apprehension of the applications of analytical chemistry on the analysis of complex substrates.
- Knowledge on the combinational use of analytical techniques and methods
- Knowledge of the use and search of international research literature.

Skills
- Skills related to the correct treatment of the results and solving analytical problems
- Skills related to the determination of information of the matter composition.

Abilities
- Ability to apply the knowledge for the problems solving related to basic statistic treatment of the data and to analyze inorganic and organic compounds.
- Ability of recognizing and applying the basic steps of analytical chemistry (method selection, method validation, sampling, method calibration, sample preparation, analysis and conclusions)
• Ability to use the existing literature for the proper method selection and exploitation in relation to the available equipment and consumables of a chemistry Laboratory.

• Ability of interaction with other students or researchers for chemical analysis concepts.

**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...

**Theoretical thinking and transformation ability of theory to practice**

- Ability of application of knowledge gained to solving problems related to Analytical Chemistry
- Search, analysis and synthesis of data and information, by using the proper technologies.
- Working independently
- Team work
- Theoretical and practical knowledge background to proceed to advanced educational levels such as Master of Science and Doctoral diploma.
- Promoting free, creative and inductive thinking
- Working in interdisciplinary environment

(3) **SYLLABUS**

Introduction to qualitative analysis, Qualitative analysis of cations, Qualitative analysis of anions, Analysis of solid samples, Introduction to quantitative chemical analysis and statistical analysis, acid-base titrations, redox titrations, complexation titrations, gravimetric analysis.

(4) **TEACHING and LEARNING METHODS - EVALUATION**

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</strong></td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td>Use of PowerPoint in lectures to support learning difficulties. Communication via email.</td>
</tr>
<tr>
<td><strong>TEACHING METHODS</strong></td>
<td>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.</td>
<td>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>
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<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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<tr>
<td>Lectures on theoretical aspects</td>
<td>13</td>
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<tr>
<td>Laboratory exercise</td>
<td>52</td>
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<tr>
<td>Personal essay writing</td>
<td>40</td>
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<tr>
<td>Personal study-preparation</td>
<td>20</td>
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</table>

Course total: 125

**STUDENT PERFORMANCE EVALUATION**

Description of the evaluation procedure

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

- Written examination (50%) in Greek including:
  1. Subjects elaboration
  2. Short answer questions
  3. Answer to judgment questions
  4. Solving problems
- Personal essay with all laboratory exercises (50%)
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

<table>
<thead>
<tr>
<th>ΧΗΜΙΚΗ ΙΣΟΡΡΟΠΙΑ ΚΑΙ ΑΝΟΡΓΑΝΗ ΠΟΙΟΤΙΚΗ ΗΜΙΜΙΚΡΟΑΝΑΛΥΣΗ</th>
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<th>ΕΛΕΝΗ ΧΑΤΖΗΪΩΑΝΝΟΥ</th>
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<td>Α. ΒΑΣΕΣΙΔΗΣ, Μ. ΠΡΟΔΡΟΜΙΔΗΣ, Β. ΣΑΚΚΑΣ, Κ. ΚΩΝΙΔΑΡΗ, Δ. ΓΚΙΩΚΑΣ, Κ. ΣΤΑΛΙΚΑΣ, Τ. ΛΑΜΠΙΑΝΗΣ</td>
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</table>

- Related academic books:
1. «ΠΟΙΟΤΙΚΗ ΑΝΑΛΥΣΗ ΚΑΙ ΧΗΜΙΚΗ ΙΣΟΡΡΟΠΙΑ», Θ.Π. Χατζηϊωάννου, Αθήναι, 1989
2. «ΧΗΜΙΚΗ ΙΣΟΡΡΟΠΙΑ ΚΑΙ ΑΝΟΡΓΑΝΗ ΠΟΙΟΤΙΚΗ ΗΜΙΜΙΚΡΟΑΝΑΛΥΣΗ», Θ.Π. Χατζηϊωάννου, 1993
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>SCHOOL OF SCIENCES</th>
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<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
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<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΧΗΥ 051</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>4th</td>
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<tr>
<td>COURSE TITLE</td>
<td>BIOCHEMISTRY I</td>
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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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tr>
<td>Lectures 4</td>
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<tr>
<td>Project preparation</td>
<td>1</td>
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Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE
General background

PREREQUISITE COURSES:
No

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:
Yes

COURSE WEBSITE (URL)

(2) 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 will be able to:

- Describe basic concepts related to chemistry, biochemistry and properties of biomolecules
- Find the kinetic parameters of enzymes and solve related problems
- Know and describe the basic concepts of bioenergetics
- Describe the linked pathways of metabolism.
- Compare and contrast anabolism and catabolism.
- Describe how enzymes control metabolic reactions.
- Explain how metabolic pathways are regulated
- Explain how ATP stores chemical energy and makes it available to a cell
- Explain how the reactions of cellular respiration release chemical energy.
- Describe the general metabolic pathways of carbohydrate metabolism, pentose phosphate, citric citrate and glyoxylate cycles, oxidative phosphorylation linked with respiratory chain and the metabolism of fatty acids.
- Understand and describe the molecular level of health disorders associated with malfunctions in
metabolism
• Know and write the chemical reactions and mechanisms taking place in the above pathways.
• Describe the function of the regulatory enzymes involved in the above pathways
• Solve problems of data interpretation and calculation of biochemical parameters

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 |
| Decision-making | Respect for difference and multiculturalism |
| Working independently | Respect for the natural environment |
| Team work | Showing social, professional and ethical responsibility and sensitivity to gender issues |
| Working in an international environment | Criticism and self-criticism |
| Working in an interdisciplinary environment | Production of free, creative and inductive thinking |
| Production of new research ideas | Others... |

• Search, analysis and synthesis of data and information, by using the proper technologies.
• Autonomous work
• Working in an interdisciplinary environment
• Promoting free, creative and inductive thinking

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>TEACHING METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
<td>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>
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</table>

<table>
<thead>
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<th>Activity</th>
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<td>Lectures</td>
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<td>Study and self preparation</td>
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<tr>
<td>Projects preparation and presentation</td>
<td>15</td>
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<tr>
<td>Course total</td>
<td>125</td>
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</tbody>
</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.

Written examination (90%) in Greek, with questions for analytical answers, multiple choice and short-answer questions. Optional written projects with public presentation (10%).

### (5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

<table>
<thead>
<tr>
<th>βιοχημεία</th>
<th>BERG J.M., TYMOCZKO J.L., STRYER L.</th>
<th>ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ</th>
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<tr>
<td>LEHNINGER ΒΑΣΙΚΕΣ ΑΡΧΕΣ</td>
<td>NELSON DAVID L., COX MICHAEL M.</td>
<td>BROKEN HILL PUBLISHERS LTD</td>
</tr>
<tr>
<td>ΒΙΟΧΗΜΕΙΑ</td>
<td></td>
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</tbody>
</table>

http://www.ncbi.nlm.nih.gov/pmc/
http://www.sciencedirect.com/
https://www.google.gr/

- **Related academic journals:**
  1. Biochimica et Biophysica Acta
  2. Nature Reviews
  3. Journal of Biological Chemistry
  4. Biochemistry
### COURSE OUTLINE

#### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>CHEMISTRY DEPARTMENT</td>
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<td>ΧΗΥ 022</td>
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<td>SEMESTER</td>
<td>2</td>
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<tr>
<td>COURSE TITLE</td>
<td>INORGANIC CHEMISTRY II</td>
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**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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tr>
<td>4</td>
<td>5</td>
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</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

**COURSE TYPE**

Scientific Area / Special Background / Development Skills

**PREREQUISITE COURSES:**

NONE

**LANGUAGE OF INSTRUCTION AND EXAMINATIONS:**

GREEK

**IS THE COURSE OFFERED TO ERASMUS STUDENTS:**

YES

**COURSE WEBSITE (URL)**

http://users.uoi.gr/iplakatu/site/ARXIKH.htm
http://users.uoi.gr/shadjika/Hadjikakou_1/Hadjikakou_08.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

After successfully completing the course, descriptive marker 6 of the European Qualifications Framework, students should be able to:

- Understand ways of interacting transition metals with ligands.
- Understand the role of coordination compounds in life and technology.
- Understand ligand exchange reactions.
- Understand the basic principles of bond theories and their application to Coordination Chemistry.
- Understand the relationship between bond theories and reactions involving metal complexes.
- Understand the spectroscopic and magnetic properties of coordination compounds.
- Understand the imperfections of some bond theories and choose the appropriate theory for use.
- The second part of the course covers the part of the matter of Inorganic Chemistry referring to the chemical elements of the main groups of the periodic table and their compounds. In this lesson, young chemists meet with to the most important new developments in inorganic chemistry. The presentation of the properties of the chemical elements and their compounds is done in a systematic manner according to the groups of the periodic table. The presentation method is comparative. Each chapter develops
both the normal and the unusual behaviour of certain elements. In the manufacturing processes, the main treatments necessary for the isolation of the elements are generally reported. Along with the reference to new methods of manufacturing certain elements and their compounds, they develop their most characteristic chemical properties as well as their most important applications in other fields of science and technology. Finally, the student has the notes in a modern way of presenting the chapters to be examined.

**Knowledge**
- Knowledge and understanding of basic and advanced principles of coordination chemistry.
- Knowledge and understanding of all bond theories applied to complexes.
- Knowledge and understanding of the evolution of bond theories, and their imperfections.
- Knowledge and understanding of complex formation and substitution reactions.
- Knowledge and understanding of the relationships between structure and reactivity of the complexes.
- Knowledge and understanding of spectroscopic and magnetic properties of coordination compounds.
- Knowledge of structure and properties of various compounds containing metals.
- Knowledge of the most important new developments in inorganic chemistry.
- Knowledge of the properties of the chemical elements and their compounds.
- Knowledge of both the normal and unusual behaviour of certain elements.
- Knowledge of the manufacturing processes, the main treatments necessary to isolate the elements.

**Skills**
- Skills to solve problems related to coordination chemistry.
- Skills to solve problems related to structural coordination chemistry.
- Skills to solve problems related to the reactivity of complex compounds.
- Skills to solve problems associated with spectroscopy and magnetism in complexes.

**Abilities**
- Ability to apply their knowledge in addressing issues related to coordination chemistry.
- Ability to combine bibliographic / experimental data and provide for chemical reaction products containing complexes.
- Ability to interact with other students or researchers in the field of coordination chemistry and transition metals.
- Ability to select and apply relevant methodology for solving a particular spectroscopic and / or magnetochemical problems involving a metal center.

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

The general competencies that the student should have acquired and to which the course is aimed are:
- Theoretical thinking and ability to translate theory into practice.
- Ability to apply knowledge acquired during the study period and related courses of the curriculum of the Department of Chemistry.
- Ability to search, analyze and synthesize data and information from international literature and use the necessary technologies related to the presentation of research results.
- Acquiring the appropriate theoretical and practical knowledge base to allow further education at the postgraduate level of specialization and doctorate.
- Working in an interdisciplinary environment.
• Ability to work together at team level to achieve these goals.

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Classroom</th>
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<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
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<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>e-mail, Powerpoint</th>
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<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
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<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
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<tbody>
<tr>
<td>The manner and methods of teaching are described in detail.</td>
<td>Lectures, tutoring 52</td>
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<tr>
<td>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.</td>
<td>Study, preparation 73</td>
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<tr>
<td>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>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Description of the evaluation procedure</td>
<td>Student evaluation is made through progress exams during the course and written final examination (evaluation) in Greek which includes:</td>
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<tr>
<td>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>Theoretical questions</td>
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<td>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td>Multiple choice questions</td>
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<td>Responses to questions of judgement</td>
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<td>Problem solving.</td>
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<tr>
<td>3.</td>
<td>INORGANIC CHEMISTRY (IN GREEK), C. E. HOUSECROFT, A. G. SHARPE,</td>
</tr>
<tr>
<td>5.</td>
<td>Chemistry Principles, Nick Hadjiliadis</td>
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**Related Journals**
- ACS: JACS, Inorganic Chemistry
- Wiley: European Journal of Inorganic Chemistry
## COURSE OUTLINE

### (1) GENERAL

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### INDEPENDENT TEACHING ACTIVITIES

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Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
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<th>COURSE TYPE</th>
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<tr>
<td>PREREQUISITE COURSES:</td>
<td>No</td>
</tr>
<tr>
<td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td>
<td>Greek</td>
</tr>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>Yes</td>
</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td>No</td>
</tr>
</tbody>
</table>

### (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 will gain basic knowledge on analytical chemistry and instrumental analysis

Knowledge
- Knowledge and correct understanding of the basic concepts, principles and theories related to chemical analysis by instrumental analytical techniques.
- Knowledge and understanding of the main parts of the laboratory instrumentation.
- Knowledge and understanding of the applications of electroanalytical, spectrometric and separating techniques in chemical analysis.
- Knowledge of the adoption of quality criteria for analytical techniques and methods.
- Knowledge of the use and search of international bibliography.

Skills
- Skills in selecting and using the appropriate analytical technique or combination of techniques to solve complex problems of analytical chemistry.

Abilities
- Ability to interact with other students or researchers in chemical analysis.
- Ability to work in a team but also in a self-contained way of working.
- Ability to analyze bibliographic sources and utilize the appropriate method based on the
infrastructures and available reagents of a chemical laboratory.

- Ability to select and apply the most appropriate experimental conditions to solve a specific problem at the level of routine analysis as well as research level.
- Work opportunities in an international environment.

### 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

Search, analysis and synthesis of data and information, by using the proper technologies.

Team work

Respect of natural environment

Promoting free, creative and inductive thinking

Understanding analytical science, demonstrate a coherent understanding of analytical chemistry

Depth and breadth of analytical chemistry knowledge

Inquiry and problem solving, critically analyse and solve problems in analytical chemistry

Personal and professional responsibility, be accountable for individual learning and scientific work in analytical chemistry

### (3) SYLLABUS


### (4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face in groups of 3-5 students</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Lectures</td>
<td>13</td>
</tr>
<tr>
<td>Laboratory practice</td>
<td>52</td>
</tr>
<tr>
<td>Individual report</td>
<td>40</td>
</tr>
<tr>
<td>Non directed study</td>
<td>20</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
<th>Student evaluation is done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</td>
<td>A) by written and oral examination during the laboratory exercise concerning the degree of</td>
</tr>
</tbody>
</table>
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.

understanding and assimilation of the theoretical knowledge, the control of the laboratory performance and skill required to perform the experiments and includes:

- short-answer questions
- problem solving
- analysis of individual samples
- writing of individual report (Includes entry of experimental results, critical evaluation of results, etc.)

The evaluation of the above results in the Laboratory Grade (LG) as the average of the individual laboratory exercises performed by the student during the semester.

B) Written final examination including:

- the development of topics
- short answer questions
- multiple choice questionnaires
- Problem solving.

So the Written Examination Grade (WEG) level resulted.

The final grade of the course results as an average of LG and WEG.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

  ΕΡΓΑΣΤΗΡΙΑΚΕΣ ΑΣΚΗΣΕΙΣ ΕΝΟΡΓΑΝΗΣ ΑΝΑΛΥΣΗΣ 
  Μ. ΚΑΡΑΓΙΑΝΝΗΣ, Χ. ΝΑΝΟΣ, Κ. ΣΤΑΛΙΚΑΣ, Ι. ΦΙΑΜΕΓΚΟΣ, Α. ΦΛΩΡΟΥ 
  ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ (ΣΗΜΕΙΩΣΕΙΣ)

  Γνώμες Ανάλυση. Θ.Π. Χατζηιωάννου, Μ.Α. Κουππάρης. Πανεπιστήμιο Αθηνών, Αθήνα 2000.
  Ενόργανες Τεχνικές Αναλύσεως. Κ. Η. Ευσταθίου, Θ.Π. Χατζηιωάννου, , Τόμος Α, Παν/μιο Αθηνών, Αθήνα 1992

- Related academic journals:
  Journal of Chemical Education
  Analytical Chemistry
  Analytica Chimica Acta
  Talanta
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Graduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΧΗΥ 055</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>4</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Laboratory of Physical Chemistry II</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

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:
Introductory Laboratory of Chemistry

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

After completion of this lab lesson, the students should be able to:
- Understand the physicochemical processes related to electrochemistry and kinetics and physicochemical properties of dilute polymeric solutions
- Get familiar and optimize the process of preparing a lab project, in which physicochemical calculations are done and diagrams are plotted in order to derive the specific physicochemical parameter
- Improve themselves in the presentations taking place during the lab lesson

Knowledge
- Knowledge and understanding of the basic principles and theories which are related with the fields of electrochemistry, kinetics and polymer physical chemistry.
- Knowledge and understanding of applied spectroscopic techniques, such as UV/Vis, polosimetry, conductance, viscosity measurement etc.
- Knowledge in utilization of spectroscopic data from international literature.
**Skills**
- Skills concerning the understanding and elaboration of UV-Vis spectra.
- Utilization of the proper spectroscopic method or combination in order to solve complex problems of physical chemistry.
- Complex skills of resolving problems through data analysis of international literature.

**Capabilities**
- Capability to implement the knowledge to solve problems, which belong to the fields of electrochemistry, kinetics and polymer physical chemistry.
- Capability to interpret the spectral data from one or more techniques and extract various physicochemical parameters.
- Capability to interact with colleagues or researchers in issues concerning electrochemistry, kinetics and polymer physical chemistry.
- Capability to choose and apply the most appropriate spectroscopic methods and related methodology for the resolution of a specific research problem.
- Capability in team work as well as an individual person.

Capabilities of working in an international professional environment.

---

**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?*

<table>
<thead>
<tr>
<th>General Competence</th>
<th>Other Competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for, analysis and synthesis of data and</td>
<td>Project planning and management</td>
</tr>
<tr>
<td>information, with the use of the necessary technology</td>
<td>Respect for difference and multiculturalism</td>
</tr>
<tr>
<td>Adapting to new situations</td>
<td>Respect for the natural environment</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Showing social, professional and ethical responsibility and sensitivity to gender issues</td>
</tr>
<tr>
<td>Working independently</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Team work</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Others...</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td></td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td></td>
</tr>
</tbody>
</table>

The general capabilities which should be obtained by the student are:
- Theoretical thinking and the ability to convert the knowledge of theory into calculation of experimental parameters.
- Ability to implement knowledge obtained during study into related lessons taught in the department.
- Ability to search, analyze and synthesize data and information from international literature and utilization of appropriate technologies related to the presentation of research results.
- Obtaining the appropriate practical background of knowledge in order to be able to follow lessons in postgraduate level.
- Work in multidisciplinary environment.
- Ability to collaborate as a team for managing the aforementioned goals.
(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Theoretical introduction in auditorium and practical application in the lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Utilization of Handbook and Internet for finding physicochemical parameters – Teaching the project method</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>Activity</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>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.</td>
<td>Lab lessons</td>
</tr>
<tr>
<td></td>
<td>Preparation of personal reports</td>
</tr>
<tr>
<td></td>
<td>Lectures</td>
</tr>
<tr>
<td></td>
<td>project</td>
</tr>
<tr>
<td>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>Course total (17 hours of work per credit unit)</td>
</tr>
<tr>
<td>STUDENT PERFORMANCE EVALUATION</td>
<td>The evaluation of students is done by combining: I. Written/oral final exam (40%) which contains: o Problem development o Short response questions o Critical questions o Problem solving. II. Preparation of personal reports for each laboratory lesson and project presentation (60%)</td>
</tr>
</tbody>
</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.
(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

| Notes of Laboratory of Physical Chemistry II | M. KOSMAS | IOANNINA UNIVERSITY (NOTES) |
| Notes of Electrochemistry and Chemical Kinetics Lab Exercises | A. KALAMPOUNIAS, M. KOSMAS, A. MYAONA-KOSMA, D. TAVIS, G. TSAPARLIS | IOANNINA UNIVERSITY (NOTES) |

- Related academic journals:

  Journal of chemical education
  Journal of physical chemistry
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>XHE 611</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>FOOD BIOCHEMISTRY AND BIOTECHNOLOGY</td>
</tr>
</tbody>
</table>

**INDEPENDENT TEACHING ACTIVITIES**

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

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.

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

**COURSE TYPE**

Specialized general knowledge, skills development

**PREREQUISITE COURSES:**

No

**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

After successfully completing the course, level 6 of the European Qualifications Framework) students will be able to comprehend the basic principles of the biochemistry of raw foods, of food indigenous enzymes, of the use of enzymes in food technology, of activities of food indigenous microorganisms, of the use of microorganisms in food technology, health-related properties of food constituents, and of functional foods.
Moreover, they will be able to solve problems and exercises related to the subjects of the course, and to correlate activities of enzymes, microorganisms and bioactive compounds with properties and characteristics of foods.
They will be able to conduct a literature search using modern technologies.

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. Working independently. Criticism and self-criticism. Production of free, creative and inductive thinking.

(3) SYLLABUS

## (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.

### 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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures, seminars, educational visits</td>
<td>26</td>
</tr>
<tr>
<td>Study and analysis of bibliography, essay writing</td>
<td>34</td>
</tr>
<tr>
<td>Not guided study</td>
<td>65</td>
</tr>
<tr>
<td><strong>Course total</strong></td>
<td><strong>125</strong></td>
</tr>
</tbody>
</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, etc.

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

The language of evaluation is Greek. The total evaluation consists of a) written examination (65 %), with open-ended questions, short-answer questions and multiple choice questionnaires, and b) written work, public presentation (35 %).
# ATTACHED BIBLIOGRAPHY

- **Suggested bibliography:**

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Publisher</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOOD BIOCHEMISTRY</td>
<td>VAFOPOULOU-MASTROGIANNAKI A.</td>
<td>Ziti Publishing</td>
<td>2003</td>
</tr>
<tr>
<td>FOOD BIOTECHNOLOGY</td>
<td>ROUKAS T.</td>
<td>Giachoudis Publishing</td>
<td>2009</td>
</tr>
<tr>
<td>FOOD BIOCHEMISTRY AND BIOTECHNOLOGY</td>
<td>ROUSSIS I.</td>
<td>UNIVERSITY OF IOANNINA</td>
<td>(ΣΗΜΕΙΩΣΕΙΣ)</td>
</tr>
</tbody>
</table>

- **Related academic journals:**
  1. Journal of Food Biochemistry
  2. Food Biotechnology
  4. Food Technology and Biotechnology

- **Related books:**
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
<td>FOOD CHEMISTRY</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INDEPENDENT TEACHING ACTIVITIES</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Special background, specialised general knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREREQUISITE COURSES</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LANGUAGE OF INSTRUCTION and EXAMINATIONS</th>
<th>Greek</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>Yes</td>
</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td></td>
</tr>
</tbody>
</table>
(2) LEARNING OUTCOMES

<table>
<thead>
<tr>
<th>Learning outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
<tr>
<td>Consult Appendix A</td>
</tr>
<tr>
<td>• Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</td>
</tr>
<tr>
<td>• Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</td>
</tr>
<tr>
<td>• Guidelines for writing Learning Outcomes</td>
</tr>
</tbody>
</table>

After successfully completing the course, level 6 of the European Qualifications Framework, students will be able to comprehend the basic principles of the chemistry of food constituents, of nutrition and effect of food constituents in human health, of the chemical composition of food, of food analysis with emphasis in the use of GC and HPLC in food analysis. Moreover, they will be able to solve problems and exercises related to the subjects of the course, and to correlate chemical composition with food properties.

<table>
<thead>
<tr>
<th>General Competences</th>
</tr>
</thead>
<tbody>
<tr>
<td>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?</td>
</tr>
<tr>
<td>Search for, analysis and synthesis of data and information, with the use of the necessary technology</td>
</tr>
<tr>
<td>Adapting to new situations</td>
</tr>
<tr>
<td>Decision-making</td>
</tr>
<tr>
<td>Working independently</td>
</tr>
<tr>
<td>Team work</td>
</tr>
<tr>
<td>Working in an international environment</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
</tr>
<tr>
<td>Production of new research ideas</td>
</tr>
</tbody>
</table>

Production of free, creative and inductive thinking. Criticism and self-criticism.

(3) SYLLABUS

Introduction in the chemistry of foods. Chemistry of food constituents (proteins, lipids, carbohydrates, water and inorganic constituents, vitamins, enzymes, phenolics, acids, alcohols, colourants, flavour compounds, additives). Introduction in nutrition, effect of food constituents in human health. Chemical composition of foods (dairy products, cereals, fruits and vegetables, legumes, meat and meat products, eggs, oils and lipids, sweeteners, spices, alcoholic and non-alcoholic beverages, potable water). Food analysis with emphasis in the use of GC and HPLC in food analysis.
### DELIVERY

<table>
<thead>
<tr>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
</tr>
</tbody>
</table>

### USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Use of ICT in teaching, laboratory education, communication with students.

### 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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures, seminars, educational visits</td>
<td>52</td>
</tr>
<tr>
<td>Not guided study</td>
<td>73</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

### STUDENT PERFORMANCE EVALUATION

**Description of the evaluation procedure**

The language of evaluation is Greek. The total evaluation consists of written examination, with open-ended questions, short-answer questions and multiple choice questionnaires, problem solving.

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, etc.

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.
### (5) ATTACHED BIBLIOGRAPHY

**- Suggested bibliography:**

<table>
<thead>
<tr>
<th>Field</th>
<th>Author(s)</th>
<th>Publisher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Chemistry</td>
<td>BELITZ HANS - DIETER, GROSCH WERNER, SCHIEBERLE PETER</td>
<td>TSOLIS PUBLISHING</td>
</tr>
<tr>
<td>Food Chemistry</td>
<td>BOSKOU D.</td>
<td>GARTAGANIS PUBLISHING</td>
</tr>
<tr>
<td>Nutrition and Food Chemistry</td>
<td>GALANOPOLOU et al.</td>
<td>STAMOULI PUBLISHING</td>
</tr>
<tr>
<td>Introduction in Food Chemistry</td>
<td>VOUDOUDIS E., KONTOMINAS M.</td>
<td>UNIVERSITY OF IOANNINA</td>
</tr>
<tr>
<td>Food Analysis</td>
<td>VOUDOUDIS E., KONTOMINAS M.</td>
<td>UNIVERSITY OF IOANNINA</td>
</tr>
<tr>
<td>Food Chemistry and Analysis</td>
<td>ROUSSIS I.</td>
<td>UNIVERSITY OF IOANNINA</td>
</tr>
</tbody>
</table>

**- Related academic journals:**

1. Food Chemistry
2. Food Research International
3. Journal of agricultural and Food Chemistry
4. Journal of Food composition and Analysis

**- Συναφή βιβλία**

COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
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</tr>
<tr>
<td>SEMESTER</td>
<td>5th</td>
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<tr>
<td>COURSE TITLE</td>
<td>Laboratory of Biochemistry</td>
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</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE
Scientific area, specialist background, skills development

PREREQUISITE COURSES:
No

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:
Yes

COURSE WEBSITE (URL)
http://ecourse.uoi.gr/course/view.php?id=990

(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

Learning objectives
The purpose of the course is to train students in biochemistry techniques in order to have the basic practical and theoretical background for understanding and conduct experiments of modern biochemistry and its fields of application.

In a general context Learning is:
• Cell development, measurement, selection, and microscopic observation as well techniques for homogenizing and separating subcellular organelles.
• The isolation and characterization of various organisms as intermediates Metabolism of the major categories of biomolecules, including Carbohydrates, lipids, proteins and nucleic acids.
• The use of basic principles of Chemistry such as stoichiometry, photometry, oxidation, reduction, chromatography, kinetics, electrophoresis, centrifugation, extraction, precipitation etc
• the isolation of biomolecules, their purification and characterization
• Knowledge and understanding of the basic concepts, principles and theories of
Biochemistry

Skills
• Determination, analysis and detection of biomolecules
• Complex skills, data analysis and solution of complex problems (eg kinetics Enzymes)

Abilities
• Ability to apply the knowledge provided in troubleshooting and analysis related to Biochemistry.
• Capability of cell growth observation study and measurement.
• Study and experimental ability to detect induction and induction expression of the biomolecules in the cells.
• The ability to isolate, purify, measure the enzymatic activity and kinetic characteristics of enzymes.
• Capability of analyzing and determining lipids.
• Capacity to isolate and characterize genomic and plasmid DNA.
• Ability to work independently and to interact with others students on subjects of the course.

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
- Production of new research ideas
- Others...

The general competencies that the student should have acquired and in which aims the lesson is:
• Ability to apply knowledge acquired in related courses of the program of the Department of Chemistry.
• Ability to search, analyze, compose data and information from the international bibliography, use of the necessary technologies and programs related to the presentation of research results.

Acquiring the appropriate theoretical and practical knowledge base to be further education at postgraduate and PhD level.
• Work in an interdisciplinary environment.
• Possible cooperation at group level to achieve these goals.

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS – EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Laboratory Exercise; Face to Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td>Posting additional notes, exercises etc. on the teachers' websites Use of PowerPoint in lectures.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>Use of ICT in teaching, laboratory education,</th>
</tr>
</thead>
</table>
Communication with students

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.

<table>
<thead>
<tr>
<th>Activity</th>
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</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>13</td>
</tr>
<tr>
<td>Laboratory Excercise</td>
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<tr>
<td>Written assignment</td>
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</tr>
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<td>Course total</td>
<td>125</td>
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</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.

Student assessment includes:
1. Evaluation / graduation of individual work
   Refers to each laboratory exercise (70%)
2. Written final exam including development Topics (30%)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  1) Πειραματική βιοχημεία: Clark J. M., Switzer R. L., Παπαδόπουλος Γ., Παπαδόπουλος Μ., Πανεπιστημιακές Εκδόσεις Κρήτης 1992
  2) Εργαστηριακές σημειώσεις Βιοχημείας. Μέλη Δ.Ε.Π. & ΕΔΙΠ Βιοχημείας Πανεπιστημίου Ιωαννίνων
  3) Βιοχημεία: Stryer L, Αλετράς , Α., Παπαδόπουλος Γ., Κούβελας , Η., Πανεπιστημιακές Εκδόσεις Κρήτης 1995-1997
  5) Βασικές αρχές κυτταρικής βιολογίας : εισαγωγή στη μοριακή βιολογία του κυττάρου Alberts B. 1938, Ζιούδρου Χ., Σταματόπουλος Κ. Αθήνα : Π. Χ. Πασχαλίδης c2000
  6) Εισαγωγή στη Βιοχημεία: Γεωργάτος Ι.Γ. Θεσσαλονίκη : Γιαχούδη-Γιαπούλη c1993
  7) Βιοχημεία: Karlson P. 1918-, Doenecke , Detlef, Koolman , Jan, Σέκερης , Κ. Ε., Φραγκόγνης Εμμ. Γ., Σέκερη-Παταργιά, Κ.Ε. Αθήνα:Λίτσας c1998

- Related academic journals:
## COURSE OUTLINE

### (1) GENERAL

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**INDEPENDENT TEACHING ACTIVITIES**

<table>
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<tr>
<td>4</td>
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<td>Laboratory</td>
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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.

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:**

- Inorganic Chemistry I
- Inorganic Chemistry II

**LANGUAGE OF INSTRUCTION and EXAMINATIONS:**

- Greek

**IS THE COURSE OFFERED TO ERASMUS STUDENTS:**

- No

**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

After the successful completion of course of Level 6 descriptor, student will be able to:

- Understand the function of organometallic compounds in biological systems and the application of organometallic compounds.
- Understand the electron transfer reactions and their applications in everyday life (conversion of solar energy to electric one, use of H₂ for energy production etc.)
- Understand the basic principles of the Inorganic Reactions Mechanisms and their relation to basic inorganic reactions.
- Understand the basic catalytic reactions and their relation to stoichiometric inorganic reactions and at the same time to understand the mechanistic path.
- Understand some biological functions as respiration and how do these are related to action of metal complexes

**Knowledge**

- Knowledge and understanding of the basic principles of organometallic chemistry
- Knowledge and understanding of electron transfer reactions
• Knowledge and understanding of the basic principles, meanings and theories related to inorganic reaction mechanisms.
• Knowledge and understanding of the basic principles, meanings, stoichiometric reactions and mechanisms related to catalytic reactions.
• Knowledge and understanding of fundamental biological functions related to active metal complexes

Skills
• Skills in solving problems related to inorganic reaction mechanisms as well as predicting the molecular structure of reaction products of catalytic processes of industrial interest.
• Skills in solving problems related to organometallic chemistry
• Skills in solving problems related to electron transfer
• Skills in solving problems related to inorganic reaction mechanisms as well as predicting the molecular structure of reaction products of catalytic process.
• Skills in solving problems related to intermediate reactions, molecular structures and oxidation states of catalytic reactions.
• Skills in data analysis in order to explain and/or propose the most probable catalytic cycle taking place.
• Skills in solving problems related to biological function of active metal complexes

Abilities
• Ability to employ its knowledge to deal with problems related to inorganic reaction mechanisms.
• Ability to combine experimental data with those obtained from literature in order to propose a possible reaction mechanism.
• Ability to interact with other students or researchers on topics related to catalytic or/and bio-catalytic reaction mechanisms.

Ability to choose and employ a certain methodology to solve a specific issue of a reaction mechanism related to the metallic center.

General Competences

| 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 | Others... |

The general skills acquired by the students after attending the course are the following:
• Theoretical conception and ability to transform this theory to practice.
• Ability to employ the acquired knowledge after completed the course as well as of all the related courses taught in earlier semesters.
• Acquire the most suitable theoretical and practical knowledge background to give the opportunity to attend further training in the framework of postgraduate MSs or even PhD studies.
• Ability to interact at a multi-disciplinary level
• Ability to cooperate at a team level in order to achieve the above targets.
(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
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<td>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></td>
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<tr>
<td>Activity</td>
<td>Semester workload</td>
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<tr>
<td>----------</td>
<td>-------------------</td>
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<tr>
<td>Lectures</td>
<td>52</td>
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<tr>
<td>Personal study and preparation</td>
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<td>Course total</td>
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</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, etc.

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

Students evaluation is performed via:

- written final exam in Greek language comprising:
  - Answering questions
  - Questions with short answers
  - Answering critical thinking questions
  - solving problems

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
<table>
<thead>
<tr>
<th>ΒΑΣΙΚΗ ΑΝΟΡΓΑΝΗ ΧΗΜΕΙΑ (Basic Inorganic Chemistry)</th>
<th>F. ALBERT COTTON, GEOFFERY WILKINSON, PAUL GAUS, ΠΑΡΙΣΙΑΝΟΥΑ.Ε., 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΒΑΣΙΚΗ ΟΡΓΑΝΟΜΕΤΑΛΛΙΚΗ ΧΗΜΕΙΑ (Basic Organometallic Chemistry)</td>
<td>HAIDUC IONEL, ZUCKERMAN JERRY J. ΠΑΝΑΓΙΩΤΗΣ</td>
</tr>
<tr>
<td>ΑΝΟΡΓΑΝΗ ΧΗΜΕΙΑ (Inorganic Chemistry)</td>
<td>CATHERINE E. HOUSECROFT, ALAN G. SHARPE ΧΑΤΖΗΛΙΑΔΗΣ, Θ. ΚΑΜΠΑΝΟΣ, Α. ΚΕΡΑΜΙΔΑΣ, Σ. ΠΕΡΛΕΠΕΣ</td>
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</table>


- Related academic journals:

ACS: JACS, ACS Catalysis, Inorganic Chemistry, Organometallics
Wiley: European Journal of Inorganic Chemistry
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
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<td>ACADEMIC UNIT</td>
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<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
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<tr>
<td>SEMESTER</td>
<td>6th</td>
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<tr>
<td>COURSE TITLE</td>
<td>APPLICATIONS OF STATISTICAL MECHANICS</td>
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</table>

#### 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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
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<td>4</td>
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Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

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<th>COURSE TYPE</th>
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<th>PREREQUISITE COURSES:</th>
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<table>
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<th>IS THE COURSE OFFERED TO ERASMUS STUDENTS:</th>
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<table>
<thead>
<tr>
<th>COURSE WEBSITE (URL):</th>
<th>No</th>
</tr>
</thead>
</table>

### (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 will gain basic knowledge on theoretical chemistry and more specifically those of Molecular Quantum Chemistry and Statistical Thermodynamics and their applications. They will learn how to search in literature and analyze data using new technologies. Their survey and bibliographic work will promote free, creative and inductive thinking.

#### 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?

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

Search, analysis and synthesis of data and information, by using the proper technologies.

- Working independently
- Team work
- Respect of natural environment
Promoting free, creative and inductive thinking
Understanding analytical science, demonstrate a coherent understanding of the subject
Depth and breadth of Statistical Mechanics knowledge
Inquiry and problem solving, critically analyze and solve problems in Statistical Mechanics
Personal and professional responsibility, be accountable for individual learning and scientific work in Statistical Mechanics

(3) SYLLABUS

Canonical statistical ensemble and applications. Transportation, Rotation and Vibration of molecules. Development of Quantum Mechanics and applications
Canonical statistical ensemble – Classical Statistical Mechanics.
Chemical reactions – Equilibrium Constants.
Kinetic description of dilute gases. Elementary Kinetic Theory of Transport Processes
Thermodynamic properties of solids and liquids, Einstein and Debye models.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Combined use of PowerPoint and classroom board in lectures. Communication via email.</td>
</tr>
<tr>
<td>THE TEACHING METHODS</td>
<td>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.</td>
</tr>
<tr>
<td>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></td>
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</table>

<table>
<thead>
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<th>Activity</th>
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<tr>
<td>Lectures</td>
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<td>Not guided study</td>
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</tr>
<tr>
<td>Course total</td>
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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, etc.

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

Written examination in Greek, with multiple choice questionnaires and short-answer questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - ΦΥΣΙΚΟΧΗΜΕΙΑ, ΚΑΤΣΑΝΟΣ ΝΙΚΟΛΑΟΣ, Α. Εκδόσεις ΠΑΠΑΖΗΣΗΣ
  - ΜΟΡΙΑΚΗ ΚΒΑΝΤΙΚΗ ΜΗΧΑΝΙΚΗ, ATKINS PETER WILLIAM, Εκδόσεις ΠΑΠΑΖΗΣΗΣ
  - Ο ΧΗΜΙΚΟΣ ΔΕΣΜΟΣ, MURELL J.N., KETTLE S.A., TEDDER J.N., Εκδόσεις ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ
  - ΕΙΣΑΓΩΓΗ ΣΤΗΝ ΚΒΑΝΤΙΚΗ ΧΗΜΕΙΑ, ΤΣΙΠΗΣ ΚΩΝ/ΝΟΣ, Εκδόσεις ΖΗΤΗ ΠΕΛΑΓΙΑ ΚΑΙ ΣΙΑ Ο.Ε.

- Related academic journals:
Journal of Chemical Physics, Journal of Physical Chemistry
and any other international scientific journal of theoretical and computation chemistry
COURSE OUTLINE

(1) GENERAL

<table>
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<tr>
<th>SCHOOL</th>
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<td>COURSE TITLE</td>
<td>APPLICATIONS OF STATISTICAL MECHANICS</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
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</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
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<tr>
<td>knowledge, skills</td>
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<td>development</td>
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PREREQUISITE COURSES: No

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<tr>
<th>LANGUAGE OF INSTRUCTION</th>
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</thead>
<tbody>
<tr>
<td>and EXAMINATIONS</td>
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IS THE COURSE OFFERED TO ERASMUS STUDENTS: No

<table>
<thead>
<tr>
<th>COURSE WEBSITE (URL)</th>
<th>No</th>
</tr>
</thead>
</table>

(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 will gain basic knowledge on theoretical chemistry and more specifically those of Molecular Quantum Chemistry and Statistical Thermodynamics and their applications. They will learn how to search in literature and analyze data using new technologies. Their survey and bibliographic work will promote free, creative and inductive thinking.

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, by using the proper technologies.
- Working independently
- Team work

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...

...and...

Team work

Respect of natural environment
Promoting free, creative and inductive thinking
Understanding analytical science, demonstrate a coherent understanding of the subject
Depth and breadth of Statistical Mechanics knowledge
Inquiry and problem solving, critically analyze and solve problems in Statistical Mechanics
Personal and professional responsibility, be accountable for individual learning and scientific work in Statistical Mechanics

(3) SYLLABUS

Canonical statistical ensemble and applications. Transportation, Rotation and Vibration of molecules. Development of Quantum Mechanics and applications
Canonical statistical ensemble – Classical Statistical Mechanics.
Chemical reactions – Equilibrium Constants.
Kinetic description of dilute gases. Elementary Kinetic Theory of Transport Processes
Thermostatic properties of solids and liquids, Einstein and Debye models.

(4) TEACHING and LEARNING METHODS - EVALUATION

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<tr>
<th>DELIVERY</th>
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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. Written examination in Greek, with multiple choice questionnaires and short-answer questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - ΦΥΣΙΚΟΧΗΜΕΙΑ, ΚΑΤΣΑΝΟΣ ΝΙΚΟΛΑΟΣ, Α. Εκδόσεις ΠΑΠΑΖΗΣΗΣ
  - ΜΟΡΙΑΚΗ ΚΒΑΝΤΙΚΗ ΜΗΧΑΝΙΚΗ, ATKINS PETER WILLIAM, Εκδόσεις ΠΑΠΑΖΗΣΗΣ
  - Ο ΧΗΜΙΚΟΣ ΔΕΣΜΟΣ, MURELL J.N., KETTLE S.A., TEDDE R J.N., Εκδόσεις ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ
  - ΕΙΣΑΓΩΓΗ ΣΤΗΝ ΚΒΑΝΤΙΚΗ ΧΗΜΕΙΑ, ΤΣΙΠΗΣ ΚΩΝ/ΝΟΣ, Εκδόσεις ΖΗΤΗ ΠΕΛΑΓΙΑ ΚΑΙ
- Related academic journals:
  Journal of Chemical Physics, Journal of Physical Chemistry
  and any other international scientific journal of theoretical and computational chemistry
COURSE OUTLINE

(1) GENERAL

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<tr>
<td>COURSE CODE</td>
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<td>SEMESTER</td>
<td>6</td>
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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

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COURSE TYPE

Specialised General Knowledge/Skills Development

PREREQUISITE COURSES:

According to the curriculum of the Department of Chemistry, there are no prerequisites, but it is not possible to carry out effective monitoring without the necessary knowledge of the Organic Chemistry I, II and III courses as well as of the Laboratories of the Introductory Laboratory and Organic Chemistry.

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

Learning objectives

• The main objective of the Organic Chemistry Laboratory II for each student of the Department of Chemistry, since it has been informed and learned basic knowledge in the laboratory techniques of isolation, separation, purification and identification of organic compounds in the Laboratory of Organic Chemistry I, is to acquire experimental competence concerning:
  • synthesis of organic compounds
  • the isolation of the organic molecules produced
  • cleaning them and finally
  • their characterization.

Knowledge

Knowledge and understanding of the basic concepts, principles and theories related to the synthesis and physical chemical characterization of organic compounds.
Skills
Skills in the synthesis and purification of organic compounds.
Complex problem-solving skills through careful analysis of the provided data.

Abilities
Ability to apply the provided knowledge to the problem (theoretical and synthetic) related to Organic Chemistry.
Ability to synthesize organic compounds in pure form.
Ability to interpret spectroscopic data.
Ability to work independently and to interact with other students on subject matter.

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 | Others... |

The general competencies the student should have acquired and to which the course is aimed are:
Search, analyze and synthesize data and information and make decisions.
Conversion of theory into practice.
Promote free, creative and inductive thinking.
Autonomous but also teamwork.
Acquiring appropriate theoretical and practical knowledge base to enable further education both at a theoretical level (in more specific subjects of organic chemistry) and in a laboratory.

(3) SYLLABUS

In particular, the course consists of the following subjects:
The main objective of the Organic Chemistry II Laboratory for each student of the Department of Chemistry is to acquire experimental readiness and to acquire basic knowledge that has been previously informed and learned about the laboratory techniques of isolation, separation, purification and identification of organic compounds in the Organic Chemistry I Laboratory. Concern:
- synthesis of organic compounds
- the isolation of the organic molecules produced
- cleaning them and finally
- their characterization.

The experiments are:

1. Preparation of the compound methyl orange
Description of the topic: The preparation of the compound "methyl orange" is described. In principle, the compound formation reaction and its exact mechanism are studied. Useful points are then given (i.e. what the student should watch during the experiment, first aid, etc.). Below is a list of reagents and analytically the method of preparation of methyl orange. Finally, the UV spectrum of the compound produced is shown.
Keywords: methyl orange, synthesis, isolation, purification, characterization.

2. Preparation of the compound Diphenylmethanol
Description of the topic: The preparation of the compound diphenylmethanol (benzhydrol) is described. In principle, the reaction and its exact mechanism are studied. Useful points are then given (i.e. what the student should watch during the experiment, first aid, etc.). Below is a list of
3. Preparation of the compound Ethyll Benzoate (A) and methyl ester (B)

**Description of the topic:** The preparation of the compounds (a) ethyl benzoate and (b) methyl benzoate are described. In principle, the formation reactions and their precise mechanisms are studied. Useful points are then given (i.e. what the student should watch during the experiment, first aid, etc.). Below is a list of reagents and analytical methods for the preparation of ethyl benzoate and methyl benzoate. Finally, observations, explanations, questions as well as the ($^{13}$C-NMR, IR, MS) spectra of the compounds prepared were given.

**Keywords:** Ethyl benzoate, methyl benzoate, carboxylic acid esterification with alcohol and acid catalysis (Fischer), synthesis, isolation, purification, characterization.

4. Saponification of olive oil

**Description of the topic:** Describe the saponification of olive oil. In principle, the saponification reaction and its mechanism are studied. Below is a list of reagents and analytically the method of preparation of the product. Finally, observations, explanations and questions about the course of laboratory work are given.

**Keywords:** Saponification of olive oil, alkaline hydrolysis of carboxylic acid ester, synthesis, isolation, purification, characterization.

5. Formation of the compound Benzylideneaniline (imine) and N-Benzylaniline (N-phenylbenzylamine)

**Description of the topic:** The preparation of compounds (a) Benzylideneaniline (imine) and (b) N-Benzylaniline (N-phenylbenzylamine) are described. Initially, the formation reactions of these compounds and their precise mechanisms are studied. A list of reagents and analytical methods for the preparation of benzylideneaniline (imine) and (b) N-benzylaniline (N-phenylbenzylamine) are shown below. Finally, observations, explanations, questions as well as the ($^{13}$C-NMR, IR, MS) spectra of the compounds prepared were given.

**Keywords:** Benzylideneaniline (imine), N-Benzylaniline (N-phenylbenzylamine), nucleophilic addition of amine to aldehyde and water removal, imine reduction, preparations, synthesis, isolation, purification, characterization.

6. Preparation of Acetophenone (E)-Oxime

**Description of the topic:** The preparation of Acetophenone (E)-Oxime is described. Initially, the formation reaction of acetophenone (E)-Oxime and its exact mechanism are studied. Below is a list of reagents and analytical method for making the compound. Finally, observations are made on the course of the exercise.

**Keywords:** Condensation of a carbonyl compound with hydroxylamine, oxime formation, preparation, synthesis, isolation, purification, characterization.

7. Preparation of the compound Acetylsalicylic acid (2-acetoxybenzoic acid, aspirin).

**Description of the topic:** The preparation of the compound Acetylsalicylic acid (2-acetoxybenzoic acid, aspirin) is described. In principle, the reaction and its exact mechanism are studied. Useful points are then given (eg what the student should watch during exercise, first aid, etc.). Below is a list of reagents and analytically the method of preparing the compound acetylsalicylic acid (2-acetoxybenzoic acid, aspirin). Finally, observations, explanations, questions concerning the course of the exercise as well as the ($^{13}$C-NMR, IR, MS) spectra of the compound produced are given.

**Keywords:** Pyrophilic acyl-substitution, esterification, acetylsalicylic acid, 2-acetoxybenzoic acid, aspirin, synthesis, isolation, purification, characterization.

8. Preparation of Benzimidazole

**Description of the topic:** The preparation of the benzimidazole compound is described. In principle, the compound formation reaction and its exact mechanism are studied. Useful points are then given (eg what the student should watch during exercise, first aid, etc.). Below is a list of reagents and analytically the method of preparation of the benzimidazole. Finally, observations, explanations, questions concerning the course of the exercise as well as the ($^{13}$C-NMR, IR, MS) spectra of the compound produced are given.
9. Diels-Alder cycloaddition reaction

**Description of the topic**: Describe the Diels-Alder cycloaddition reaction (7-oxabicyclo [2.2.1] hept-5-ene-2,3-exo-dicarboxylic anhydride). In principle, the Diels-Alder cycloaddition reaction and its mechanism are studied. Below is a list of reagents and analytically the method of preparation of the product. Finally, observations and explanations are given on the course of laboratory work.

**Keywords**: Diels-Alder reaction, [4n+2] cycloaddition reaction, furan, maleic anhydride, synthesis, isolation, purification, characterization.

10. Preparation of the compound 1,1-Diphenyl-1-pentanol and 1,1-diphenyl-1-pentene

**Description of the topic**: The preparation of compounds (a) 1,1-Diphenyl-1-pentanol and (b) 1,1-diphenyl-1-pentene. Initially, the formation reactions of these compounds and their precise mechanisms are studied. The following are the list of reagents and analytical methods for the preparation of 1,1-diphenyl-1-pentanol and 1,1-diphenyl-1-pentene.

**Keywords**: 1,1-Diphenyl-1-pentanol, 1,1-diphenyl-1-pentene, n-butylmagnesium bromide, preparation of Grignard reagent, addition of Grignard reagent to ketone, alcohol hydrolysis, alcohol dehydration in alkene, isolation, purification, characterization.

11. Carbonyl Protection - Acetal Formation

**Description of the topic**: Describe the protection of the carbonyl and the formation of the acetal. At first, the acetal formation reaction and the precise mechanism of the acetal is studied. Below is a list of reagents and analytical method for the preparation of the acetal. Finally, there are explanations on the course of the exercise.

**Keywords**: Ketone carbonyl protection, carbonyl protection, acetal formation, synthesis, isolation, purification, characterization.

12. Amino acid protection: Fmoc-alanine, Fmoc-Ala

**Description of the topic**: The amino acid protection of amino acids is described: N-[(9H-fluoren-9-ylmethoxy) carbonyl] - alanine (Fmoc-alanine, Fmoc-Ala). Initially, the reaction is studied: Fmoc-protection of the α-amino group of the amino acids. Below is a list of reagents and analytical method for preparing Fmoc-Ala. Finally, comments, explanations, questions concerning the course of laboratory work and the product are presented, as well as the relevant literature.

**Keywords**: amino acid amino acid protection, Fmoc-alanine, Fmoc-Ala, synthesis, isolation, purification, characterization.

13. Preparation of Nylon – 6,10

**Description of the topic**: Describe the preparation of the Nylon compound – 6,10. In principle, the compound formation reaction, i.e. polymerization (polycondensation), is studied. Below is a list of reagents and analytical method of preparation of nylon - 6,10.

**Keywords**: Nylon - 6,10, polymerization, polycondensation.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>Activity</td>
</tr>
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<tr>
<td>Lectures-Suggestions</td>
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<td>Laboratory experiment</td>
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<td>Writing assignments</td>
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<tr>
<td>Individual study and preparation</td>
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<tr>
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<td>hours</td>
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<tr>
<td>----------</td>
<td>-------</td>
</tr>
<tr>
<td>visits, project, essay writing, artistic creativity, etc.</td>
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</tr>
<tr>
<td>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>
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</tr>
<tr>
<td><strong>Course total</strong></td>
<td><strong>250</strong></td>
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</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.

Written examination with questions of understanding of matter and basic concepts, multiple choice, matching, correct-to-short and short-term

Laboratory exercises

50% of the final grade is the written exam, and the remaining 50% is the grade of written work and laboratory exercises

The evaluation criteria are announced at the beginning of the course and posted on the electronic bulletin board

---

**ATTACHED BIBLIOGRAPHY**

**Suggested bibliography:**

**Suggested Books**

1. Techniques in Organic Chemistry: Miniscale, Standard Taper Microscale, and Williamson Microscale by Jerry R. Mohrig (Author), Christina Noring Hammond (Author), Paul F. Schatz (Author).
2. JohnMcMurry: Οργανική Χημεία, Πανεπιστημιακές Εκδόσεις Κρήτης.
3. ΕΡΓΑΣΤΗΡΙΑΚΕΣ ΑΣΚΗΣΕΙΣ ΤΟΥ ΕΡΓΑΣΤΗΡΙΟΥ ΟΡΓΑΝΙΚΗΣ ΧΗΜΕΙΑΣ ΙΙ ΜΕΛΗ ΔΕΠ ΟΡΓΑΝΙΚΗΣ ΧΗΜΕΙΑΣ ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ (ΣΗΜΕΙΩΣΕΙΣ)

**Additional bibliography**

(2) Bodanszky, M. Int. J. Peptide Protein Res. 1985, 25, 449


(9) Organicum, 19η Έκδοση, Johann Ambrosius Barth Verlag, Λειψία (Γερμανία), 1993, σελ. 173


## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
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<td>Undergraduate</td>
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<tr>
<td>COURSE CODE</td>
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</tr>
<tr>
<td>SEMESTER</td>
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**COURSE TYPE**

- General background
- Special background, specialised general knowledge, skills development

**PREREQUISITE COURSES:**

No

**LANGUAGE OF INSTRUCTION and EXAMINATIONS:**

Greek

**IS THE COURSE OFFERED TO ERASMUS STUDENTS:**

No

**COURSE WEBSITE (URL):**

No

### (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.

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#### 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, analysis and synthesis of data and information, by using the proper technologies.
Working independently
Team work
Respect of natural environment
Promoting free, creative and inductive thinking
Understanding analytical science, demonstrate a coherent understanding of Physical Chemistry
Depth and breath of Physical Chemistry knowledge
Inquiry and problem solving, critically analyse and solve problems in Physical Chemistry
Personal and professional responsibility, be accountable for individual learning and scientific work in Physical Chemistry

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

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- Ο ΧΗΜΙΚΟΣ ΔΕΣΜΟΣ, MURELL J.N., KETTLE S.A., TEDDER J.N., Εκδόσεις ΙΤΕ-ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ
• ΕΙΣΑΓΩΓΗ ΣΤΗΝ ΚΒΑΝΤΙΚΗ ΧΗΜΕΙΑ, ΤΣΙΠΗΣ ΚΩΝ/ΝΟΣ, Εκδόσεις ΖΗΤΗ ΠΕΛΑΓΙΑ ΚΑΙ ΣΙΑ Ο.Ε.

- Related academic journals:
Journal of Chemical Physics, Journal of Physical Chemistry
and any other international scientific journal of theoretical and computation chemistry
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td></td>
</tr>
<tr>
<td>SEMESTER</td>
<td>7th</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>ADVANCED ENVIRONMENTAL PROTECTION TECHNOLOGIES - PHOTOCATALYSIS</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LECTURES</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

- Specialized knowledge

PREREQUISITE COURSES:

- 

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

After the successful completion of the course, descriptive level 6 of the European Qualifications Framework for Lifelong Learning, the students will obtain knowledge on the principles of advanced technologies (advanced oxidation processes, photocatalysis, membrane separation, biological processes, nanomaterials based applications, etc.) and they will develop skills for their applications for water, wastewater and air treatment, remediation of polluted natural resources. In addition, the students will inquire knowledge in principles and technologies for the prevention of pollution in industrial chemical production planning and production, environmental pollution and toxicity to humans according to the principles of “green chemistry” and “green chemical technology”.

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
• Application of knowledge dealing with advanced methods, techniques and technologies of pollution control and environmental protection-remediation.
• Inquiring of theoretical and practical background for performing further education, postgraduate and doctoral studies.
• Utilization of laboratory infrastructures and equipment for the above-mentioned aims
• Search for, analysis and synthesis of data and information, with the use of the necessary technology
• Theoretical knowledge and bringing-applying theory to practice
• Team work as well as working independently
• Working in an international environment
• Working in an interdisciplinary environment
• Production of new research ideas
• Project planning and management
• Respect for the natural environment

(3) SYLLABUS

Advanced Oxidation Processes (AOPs) and technologies for environmental remediation: Homogeneous and Heterogeneous processes; UV-photolysis; UV/H₂O₂ processes; Fenton and photo-Fenton processes; Persulfate oxidation processes, In-Situ oxidation, Semiconductor Photocatalysis, Mechanisms of the photocatalytic degradation of organic pollutants, Photocatalytic reaction engineering, Solar photocatalysis, Electrochemical and photoelectrocatalysis treatment, Ultrasound processes (Sonolysis), Radiation processes, Wet air oxidation processes; Advantages and limitations of AOPs, Application of AOPs, in water, wastewater and soil remediation, Hybrid processes based on AOPs and biological methods, Membrane-based separation technologies, Hybrid processes based on AOPs, biological methods and membrane technologies, Nanotechnologies (carbon, iron based nanomaterials, etc.) for environmental protection and remediation, New trends in pollution prevention and control, Green Chemistry and Green Chemical Technology concepts in environmental protection and remediation.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of Technologies of Information and communications in teaching and communication with students.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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</td>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>Written assignment</td>
<td>30</td>
</tr>
<tr>
<td>Not guided study</td>
<td>43</td>
</tr>
<tr>
<td>STUDENT PERFORMANCE EVALUATION</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Description of the evaluation procedure</strong></td>
<td></td>
</tr>
<tr>
<td>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></td>
</tr>
<tr>
<td>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td></td>
</tr>
</tbody>
</table>

Written examination (80%) in Greek with a combination of open-ended questions, multiple choice questionnaires, short-answer questions and written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- **Suggested bibliography (in Greek):**
  1) Wastewater Engineering: treatment and Reuse – Metcalf & Eddie, Part B, Translated in Greek, Eds. A. Tziola and Sons,
  2) I. Konstantinou, University of Ioannina (Notes)

- **Suggested bibliography (in English):**
  4) Photocatalysis: Applications (Energy and Environment Series) by D.D. Dionysiou(Editor), G. Li Puma(Editor), J.Ye (Editor), Royal Society of Chemistry;2016, ISBN: 978-1782627098

- **Related academic journals:**
  1) Applied Catalysis B:Environmental
  2) Environmental Science and Technology
  3) Catalysis Today
  4) Journal of Chemical Technology and Biotechnology
  5) Chemical Engineering Journal
  6) Journal of Advanced Oxidation Technologies
  7) Green Chemistry

| Course total | 125 |
# COURSE OUTLINE

## (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>XHE 715</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>7</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>ADVANCED FOOD - ENOLOGY LABORATORY</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

**COURSE TYPE**

Specialized general knowledge, skills development

**PREREQUISITE COURSES:**

No

**LANGUAGE OF INSTRUCTION and EXAMINATIONS:**

Greek

**IS THE COURSE OFFERED TO ERASMUS STUDENTS:**

Yes

**COURSE WEBSITE (URL)**


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, level 6 of the European Qualifications Framework, students will be able to perform various chemical, biochemical and microbiological analyses of foods and wine. Moreover, they will be able to solve problems and exercises related to the subjects of the course, and to correlate analytical data with properties of foods and wine as well as their quality and assurance. They will be able to conduct a literature search using modern technologies.

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. Criticism and self-criticism. Production of free, creative and inductive thinking.

(3) SYLLABUS

- Enzyme and microbial activities in dairy and enology.
- Antioxidant activity and oxidation of oils and fruit juices.
- Analysis and must and correction of its acidity and sugar.
- Wine analyses.
- Control of wine stability.
- Chromatic characteristics and phenolic composition of wine.
- Food colourants and evaluation of food colour.
- Determination of ascorbic acid in foods using HPLC.
- Determination of fatty acids in oil – control of oil adulteration.
- Microbiological analysis of foods.
- Determination of yogurt and wine aroma volatiles by using SPME-GC/MS.
- Specific wine analyses.
(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
</tbody>
</table>

Use of power point in lectures. Use of ICT technologies in communication with students.

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>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>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>8</td>
</tr>
<tr>
<td>Laboratory practice</td>
<td>44</td>
</tr>
<tr>
<td>Study and analysis of bibliography, essay writing</td>
<td>33</td>
</tr>
<tr>
<td>Not guided study</td>
<td>40</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</td>
</tr>
</tbody>
</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.

The language of evaluation is Greek. The total evaluation consists of a) written examination (50 %), with open-ended questions, short-answer questions and multiple choice questionnaires, and b) laboratory work and reports (50 %).
### Suggested bibliography:

<table>
<thead>
<tr>
<th>REFERENCES</th>
<th>UNIVERSITY OF IOANNINA</th>
</tr>
</thead>
<tbody>
<tr>
<td>LABORATORY EXERCISES OF FOOD AND WINE SCIENCE ΕΡΓΑΣΤΗΡΙΑΚΕΣ</td>
<td></td>
</tr>
<tr>
<td>ROUSSIS I., BADEKA A., PIPERIDI C., RIGANAKOS K., SAVVAIDIS I.,</td>
<td></td>
</tr>
<tr>
<td>KOSMA I., TASIOLA-MARGARI M.</td>
<td></td>
</tr>
</tbody>
</table>

### Related academic journals:

1. Journal of Food Composition and Analysis
2. Food Analytical Methods
3. Food Chemistry
4. Food Research International
5. Journal of Agricultural and Food Chemistry
6. American Journal of Enology and Viticulture
7. Australian Journal of Grape and Wine Research
8. Journal International Sciences de la Vigne et du Vin

### Related books:

# COURSE OUTLINE

## 1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>School of Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΧΗΕ410</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>7</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Biological Membranes and Basic Principles in Signal Transduction</td>
</tr>
</tbody>
</table>

### 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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>3</td>
</tr>
<tr>
<td>Project preparation</td>
<td>1</td>
</tr>
</tbody>
</table>

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:

No

### LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

### IS THE COURSE OFFERED TO ERASMUS STUDENTS:

Yes

### COURSE WEBSITE (URL)

http://ecourse.uoi.gr/course/view.php?id=596

## 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 covers basic and specific knowledge starting from molecular level to the architecture of biomembranes, stipulated by chemical/physicochemical features, their biogenesis, ending up to functional issues pointing at biosignalling at a basic level.

**With the successful completion of the course the students will acquire the specific knowledge and skills to:**

- List the molecular components of biomembranes and describe their chemical/physicochemical properties
- Describe how the components of biological membranes interact to compose the supermolecular structures of biomembranes
- List and describe isolation and characterization techniques of for studying biological membranes
- Explain the basic principles of the fluid mosaic model of biomembranes.
- Outline the physicochemical properties of the lipid bilayers and associated proteins that compose biomembranes.
- List the functions of membrane proteins and explain the different ways proteins can be associated with a membrane.
• Describe the factors involved in membrane fluidity and asymmetry.
• Describe the principles of membrane biogenesis and topology of lipid and protein assemblies formation in eukaryotic cells.
• Describe the concept of cell communication.
• List the differences between neuronal and endocrine communication.
• Describe the concept of receptor affinity.
• Describe the basic scheme of signal transduction levels.
• Understand the basic principles of signal transduction mechanisms, in particular the concepts of response specificity, signal amplitude and duration, signal integration and intracellular location.
• Give examples of different types of extracellular signals and receptors, and explain their functional significance.
• Describe the mechanisms by which different receptors may be activated by their respective ligands.
• Describe and give examples of the structure and properties of the major components of signal transduction pathways.
• Explain the kinetics of ligand-receptor association.
• Compile the above knowledge to describe sensory 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 and information, with the use of the necessary technology | Project planning and management |
| Decision-making | Respect for difference and multiculturalism |
| Working independently | Respect for the natural environment |
| Team work | Showing social, professional and ethical responsibility and sensitivity to gender issues |
| Working in an international environment | Criticism and self-criticism |
| Working in an interdisciplinary environment | Production of free, creative and inductive thinking |
| Production of new research ideas | Others… |

• Search, analysis and synthesis of data and information, by using the proper technologies.
• Autonomous work.
• Working in an interdisciplinary environment.
• Promoting free, creative and inductive thinking.

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

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

- Projection and analysis of scientific videos
- Communication via email.

**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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>55</td>
</tr>
<tr>
<td>Bibliographical search</td>
<td>20</td>
</tr>
<tr>
<td>Preparation and writing of projects</td>
<td>30</td>
</tr>
<tr>
<td>Projects presentation</td>
<td>20</td>
</tr>
</tbody>
</table>

Course total: **125**

**STUDENT PERFORMANCE EVALUATION**  
*Description of the evaluation procedure*

- Written examination (70%) in Greek, with questions for analytical answers, multiple choice and short-answer questions.
- Written projects with public presentation (30%).

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

(5) **ATTACHED BIBLIOGRAPHY**

- **Suggested bibliography:**
  - ΒΙΟΛΟΓΙΚΕΣ ΜΕΜΒΡΑΝΕΣ ΚΑΙ ΜΕΤΑΓΩΓΗ ΣΗΜΑΤΩΝ ΣΗΜΕΙΩΣΕΩΝ ΤΟΥ ΔΙΔΑΣΚΟΝΤΑ ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ
  - Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. www.kallipos.gr. In http://hdl.handle.net/11419/4307

- **Related academic journals:**
  - Biological Membranes - OMICS Publishing Group
  - BBA Biomembranes, ISSN: 0005-2736
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>XHE807</td>
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<tr>
<td>SEMESTER</td>
<td>H'</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Contemporary spectroscopic methods for the identification of organic molecules</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LECTURES</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

COURSE TYPE

Specialized knowledge

PREREQUISITE COURSES:

According to the curriculum of the Department of Chemistry there are no prerequisites, but it is not possible to monitor effectively without the required knowledge of Organic Chemistry I and II

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek (posibility of teaching in English). All the power point curriculum is in English.

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

After successfully completing the course, level descriptor 6 of the European Qualifications Framework, students should be able to:

- Understand the basic principles of spectroscopy of organic compounds, especially infrared-visible spectroscopy, vibrational spectroscopy, nuclear magnetic resonance and mass spectrometry, and how they can be used for the identification and solution of structures of unknown organic compounds.
- Explain UV-visible, infrared, nuclear magnetic resonance and mass spectra, identify characteristic spectral peaks, evaluate spectral data by identifying and solving structures of organic compounds.
- Choose and apply the appropriate spectroscopic technique or combination of spectroscopic techniques to solve research problems.

Knowledge

- Knowledge and understanding of the basic concepts, principles and theories related to spectroscopy of organic compounds.
- Knowledge and understanding of applications of UV / Vis spectroscopic methods, IR,
NMR and MS in identifying and solving structures of organic compounds.
- Knowledge of the combined use of UV / Vis, IR, NMR and MS techniques in identifying and solving structures of organic compounds.
- Knowledge of the use of spectroscopic data in the international literature.

Skills
- Skills to solve and evaluate UV / Vis, IR, NMR and MS spectra.
- Use of the appropriate spectroscopic method or a combination of methods to solve complex problems of Organic Chemistry.
- Advanced problem solving skills through data analysis of international literature.

Competences
- Ability to apply knowledge in dealing with problems related to spectroscopy of organic compounds.
- Ability to interpret spectral data with the use of one or more techniques and to determine the structure of organic compounds.
- Ability to analyze spectroscopic data and investigate structural and conformational properties of the molecules.
- Ability to interact with other students or researchers in solving spectroscopic problems of organic compounds.
- Ability to select and apply the most appropriate spectroscopic methods and relevant methodology to solve specific research problem.
- Ability to work in a team but also individually.
- Job opportunities in an international environment.

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 | ...... |

The general competences are:
- Theoretical thinking and ability to translate theory into practice.
- Ability to apply knowledge acquired during the study period in related courses of the curriculum of the Department of Chemistry.
- Ability to search, analyze and synthesize data and information from international literature and use the necessary technologies related to the presentation of research results.
- Acquiring the appropriate theoretical and practical knowledge to be able to follow further education at postgraduate and doctoral level.
- Working in an interdisciplinary environment.
- Ability to collaborate at a team level.

(3) SYLLABUS

UV-VIS spectroscopy
- Introduction to spectroscopic methods of analysis of organic compounds.
- Electromagnetic radiation
- UV radiation and electronic excitation
| **Electronic transitions and selection rules** |
| **Spectra and instrumentation - Beer-Lambert Law** |
| **Chromophoric groups** |
| **Visible spectroscopy** |
| **Exercises - Interpretation of UV-VIS spectra** |

**IR spectroscopy**
- Basic concepts of infrared spectroscopy
- Masses, atoms and springs
- Frequency of infrared vibrations of diatomic molecules
- Absorption bands
- Symmetrical vibration, anti-symmetrical vibration, bending vibration
- Simple harmonic oscillator - Non-harmonic oscillator - Factors influencing infrared vibrational frequencies
- Exercises - Interpretation of infrared spectra of a representative number of organic compounds

**NMR spectroscopy**
- Introduction to NMR spectroscopy - The NMR phenomenon
- Chemical shift
- Characteristic $^1H$ NMR chemical shifts
- Integration of $^1H$ NMR signals
- Spin-spin coupling constants - Analysis of conformation of organic compounds
- Instrumentation – The NMR spectrometer
- $^{13}C$ NMR spectroscopy
- Fourier Transform NMR Spectroscopy
- Relaxation processes
- NMR time scale - Study of chemical exchange phenomena
- Principles of two-dimensional NMR spectroscopy
- Exercises - interpretation of NMR spectra of a representative number of organic compounds

**MS mass spectrometry**
- Principles of MS spectrometry
- Ionization energies of valence electrons
- Basic instrumentation of mass spectrometers
- Peaks of molecular ions
- The mass spectrum
- Isotopes
- Ion production methods
- Peaks M + 2 and M + 1
- High resolution mass spectrometry
- Fission fragments
- Exercises - interpretation of MS spectra of a representative number of organic compounds
Combined exercises
- Exercises for combined use of UV / Vis, IR, NMR and MS spectroscopic methods.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to Face</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Practical application and demonstration at the NMR Center of the University of Ioannina</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>Use of technologies of information and communications in teaching and communication with students</th>
</tr>
</thead>
<tbody>
<tr>
<td>The manner and methods of teaching are described in detail.</td>
<td>Teaching with the project method.</td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>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></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lectures</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Written assignment</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Individual study, preparation</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Course total</td>
<td>125</td>
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</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVALUATION</td>
<td>Written examination (80%) in Greek with a combination of open-ended questions, multiple choice questionnaires, short-answer questions and written work with public presentation (20%).</td>
<td></td>
</tr>
<tr>
<td>Description of the evaluation procedure</td>
<td>The evaluation of the students is done by written final examination (evaluation) in Greek which includes:</td>
<td></td>
</tr>
<tr>
<td>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>I. Written / oral final examination (60%) comprising:</td>
<td></td>
</tr>
<tr>
<td>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td>- the development of topics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- short answer questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- answers to crisis questions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- a problem solving.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>II. Atomic Work Presentation (Concluding Assessment) (40%).</td>
<td></td>
</tr>
</tbody>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Proposed Electronic Bibliography:
  1. [http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction#IRSpectroscopy](http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction#IRSpectroscopy)
  2. [http://chemwiki.ucdavis.edu/Organic_Chemistry/Organic_Chemistry_With_a_Biological_Emphasis/Chapter_04%3A_Structure_Determination_I/Section_4.3%3A_Ultraviolet_and_visible_spectroscopy](http://chemwiki.ucdavis.edu/Organic_Chemistry/Organic_Chemistry_With_a_Biological_Emphasis/Chapter_04%3A_Structure_Determination_I/Section_4.3%3A_Ultraviolet_and_visible_spectroscopy)
6. https://drive.google.com/folderview?id=0B3uVX4mPJSC1WFVvWkloUUVyMU0&usp=preview&tid=0B3uVX4mPJSC1Y3hOLWh0VUNBbA#list
10. https://www.youtube.com/watch?v=NuIH9-6Fm6U
12. https://www.youtube.com/watch?v=tOGM2gOHKPc
13. http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/maspec.html#c1

- Books:

- Scientific Journals:
  1) Journal of Chemical Education
  2) Concepts in Magnetic Resonance
  3) Magnetic Resonance in Chemistry
  4) Journal of Molecular Structure.
(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
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<td>LEVEL OF STUDIES</td>
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<tr>
<td>COURSE CODE</td>
<td>XHE 809</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>7th</td>
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<tr>
<td>COURSE TITLE</td>
<td>CRYSTAL CHEMISTRY-CRYSTALLOGRAPHY</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Specialization

general background, special background, specialised general knowledge, skills development

PREREQUISITE COURSES:

No

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

Yes

COURSE WEBSITE (URL):

No

(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 completion of this course, the students should be able to:

Understand the basic principles of crystal geometry, i.e. crystal lattice, molecular and crystalline symmetry, space groups and reciprocal lattice.

Understand X-Ray diffraction from single crystals and crystalline powder.

Describe the intermolecular forces stabilizing the structure and correlate structure with physical or chemical properties.

Knowledge

Knowledge and understanding of basic concepts and theories of crystal and molecular structure determination from X-Ray diffraction data.

Knowledge about the interplay of different intermolecular forces to stabilize the crystalline solids and correlation with properties such as: Polymorphic phenomena, adsorption properties, non-linear optical properties and photochemical solid state reactions.
Skills

Skills in growing single crystals suitable for structure determination.
Crystal structure determination using Direct and Patterson techniques.

Capabilities

Capability to interpret X-Ray data for structure determination or phase identification.
Capability to “interpret” structures using intermolecular forces.
Capability to interact with other scientists in issues concerning Synthetic Chemistry, Materials Science and Pharmaceutics.
Capability in team work.

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...

The general capabilities which should be obtained by the student are:

- Ability to work independently.
- Ability to work in multidisciplinary environment.
- Ability to search, analyze and present data from international literature.
- Ability to convert theory into practice.

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Ex cathedra.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Practical application and demonstration in the Crystallography Laboratory.</td>
</tr>
</tbody>
</table>
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Use of ICT in teaching, laboratory education, communication with students

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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>25</td>
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<tr>
<td>Project</td>
<td>25</td>
</tr>
<tr>
<td>Study, preparation</td>
<td>25</td>
</tr>
<tr>
<td>Course total</td>
<td>75</td>
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</tbody>
</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.

The evaluation of students is as follows:

1) Written/oral examination (60%).
2) Project (40%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

ΕΙΣΑΓΩΓΗ ΣΤΗΝ ΚΡΥΣΤΑΛΛΟΔΟΜΗ
ΚΡΥΣΤΑΛΛΟΔΟΜΗ
ΚΑΘΟΥΝΗΣ Α. ΚΩΝΣΤΑΝΤΙΝΟΣ
ΣΩΦΙΑ ΑΕ
# COURSE OUTLINE

## (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
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<tr>
<td>COURSE CODE</td>
<td>ΧΗΕ 071</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>7</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>ENOLOGY I</td>
</tr>
</tbody>
</table>

### 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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

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, skills development

### PREREQUISITE COURSES:

No

### 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

After successfully completing the course, level 6 of the European Qualifications Framework (students will be able to comprehend the basic principles of the following: wine and culture, activities of yeasts and malolactic acid bacteria during winemaking, enzyme activities in must and wine, sulphur dioxide and other additives in must and wine. Chemical composition of must and wine, colloidal phenomena, oxidation-reduction, spoilage of wine. Analysis of must and wine, organoleptic evaluation. Wine and nutrition, positive and negative effects of wine on human health.

Moreover, they will be able to solve problems and exercises related to the subjects of the course, and to correlate chemical composition and activities of microorganisms and enzymes with quality of wine, as well as wine bioactive compounds with human health. They will be able to conduct a literature search using modern technologies.

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. Working independently. Criticism and self-criticism. Production of free, creative and inductive thinking.

(3) SYLLABUS

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td>
<td>Use of power point in lectures. Use of ICT technologies in communication with students.</td>
</tr>
</tbody>
</table>

**DELIVERY**
- Face-to-face, Distance learning, etc.

**USE OF INFORMATION AND COMMUNICATION TECHNOLOGY**
- Use of ICT in teaching, laboratory education, communication with students
- Use of power point in lectures. Use of ICT technologies in communication with students.

**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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures, seminars, educational visits</td>
<td>26</td>
</tr>
<tr>
<td>Study and analysis of bibliography, essay writing</td>
<td>34</td>
</tr>
<tr>
<td>Not guided study</td>
<td>65</td>
</tr>
</tbody>
</table>

**Activity**
- Lectures, seminars, educational visits
- Study and analysis of bibliography, essay writing
- Not guided study

**Semester workload**
- 125

**STUDENT PERFORMANCE EVALUATION**
Description of the evaluation procedure

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

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

The language of evaluation is Greek. The total evaluation consists of a) written examination (65 %), with open-ended questions, short-answer questions and multiple choice questionnaires, and b) written work, public presentation (35 %).
(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

<table>
<thead>
<tr>
<th>ENOLOGY, SCIENCE AND TECHNOLOGY</th>
<th>SOULEROS E.</th>
<th>SOULEROS E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OINOLOGIA</td>
<td>TSAKIRIS A.</td>
<td>PSYCHALOS PUBLISHING</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OINOLOGIA</td>
<td>ROUSSIS I.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Related academic journals:
1. American Journal of Enology and Viticulture
3. Journal International Sciences de la Vigne et du Vin
5. Food Chemistry
6. Journal of Agricultural and Food Chemistry

-Related books:
4. Wine Chemistry and Biochemistry, Moreno Arribas M.V., Polo C., Springer 2009
5. Wine Microbiology and Biotechnology, Fleet G.H., CRC Press 1993
(1) GENERAL

<table>
<thead>
<tr>
<th><strong>SCHOOL</strong></th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACADEMIC UNIT</strong></td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td><strong>LEVEL OF STUDIES</strong></td>
<td>Undergraduate</td>
</tr>
<tr>
<td><strong>COURSE CODE</strong></td>
<td>XHE 507 7.6.4</td>
</tr>
<tr>
<td><strong>SEMIESTER</strong></td>
<td>7th</td>
</tr>
</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th><strong>WEEKLY TEACHING HOURS</strong></th>
<th><strong>CREDITS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

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:**
No

**LANGUAGE OF INSTRUCTION and EXAMINATIONS:**
Greek

**IS THE COURSE OFFERED TO ERASMUS STUDENTS:**
No

**COURSE WEBSITE (URL):**
No

(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

Consolidate knowledge of chemical concepts in environmental geochemistry-mineralogy.

Provide students with a firm foundation of the application of chemistry onto the natural world

Engender in students a deeper understanding of the earth and our surface environment from a chemical perspective.

The students will:

- Be able to describe geochemical data in the context of environmental processes
- Demonstrate a basic understanding of what controls the concentration of elements in a range of physical environments
- Demonstrate understanding of the most important rock forming minerals, where they are found, their quality and how they are formed
- Demonstrate insight to the most important processes that leads to the formation of the different types rocks
- Understand the processes that control mineral reactivity and stability under environmentally-relevant conditions.
- Understand the earth processes which control the abundance and distribution of minerals at the earth’s surface under a range of spatial and temporal scales.

Their survey and bibliographic work will promote free, creative and inductive thinking.
General Competences

Taking into consideration the general competences that the degree-holders 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, analysis and synthesis of data and information, by using the proper technologies
Promoting free, creative and inductive thinking
Be able to integrate theoretical concepts with their practical applications. Effectively read and critically review scientific literature.
Assess rigorously and critically scientific debates and environmental issues

(3) SYLLABUS

Differentiation of and cosmic abundance of elements
Composition of the earth
Geochemistry of igneous rocks, geochemistry of sedimentary rocks, geochemistry of metamorphic rocks
Crystal chemistry – environmental mineralogy - solution-mineral equilibria
The water envelope: oceans
Weathering and soils
Sedimentation and diagenesis

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Lectures</td>
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<tr>
<td>Written assignment</td>
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<tr>
<td>Not guided study</td>
<td>52</td>
</tr>
<tr>
<td>Course total</td>
<td>126</td>
</tr>
</tbody>
</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.

Written examination (80%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  Introduction to Geochemistry. K. Krauskopf, D. Bird
- Related academic journals:
  Applied Geochemistry, Elsevier
  Geochimica Cosmochimica Acta, Pergamon press
  Geochemistry Exploration Environment Analysis, Lyell collection
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
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<td>LEVEL OF STUDIES</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<td>COURSE TITLE</td>
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INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LECTURES</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

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.

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

PREREQUISITE COURSES:

- Specialized knowledge

COURSE TYPE

general background,
special background, specialised general
knowledge, skills development

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.

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- Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B
- Guidelines for writing Learning Outcomes

After the successful completion of the course, descriptive level 6 of the European Qualifications Framework for Lifelong Learning, the students will be capable to:

- Understand deeply the principal physical and chemical processes taking place in environmental media and environmental protection technologies, the assessment of basic parameters for taking measures and the application of methods and technologies for pollution control and environmental protection.

Learning outcomes:

- Knowledge and understanding of basic principles and theories related to pollution control and environmental protection technologies.
- Knowledge and understanding of physicochemical processes taking place in environmental media
- Knowledge for applying criteria and measures aiming in pollution control and environmental restoration.
- Knowledge of ecotoxicological concepts and methods of environmental risk.
assessments.

Skills:
- Development and application of quality standards, measures and technologies for pollution control and environmental protection.

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

- Application of knowledge dealing with methods, techniques and technologies of pollution control and environmental protection-remediation.
- Inquiring of theoretical and practical background for performing further education, postgraduate and doctoral studies.
- Utilization of laboratory infrastructures and equipment for the above-mentioned aims
- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Theoretical knowledge and bringing-applying theory to practice
- Team work as well as working independently
- Working in an international environment
- Working in an interdisciplinary environment
- Production of new research ideas
- Project planning and management
- Respect for the natural environment

(3) SYLLABUS

Introduction to environmental pollution and environmental protection (environmental chains, environmental crisis, measures for environmental protection). Liquid wastes (physical and chemical characteristics, quality parameters, self-purification of natural water systems). Purification and treatment of natural waters for the production of potable water (legislation and water remediation processes for human consumption, aeration, filtration, sedimentation, ozonation, adsorption, chlorination, UV-radiation). General principles of liquid wastes treatment (purification methods, steps-levels, purification units and efficiency). Primary and preliminary treatment (mechanical pretreatment, screening, sedimentation, coagulation, flocculation, flotation, filtration). Secondary biological treatment (aerobic and anaerobic biological treatments, conventional activated sludge processes, fluidized biological beds). Tertiary chemical treatment (coagulation-flocculation, filtration, clarification, ion exchange, disinfection). Industrial wastes (Characteristics of industrial wastes and examples of treatment-purification units). Solid wastes and treatment methods and technologies (environmental problems, treatment technologies, management of municipal solid wastes,
industrial solid wastes). Pollution control of airborne particulate matter (dispersion of suspended particles in air, methods and technologies for suspended matter removal, filtration, cyclones, wet scrubbers, electric precipitators, etc). Technologies for air pollutants control (condensation, absorption, adsorption, incineration, chemical oxidation and neutralization, etc.).

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of Technologies of Information and communications in teaching and communication with students.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>Written assignment</td>
<td>30</td>
</tr>
<tr>
<td>Not guided study</td>
<td>43</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</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.

Written examination (80%) in Greek with a combination of open-ended questions, multiple choice questionnaires, short-answer questions and written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (in Greek):
  1) Pollution and Environmental Protection Technologies – T. Albanis, Eds. A. Tziola and Sons,
  2) I. Konstantinou, T. Albanis, University of Ioannina (Notes)
  4)

- Suggested bibliography (in English):

- Related academic journals:
  1) Water Research
  2) Environmental Science and Technology
3) Applied Catalysis B: Environmental
4) Journal of Environmental Chemical Engineering
5) Journal of Environmental Management
6) Process Safety and Environmental Protection
7) Waste Management
ΠΕΡΙΓΡΑΜΜΑ ΜΑΘΗΜΑΤΟΣ

1. ΓΕΝΙΚΑ

<table>
<thead>
<tr>
<th>ΣΧΟΛΗ</th>
<th>Natural Sciences</th>
</tr>
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<tbody>
<tr>
<td>ΤΜΗΜΑ</td>
<td>Chemistry</td>
</tr>
<tr>
<td>ΕΠΙΠΕΔΟ ΣΠΟΥΔΩΝ</td>
<td>Undergraduate</td>
</tr>
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<table>
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<tr>
<th>ΚΩΔΙΚΟΣ ΜΑΘΗΜΑΤΟΣ</th>
<th>ΕΞΑΜΗΝΟ ΣΠΟΥΔΩΝ</th>
<th>ΤΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ</th>
</tr>
</thead>
<tbody>
<tr>
<td>3680</td>
<td>7ο</td>
<td>General Microbiology</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>ΑΥΤΟΤΕΛΕΙΣ ΔΙΔΑΚΤΙΚΕΣ ΔΡΑΣΤΗΡΙΟΤΗΤΕΣ</th>
<th>ΕΒΔΟΜΑΔΙΑΙΕΣ ΩΡΕΣ ΔΙΔΑΣΚΑΛΙΑΣ</th>
<th>ΠΙΣΤΩΤΙΚΕΣ ΜΟΝΑΔΕΣ</th>
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<td></td>
<td>Διαλέξεις</td>
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<tr>
<td></td>
<td>Ασκήσεις Πράξης</td>
<td>3</td>
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</tbody>
</table>

Προσδέστε σειρές αν χρειαστεί. Η οργάνωση διδασκαλίας και οι διδακτικές μέθοδοι που χρησιμοποιούνται περιγράφονται αναλυτικά στο 4.

ΤΥΠΟΣ ΜΑΘΗΜΑΤΟΣ: Core

ΠΡΟΑΠΑΙΤΟΥΜΕΝΑ ΜΑΘΗΜΑΤΑ:

- Υποθέσεις, Γενικών Γνώσεων, Επιστημονικής Περιοχής, Ανάπτυξης Δεξιοτήτων

ΠΕΡΙΓΡΑΦΗ ΤΟΥ ΕΠΙΠΕΔΟΥ ΜΑΘΗΣΗΣ:

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

ΓΕΝΙΚΕΣ ΙΚΑΝΟΤΗΤΕΣ
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
- Σχεδιασμός και διαχείριση έργων

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 Πλαίσιο Προσόντων του Ευρωπαϊκού Χώρο Ανώτατης Εκπαίδευσης
- Περιγραφικοί Δείκτες Επιπέδων 6, 7 & 8 του Ευρωπαϊκού Πλαισίου Προσόντων Διά Βίου Μάθησης
- Περιληπτικός Οδηγός συγγραφής Μαθησιακών Αποτελεσμάτων

Περιλήπτικος Οδηγός συγγραφής Μαθησιακών Αποτελεσμάτων

- History of Microbiology, Principles of Koch, classification of microorganisms
- Cell structure morphology and characteristics – Understanding principles
- Nutrition of bacterial cells and growth requirements
- Isolation and characterization of bacterial cells – Methods of determination
- Cell identification and characterization of bacteria
- Μέθοδοι απομόνωσης και ταυτοποίησης βακτηρίων
- Methods of inactivation and elimination of bacteria – physical and chemical methods of destruction of microorganisms
- Probiotics and bacteria
- An introduction to bacteria and foods

ΗΛΕΚΤΡΟΝΙΚΗ ΣΕΛΙΔΑ ΜΑΘΗΜΑΤΟΣ (URL)

Electronic uploading of the course may be available

ΤΟ ΜΑΘΗΜΑ ΠΡΟΣΦΕΡΕΤΑΙ ΣΕ ΦΟΙΤΗΤΕΣ ERASMUS Yes in English
πληροφοριών, με τη χρήση και των απαραίτητων
technologies.

Προσαρμογή σε νέες καταστάσεις

Λήψη αποφάσεων

Αυτόνομη εργασία

Ομαδική εργασία

Εργασία σε δεδομένες περιβάλλον

Εργασία σε διεπιστημονικό περιβάλλον

Παράγωγη νέων ερευνητικών ιδεών

Σεβασμός στη διαφορετικότητα και στην πολυπολιτισμικότητα

Σεβασμός στο φυσικό περιβάλλον

Επίδειξη κοινωνικής, επαγγελματικής και ηθικής υπευθυνότητας

Λήψη αποφάσεων σε θέματα φύλου

Ασκήση κριτικής και αυτοκριτικής

Προαγωγή της ελεύθερης, δημιουργικής και επαγωγικής σκέψης

• Literature, analysis as well as synthesis of data and information with the aid of technologies.
• Individual or group assessments of students or take home assignments.
• Creative, free and constructive thinking in modern cases or traditional issues, related to Microbiology, Food Safety and Probiotics.

3. ΠΕΡΙΕΧΟΜΕΝΟ ΜΑΘΗΜΑΤΟΣ

The course deals with the general aspects of microorganisms, examining basic cell structure, morphology of the bacterial cell. It also deals with cell nutrition requirements, and growth factors, discussing the effects of extrinsic parameters (temperature, oxygen, light, pH etc.) and their effects on bacterial cell growth. Methods and techniques of elimination of bacteria using physical or chemical means are also described. Finally, an introduction on Probiotics and Foods is given and their relation to bacteria.

4. ΔΙΔΑΚΤΙΚΕΣ και ΜΑΘΗΣΙΑΚΕΣ ΜΕΘΟΔΟΙ - ΑΞΙΟΛΟΓΗΣΗ

ΤΡΟΠΟΣ ΠΑΡΑΔΟΣΗΣ

Πρόσωπο με πρόσωπο, Εξ αποστάσεως εκπαίδευση κ.λπ.

ΧΡΗΣΗ ΤΕΧΝΟΛΟΓΙΩΝ ΚΑΙ ΕΠΙΚΟΙΝΩΝΙΩΝ

Χρήση Τ.Π.Ε. στη Διδασκαλία, στην Εργαστηριακή Εκπαίδευση, στην Επικοινωνία με τους φοιτητές

ΟΡΓΑΝΩΣΗ ΔΙΔΑΣΚΑΛΙΑΣ

Περιγράφονται αναλυτικά ο τρόπος και μέθοδοι διδασκαλίας,

Διαλέξεις, Σεμινάρια, Εργαστηριακή Λακησή, Ασκήσεις Πεδίου, Μελέτη & ανάλυση διβιβλιογραφίας, Φροντιστήριο, Πρακτική (Τοποθέτηση). Κλινική Λακησή, 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 καθώς και οι ώρες μη καθοδηγούμενης μελέτης ώστε ο συνολικός χρόνος μελέτης σε επίπεδο εξαμήνου να αντιστοιχεί στα στάνταρς του ECTS

<table>
<thead>
<tr>
<th>ΤΡΟΠΟΣ ΠΑΡΑΔΟΣΗΣ</th>
<th>ΧΡΗΣΗ ΤΕΧΝΟΛΟΓΙΩΝ ΚΑΙ ΕΠΙΚΟΙΝΩΝΙΩΝ</th>
<th>ΟΡΓΑΝΩΣΗ ΔΙΔΑΣΚΑΛΙΑΣ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Πρόσωπο με πρόσωπο, Εξ αποστάσεως εκπαίδευση κ.λπ.</td>
<td>Χρήση Τ.Π.Ε. στη Διδασκαλία, στην Εργαστηριακή Εκπαίδευση, στην Επικοινωνία με τους φοιτητές</td>
<td>Περιγράφονται αναλυτικά ο τρόπος και μέθοδοι διδασκαλίας, Διαλέξεις, Σεμινάρια, Εργαστηριακή Λακησή, Ασκήσεις Πεδίου, Μελέτη &amp; ανάλυση διβιβλιογραφίας, Φροντιστήριο, Πρακτική (Τοποθέτηση), Κλινική Λακησή, Καλλιτεχνικό Εργαστήριο, Διαδραστική διδασκαλία, Εκπαιδευτικές επισκέψεις, Εκπόνηση μελέτης (project), Συγγραφή εργασίας / εργασιών, Καλλιτεχνική δημιουργία, κ.λπ.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Τρόπος Αξιολόγησης</th>
<th>Φόρτος Εργασίας Εξαμήνου</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class based teaching, person to person interaction.</td>
<td>Method of teaching</td>
</tr>
<tr>
<td>Teaching methods will involve literature survey using Internet based search as well scientific data bases. Power point presentation will be presented and discussed in class. E – class platform methods will also be used as a teaching methods.</td>
<td></td>
</tr>
<tr>
<td>The methods of teaching will include:</td>
<td></td>
</tr>
<tr>
<td>1. Course documents, lectures</td>
<td></td>
</tr>
<tr>
<td>2. Interactive teaching</td>
<td></td>
</tr>
<tr>
<td>3. Lab practical work</td>
<td></td>
</tr>
<tr>
<td>4. In-class assignments and group work</td>
<td></td>
</tr>
<tr>
<td>5. Filed trip to the Food Control Authority</td>
<td></td>
</tr>
<tr>
<td>6. Take-home assignments</td>
<td></td>
</tr>
<tr>
<td>7. Presentations/seminars</td>
<td></td>
</tr>
<tr>
<td>8. Videos of effects of food chemistry on food processing</td>
<td></td>
</tr>
</tbody>
</table>
9. Educational awareness material (pamphlets)

Different teaching methods will assist the student in
1. Absorbing the course material better
2. Having an interactive environment with their instructor and with their peers
3. Selection of the proper scientific paper, preparation of slides and presentation of the final seminar
4. Use the critical thinking skills for interpretation of results
5. Becoming self-independent
6. Have external experience and hands on skills in the field

Teaching Aids

1. Lecture provided as power power-point presentations
2. Additional reading and supporting material provided as handouts and uploaded on blackboard
3. Email communication
4. White board for group presentations and discussions
5. Extra reading material available as online resources and textbooks

Προαιρετικές γραπτές εργασίες επί θέματος

Home assignments on selected literature will be assigned to each student, relevant to the course syllabus.
Language of exam assessment will be Greek for home students or English for Erasmus students. The exam may include: written final exam (100%) with a number of multiple choice questions.

There will be a bonus system for the degree of written examination based on the student’s performance during the theoretical training, and the grade of the work he may have taken. The criteria of the student bonus system are also posted and continuously available to students through E-class.

Erasmus students will be given an oral and written paper on subject related to the course.

5. ΣΥΝΙΣΤΩΜΕΝΗ-ΒΙΒΛΙΟΓΡΑΦΙΑ
-Προτεινόμενη Βιβλιογραφία:

1. General Microbiology (Book)
   Efdoxos Publishers. Code Nr: 22677089
   First Edition:/2012
   Author: Amalia Karagouni
   ISBN: 978-960-351-904-1

2. Food Microbiology (Book) Μίκροβιολογία Τροφίμων
   STELLA PARIKOU Publishers. Code Nr: 4847
   First Edition: 2010
   Authors: Montville Thomas J., Matthews Karl R.
   ISBN: 978-960-411-713-0
COURSE OUTLINE

(1) GENERAL

<table>
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<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
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<tr>
<td>ACADEMIC UNIT</td>
<td>CHEMISTRY DEPARTMENT</td>
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<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
</tr>
<tr>
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</tr>
<tr>
<td>SEMESTER</td>
<td>7</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>LANTHANIDE AND ACTINIDE CHEMISTRY – INTRODUCTION TO NUCLEAR CHEMISTRY</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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</thead>
<tbody>
<tr>
<td>Lectures</td>
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<td>5</td>
</tr>
<tr>
<td>Laboratory</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Scientific Area / Special Background / Development Skills

PREREQUISITE COURSES:

NONE

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

After successfully completing the course, descriptive marker 6 of the European Qualifications Framework, students should be able to:

- Understand the basic principles of Lanthanides and Actinides Chemistry.
- Understand significant element differences with the other elements of the Periodic Table and be able to predict their chemical behaviour in various chemical environments.

Knowledge

- Knowledge and understanding of the basic concepts, principles and theories related to Lanthanides and Actinides.
- Knowledge of metals metallurgy, their chemistry in the solid state and in solution, their applications and their environmental impact.

Skills

- Skills to solve problems related to the chemistry of these metals.
- Skills to solve problems related to spectroscopic and physicochemical properties of metals.
- Skills in interpreting and / or proposing appropriate synthetic reactions through data analysis.
- Complex problem-solving skills through data analysis of international literature.
Abilities
• Ability to interact with other students or researchers on lanthanides and actinides.
• Ability to work in a team but also independently.
• Ability to work in an international environment.
• Ability to apply their knowledge in dealing with problems related to lanthanide and actinide chemistry.
• Ability to combine bibliographic / experimental data to design products containing lanthanides and actinides.
• Ability to choose and apply relevant methodology to solve a particular problem where an $f$ center is involved.

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 | 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... |

The general competencies that the student should have acquired and to which the course is aimed are:
• Theoretical thinking and ability to translate theory into practice.
• Ability to apply knowledge acquired during the study period and related courses of the curriculum of the Department of Chemistry.
• Ability to search, analyze and synthesize data and information from international literature and use the necessary technologies related to the presentation of research results.
• Acquiring the appropriate theoretical and practical knowledge base to allow further education at the postgraduate level of specialization and doctorate.
• Ability to work together at team level to achieve these goals.

(3) SYLLABUS

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td>e-mail, Powerpoint, Teaching utilizing projects</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
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<tr>
<td>Written assignment</td>
<td>28</td>
</tr>
</tbody>
</table>
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

| Course total | 125 |

**STUDENT PERFORMANCE EVALUATION**

Description of the evaluation procedure

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

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

The evaluation of the students is done a) by written examination (evaluation) (50%) in Greek which includes:

- the description of topics
- multiple choice questions
- answers to judgement questions
- Problem solving.

And b) presentation of their written assignment (evaluation) (50%)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - Lanthanide and Actinide Chemistry, Simon Cotton, John Wiley & Sons Ltd, 2006, Chichester
  - Rare Earth Coordination Chemistry, C. Huang Ed., John Wiley & Sons Ltd, 2010, Singapore
  - Rare Earths, Structure and Bonding, Vol. 22, 1975, Dordrecht
  - Extractive Metallurgy of Rare Earths, C.K.Gupta, N.Krishnamurthy, CRC Press, 2005, Boca Raton

- Related academic journals:
  - ACS: JACS Inorganic Chemistry, Organometallics, Crystal Growth and Design
  - RSC: Dalton Transactions, CrystEngCom, RSC Advances
  - Wiley: European Journal of Inorganic Chemistry
(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
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<td>COURSE TITLE</td>
<td>Mechanisms in Organic Chemistry</td>
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</tbody>
</table>

**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.

<table>
<thead>
<tr>
<th></th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>Lectures</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

**COURSE TYPE**

Specialised General Knowledge

**PREREQUISITE COURSES:**


**LANGUAGE OF INSTRUCTION and EXAMINATIONS:**

Greek

**IS THE COURSE OFFERED TO ERASMUS STUDENTS**

NO

**COURSE WEBSITE (URL)**

https://sites.google.com/site/organicchemistryv

(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

**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, independent working, production of novel research ideas

(3) SYLLABUS

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>NO</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
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<tr>
<td>Lectures</td>
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<tr>
<td>Course total</td>
<td>125</td>
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</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.

Oral examination

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
1. Mechanism and theory in Organic Chemistry των Lowry, T.H και Richardson, K.S.
6. Principles of Chemical Kinetics, House, J.E.
(1) GENERAL

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<tr>
<th>SCHOOL</th>
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<th>COURSE TITLE</th>
<th>METALLOBIOMOLECULES</th>
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</table>

<table>
<thead>
<tr>
<th>INDEPENDENT TEACHING ACTIVITIES</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td></td>
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</tr>
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<td>CLASSROOM</td>
<td>4</td>
<td>5</td>
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</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Scientific area, special background, specialised general knowledge</th>
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</table>

<table>
<thead>
<tr>
<th>PREREQUISITE COURSES:</th>
<th>NONE</th>
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</thead>
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<table>
<thead>
<tr>
<th>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</th>
<th>GREEK</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>IS THE COURSE OFFERED TO ERASMUS STUDENTS:</th>
<th>YES</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>COURSE WEBSITE (URL)</th>
<th></th>
</tr>
</thead>
</table>

(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 aim of the course is to teach and embody basic principles of inorganic biochemistry
- Upon successful completion of the course, students should be able to:
  1. Recognize the contribution of bioinorganic chemistry to the development of chemistry and other related disciplines
  2. Be able to evaluate the role of metal ions in biological systems.
  3. Know the function of metalloporphyrins of hemoglobin in oxygen binding of metal ions.
  4. Be aware of the structure and function of metalloenzymes and metalloproteins.
  5. Know iron biochemistry
  6. Understand the role of metal ions in photosynthesis in Cobalamines B12 and in basic functions of living beings.
  7. Know that trace elements are involved in basic functions of the organism.
  8. Recognize the applications of metallobiomolecules in organisms growth
  9. Be able to evaluate the applications of complexes as metallotherapeutics.
  10. Be aware of the applications of the metal ions in toxicology.

Knowledge
Knowledge and understanding of the basic concepts, principles and theories related to the inorganic
Biological Chemistry—Bioinorganic chemistry, the role of metal ions in biological systems, the structure and function of metalloproteins and metalloenzymes, the role of metal ions in nucleic acids, metalloporphyrins.

Skills
Skills in predicting and assessing the role of metal ions in biological systems both as an external and as an internal factor.

Abilities
Ability to apply the knowledge provided in dealing with problems related to Inorganic Biological Chemistry and Bio-Inorganic Chemistry.
Ability to interpret the type of metal ion binding with biomolecules.
Ability to accurately assess the data provided to solve complex problems.
Ability to work independently and to interact with other students on related subjects

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?

<table>
<thead>
<tr>
<th>Competence</th>
<th>Course Aim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for, analysis and synthesis of data and information, with the use</td>
<td>Project planning and management</td>
</tr>
<tr>
<td>of the necessary technology</td>
<td>Respect for difference and multiculturalism</td>
</tr>
<tr>
<td>Adapting to new situations</td>
<td>Respect for the natural environment</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Showing social, professional and ethical responsibility and sensitivity</td>
</tr>
<tr>
<td>Working independently</td>
<td>to gender issues</td>
</tr>
<tr>
<td>Team work</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td></td>
</tr>
<tr>
<td>Production of new research ideas</td>
<td></td>
</tr>
</tbody>
</table>

The general competencies that the student should have acquired and to which the course is aimed are:
Search, analyze and evaluate data-information and make decisions.
Conversion of theory into practice.
Promote free, creative and inductive thinking.
Autonomous and teamwork as well.
Acquiring the appropriate theoretical background knowledge to enable further education both at a theoretical level (and in a laboratory).

(3) SYLLABUS

1. Metal ions in living organisms
   Why certain metals can be found in living organisms and their metabolism.
   How do fundamental principles of inorganic chemistry and coordination chemistry apply to understanding the structure and function of metal-containing regions in biological molecules (mainly proteins) and topics related to toxicity and pharmaceutical activity of metal compounds.
   The role of metal ions in biological systems, the biological periodic table, essential and non-essential elements.

2. MetalloProtein Function
   A. Managing, storing and transporting molecular oxygen (breathing)
   B. Transfer of electrons (photosynthesis)
   C. Molecular oxygen management - its involvement in enzymes
   Metalloproteins, enzymes, non-protein systems, metal transport, metal storage.

3. Anticancer Drugs
   Anti-cancer drugs based on platinum and mechanisms of action. Optimization. Metallo-pharmaceuticals, cis-platinum and others, Ru.

4. Nucleic Acid Metal Ion Interaction Chemistry
   The toxicity of metal ions also arises from their reactions with nucleic acids.
   They interfere with metal-regulatory proteins by blocking gene expression
   Synthesis of new anticancer drugs based on cisplatin.
   Diagnostic reagents for the structure and function of DNA.
   Nature has chosen Fe to bleomycin to target and cause damage to foreign DNA, Zn to Zn-finger proteins to bind to DNA and regulate transcription.
   Metal ions and DNA, metallo-genome.

5. Peptide-based metal ion complexes
The importance of metal ions in biological systems is studied:
Proteins - enzymes, Models - peptides, Bioorganic Chemistry
Amino acids, peptides and proteins and their interactions with metalloids.
6. Interactions of Cu (II) and Ni (II) with Histone Peptide Models
Indirect effect of metalloids on DNA and induced toxicity. Hydrolysis of histones and its products as oxidation catalysts for DNA bases.
Histones, histone hydrolysis, oxidation of DNA bases.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND</td>
<td>e-mail communication with the students, Power point presentations, Additional notes-exercises websites.</td>
</tr>
<tr>
<td>COMMUNICATIONS TECHNOLOGY</td>
<td></td>
</tr>
<tr>
<td>USE OF ICT in teaching,</td>
<td></td>
</tr>
<tr>
<td>laboratory education,</td>
<td></td>
</tr>
<tr>
<td>communication with students</td>
<td></td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td></td>
</tr>
<tr>
<td>The manner and methods of</td>
<td></td>
</tr>
<tr>
<td>teaching are described in</td>
<td></td>
</tr>
<tr>
<td>detail.</td>
<td></td>
</tr>
<tr>
<td>Lectures, seminars,</td>
<td></td>
</tr>
<tr>
<td>laboratory practice,</td>
<td></td>
</tr>
<tr>
<td>fieldwork, study and analysis</td>
<td></td>
</tr>
<tr>
<td>of bibliography, tutorials,</td>
<td></td>
</tr>
<tr>
<td>placements, clinical practice,</td>
<td></td>
</tr>
<tr>
<td>art workshop, interactive</td>
<td></td>
</tr>
<tr>
<td>teaching, educational visits,</td>
<td></td>
</tr>
<tr>
<td>project, essay writing,</td>
<td></td>
</tr>
<tr>
<td>artistic creativity, etc.</td>
<td></td>
</tr>
<tr>
<td>The student's study hours for</td>
<td></td>
</tr>
<tr>
<td>each learning activity are</td>
<td></td>
</tr>
<tr>
<td>given as well as the hours of</td>
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</tr>
<tr>
<td>non-directed study according</td>
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<tr>
<td>to the principles of the</td>
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<tr>
<td>ECTS</td>
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</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>39</td>
</tr>
<tr>
<td>Individual study,</td>
<td>51</td>
</tr>
<tr>
<td>preparation</td>
<td></td>
</tr>
<tr>
<td>Writing a paper to present</td>
<td>35</td>
</tr>
</tbody>
</table>

Course total
(25 hours of workload per credit unit) 125

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure
Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other
Specifically-defined evaluation criteria are given, and if and where they are accessible to students.

Students are evaluated (in Greek) by presenting to the teaching committee and individual public audience of a project and by final written examination. The exams include questions and problems (multiple choice, short response, problem solving)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (first in Greek):

**Additional Material**
Metal Ions in Biological Systems, 43 Vol. Set, CRC Press.

-Related Scientific Journals:

COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
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</tr>
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<td>COURSE CODE</td>
<td>ΧΗΕ 305</td>
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<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
<td>Peptide Chemistry</td>
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</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
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</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE
specialization, skills development

PREREQUISITE COURSES:
No

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:
Yes

COURSE WEBSITE (URL):
No

(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, descriptive level 6 of the European Qualifications Framework, students should be able to:
- Understand the basic principles governing Peptide chemistry, in particular amino acid analysis methods, amino acid sequencing, (Peptide bond, secondary structure, tertiary structure, quaternary structure), methods of peptide structure analysis (ORD, CD, NMR, X-ray crystallography) and prediction of the structure of the peptides.
- Rational design of model peptides as organocatalysts in asymmetric synthesis. Applications in aldol reactions and Mannic reactions. Mechanistic implications.
Knowledge

- Knowledge and understanding of the basic concepts, principles and theories governing Peptide chemistry
- Knowledge and understanding of methods of peptide synthesis and analysis of the structure of peptides.
- Knowledge of the use of international literature.

Skills

- Skills in peptide synthesis and analysis of peptide structure.
- Advanced problem-solving skills through data analysis of international literature.

Abilities

- Ability to apply his / her knowledge in dealing with problems related to Peptide chemistry 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 | Project planning and management |
| information, with the use of the necessary technology | Respect for difference and multiculturalism |
| Adapting to new situations | Respect for the natural environment |
| Decision-making | Showing social, professional and ethical responsibility and sensitivity to gender issues |
| Working independently | Production of free, creative and inductive thinking |
| Team work | Criticism and self-criticism |
| Working in an international environment | Production of new research ideas |
| Working in an interdisciplinary environment | Others... |
| Production of new research ideas | ...... |

Theoretical thinking and ability to translate theory into practice.

- Ability to apply knowledge acquired during the study period and related courses of the curriculum of the Department of Chemistry.
- Ability to search, analyze and synthesize data and information from international bibliography and use the necessary technologies related to the presentation of research results.
- Acquiring the appropriate theoretical and practical knowledge base to allow further education at postgraduate level of specialization and doctorate.
- Working in an interdisciplinary environment.
- Ability to work together at team level to achieve these goals.

(3) SYLLABUS

Rational design of model peptides as organocatalysts in asymmetric synthesis. Applications in aldol reactions and Mannich reactions. Mechanistic implications.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td>
<td>Use of PowerPoint in lectures.</td>
</tr>
<tr>
<td>THE TEACHING METHODS</td>
<td></td>
</tr>
<tr>
<td>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></td>
</tr>
<tr>
<td></td>
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<tr>
<td>ACTIVITY</td>
<td>SEMESTER WORKLOAD</td>
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<tr>
<td>LECTURES</td>
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<tr>
<td>THE STUDENT'S STUDY HOURS</td>
<td>73</td>
</tr>
<tr>
<td>COURSE TOTAL</td>
<td>125</td>
</tr>
</tbody>
</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, etc.

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

Written examination (100%) in Greek, with open-ended questions and problem solving

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  Peptide Chemistry, M. Bodanszky

- Related academic journals:
  Journal of Peptide Science
(1) GENERAL

<table>
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<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
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<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
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<tr>
<td>LEVEL OF STUDIES</td>
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<td>COURSE TITLE</td>
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**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.

<table>
<thead>
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<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>6</td>
<td>5</td>
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</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

**COURSE TYPE**

- Specialization
- General background, special background, specialised general knowledge, skills development

**PREREQUISITE COURSES:**

- No

**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

Following the successful completion of the course, the descriptive marker 6 of the European Qualifications Framework, students should be able to:

Understand and apply the basic principles governing biochemical analysis by instrumental analytical techniques.

**Knowledge**

- Knowledge and correct understanding of the underlying concepts, principles and theories
- Knowledge and understanding of the main parts of the analytical analyzes

**Provisions**

- Knowledge and understanding of the molecular approaches of molecular biology, Chemistry and Biochemistry
- Knowledge of the use and search of international bibliography

**Skills**

- Skills in choosing and using the appropriate combination of techniques for study and
solving complex problems of Biochemistry and Molecular Biology

- Development of analytical methods adapted to the requirements of its uterus of each sample, for the determination of constituents
- Comprehensive problem-solving skills through international data analysis Bibliography

**Abilities**

- Ability to understand bibliographic sources and use the appropriate resources,
- Methodology based on the infrastructures and available reagents of a biochemical Laboratory
- Ability to choose and apply the most appropriate experimental conditions to solve a specific problem at the level of routine analysis as well as research level
- Ability to interact with other students or researchers in chemical matters analysis
- Ability to work together as well as to the independent way of working
- Work opportunities in an international environment

**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?

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

The general skills that the student should have acquired to which the course aims is:

- Experimental skills and ability to translate theory into practice.
- Ability to apply knowledge acquired during the period studies and related courses of the Department’s Chemistry.
- Ability to search, analyze and synthesize data and information from international literature and the use of the necessary technologies related to the presentation of research results.
- Acquiring appropriate experimental and theoretical knowledge background to enable further education at the level postgraduate studies and PhD.
- Working in an interdisciplinary environment.
- Ability to collaborate at team level to achieve the above objectives

(3) SYLLABUS

- Introduction to cultures of cell lines & Determination of inflammatory markers; Activation of A549 cells with LPS. Separation of A549 cell extract proteins. Detection of phospholipase A<sub>2</sub> (PLA<sub>2</sub>) by immunoblotting. Introduction to metabolomics/lipidomics analysis; Hydrolysis of phospholipids by PLA<sub>2</sub> and lipidomic approach using LC-MS. Edman Degradation; Sequence determination of amino acids in peptides and proteins (primary structure). Induction and suppression of yeast α-glycosidase enzyme Saccharomyces cerevisiae. Determination of human ABO blood type from buccal epithelial (cheek) cells and white blood cells found in saliva by PCR: a) DNA isolation, electrophoresis and PCR of the gene that determines the ABO blood group phenotype. b) digestion of these PCR products, electrophoresis, results analysis. Enzymatic kinetics; I. Determination of Km and Vmax of tyrosinase II. Tyrosinase inhibition. Introduction to Flow Cytometry. Determination of Toll Like Receptors (TLRs) in human peripheral blood monocytes by flow cytometry.
(4) TEACHING and LEARNING METHODS – EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to Face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
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<tr>
<td>Laboratory Exercise</td>
<td>55</td>
</tr>
<tr>
<td>Written assignment</td>
<td>25</td>
</tr>
<tr>
<td>Course total</td>
<td>100</td>
</tr>
</tbody>
</table>

Students are assessed on the basis of:
A) performance in the performance and understanding of the experiment during the laboratory exercise on the degree of understanding and assimilation of theoretical knowledge, the control of the laboratory performance and skill required to perform the experiments and includes:
  i) short answer questions
  ii) answers to questions of theoretical background and judgment
  iii) critical assessment of the results

B) Writing individual work that includes recording and interpreting experimental results

C) Oral examination including:
  • questions of understanding of each laboratory exercise
  • questions to understand the theoretical background and exercise
  • Judgement Questions

The final score is as follows:
70% (A + B) + 30% (C)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

<table>
<thead>
<tr>
<th>ΒΑΣΙΚΕΣ ΑΡΧΕΣ ΚΥΤΤΑΡΙΚΗΣ ΒΙΟΛΟΓΙΑΣ</th>
<th>ALBERTS B., BRAY D., HOPKIN K., JOHNSON A., LEWIS J., RAFF M., ROBERTS K., WALTER P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΠΡΟΧΩΡΗΜΕΝΟ ΕΡΓΑΣΤΗΡΙΟ ΒΙΟΧΗΜΕΙΑΣ</td>
<td>ΣΗΜΕΙΩΣΕΙΣ ΤΩΝ ΔΙΔΑΣΚΟΝΤΩΝ (Β’ έκδοση 2016)</td>
</tr>
<tr>
<td></td>
<td>ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ (ΣΗΜΕΙΩΣΕΙΣ)</td>
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</table>

- Related academic journals:
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΧΗΕ504</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>7th</td>
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<tr>
<td>COURSE TITLE</td>
<td>ENVIRONMENTAL PROTECTION TECHNOLOGY</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LECTURES</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
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</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Specialized knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREREQUISITE COURSES:</td>
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</tr>
<tr>
<td>LANGUAGE OF INSTRUCTION</td>
<td>GREEK</td>
</tr>
<tr>
<td>and EXAMINATIONS:</td>
<td></td>
</tr>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>YES</td>
</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td>-</td>
</tr>
</tbody>
</table>

(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 the successful completion of the course, descriptive level 6 of the European Qualifications Framework for Lifelong Learning, the students will be capable to:

- Understand deeply the principal physical and chemical processes taking place in environmental media and environmental protection technologies, the assessment of basic parameters for taking measures and the application of methods and technologies for pollution control and environmental protection.

Learning outcomes:
- Knowledge and understanding of basic principles and theories related to pollution control and environmental protection technologies.
- Knowledge and understanding of physicochemical processes taking place in environmental media.
- Knowledge for applying criteria and measures aiming in pollution control and environmental restoration.
- Knowledge of ecotoxicological concepts and methods of environmental risk.
assessments.

Skills:
• Development and application of quality standards, measures and technologies for pollution control and environmental protection.

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...

• Application of knowledge dealing with methods, techniques and technologies of pollution control and environmental protection-remediation.
• Inquiring of theoretical and practical background for performing further education, postgraduate and doctoral studies.
• Utilization of laboratory infrastructures and equipment for the above-mentioned aims
• Search for, analysis and synthesis of data and information, with the use of the necessary technology
• Theoretical knowledge and bringing-applying theory to practice
• Team work as well as working independently
• Working in an international environment
• Working in an interdisciplinary environment
• Production of new research ideas
• Project planning and management
• Respect for the natural environment

(3) SYLLABUS

Introduction to environmental pollution and environmental protection (environmental chains, environmental crisis, measures for environmental protection). Liquid wastes (physical and chemical charactereristics, quality parameters, self-purification of natural water systems). Purification and treatment of natural waters for the production of potable water (legislation and water remediation processes for human consumption, aeration, filtration, sedimentation, ozonation, adsorption, chlorination, UV-radiation). General principles of liquid wastes treatment (purification methods, steps-levels, purification units and efficiency). Primary and preliminary treatment (mechanical pretreatment, screening, sedimentation, coagulation, flocculation, flotation, filtration). Secondary biological treatment (aerobic and anaerobic biological treatments, conventional activated sludge processes, fluidized biological beds). Tertiary chemical treatment (coagulation-flocculation, filtration, clarification, ion exchange, disinfection). Industrial wastes (Characteristics of industrial wastes and examples of treatment-purification units). Solid wastes and treatment methods and technologies (environmental problems, treatment technologies, management of municipal solid wastes,
industrial solid wastes). Pollution control of airborne particulate matter (dispersion of suspended particles in air, methods and technologies for suspended matter removal, filtration, cyclones, wet scrubbers, electric precipitators, etc). Technologies for air pollutants control (condensation, absorption, adsorption, incineration, chemical oxidation and neutralization, etc.).

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>TEACHING METHODS</th>
<th>STUDENT PERFORMANCE EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face to face, Distance learning, etc.</td>
<td>Use of Technologies of Information and communications in teaching and communication with students.</td>
<td>The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placemements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</td>
<td>Description of the evaluation procedure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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>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>
</tr>
<tr>
<td></td>
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<td></td>
<td>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>Written examination (80%) in Greek with a combination of open-ended questions, multiple choice questionnaires, short-answer questions and written work with public presentation (20%).</td>
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<table>
<thead>
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<th>Activity</th>
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</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (in Greek):
  1) Pollution and Environmental Protection Technologies – T. Albanis, Eds. A. Tziola and Sons,
  2) Ι. Konstantinou, T. Albanis, University of Ioannina (Notes)
  4) 

- Suggested bibliography (in English):

- Related academic journals:
  1) Water Research
  2) Environmental Science and Technology
<table>
<thead>
<tr>
<th></th>
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<tr>
<td>3</td>
<td>Applied Catalysis B: Environmental</td>
</tr>
<tr>
<td>4</td>
<td>Journal of Environmental Chemical Engineering</td>
</tr>
<tr>
<td>5</td>
<td>Journal of Environmental Management</td>
</tr>
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<td>6</td>
<td>Process Safety and Environmental Protection</td>
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<td>7</td>
<td>Waste Management</td>
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COURSE OUTLINE

(1) GENERAL

<table>
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<th>Natural Sciences</th>
</tr>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
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<tr>
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<td>COURSE TITLE</td>
<td>Polymer Science</td>
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**INDEPENDENT TEACHING ACTIVITIES**

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
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</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>general background, special background, specialised general knowledge, skills development</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PREREQUISITE COURSES:</th>
<th>No</th>
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</thead>
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<table>
<thead>
<tr>
<th>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</th>
<th>Greek</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>IS THE COURSE OFFERED TO ERASMUS STUDENTS:</th>
<th>No</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>COURSE WEBSITE (URL):</th>
<th>No</th>
</tr>
</thead>
</table>

(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 will gain basic knowledge on polymer chemistry, classes of polymers and industrial production of polymers. They will also gain knowledge on properties of polymers in solid state and polymer solutions, polymer blends and copolymers. They will learn how to search in literature and analyze data using new technologies. They will also be taught to respect the environment. Their survey and bibliographic work will promote free, creative and inductive thinking.

**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, analysis and synthesis of data and information, by using the proper technologies.
Autonomous work
Respect of natural environment
Promoting free, creative and inductive thinking

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>48</td>
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<td>Written assignment</td>
<td>24</td>
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<tr>
<td>Not guided study</td>
<td>52</td>
</tr>
</tbody>
</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.

Written examination (80%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Χημεία πολυμερών Καραγιαννίδης Γεώργιος Π., Σιδερίδου Ευρήνη 2006, Ζήτη Πελαγία & Σια Ο.Ε. ISBN 960-431-991-4


- Related academic journals:
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
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<tr>
<td>LEVEL OF STUDIES</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
<td>Environmental Geochemistry-Mineralogy</td>
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</table>

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

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<th>WEEKLY TEACHING HOURS</th>
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<tbody>
<tr>
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<td>4</td>
</tr>
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<td></td>
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Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

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<td></td>
<td>general background, special background, specialised general knowledge, skills development</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>PREREQUISITE COURSES:</th>
<th>No</th>
</tr>
</thead>
</table>

| LANGUAGE OF INSTRUCTION | Greek |
|                        |      |
| and EXAMINATIONS:       |       |
| IS THE COURSE OFFERED TO ERASMUS STUDENTS | No |
| COURSE WEBSITE (URL)    | No |

(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

Consolidate knowledge of chemical concepts in environmental geochemistry-mineralogy.
Provide students with a firm foundation of the application of chemistry onto the natural world
Engender in students a deeper understanding of the earth and our surface environment from a chemical perspective.
The students will:
Be able to describe geochemical data in the context of environmental processes
Demonstrate a basic understanding of what controls the concentration of elements in a range of physical environments
Demonstrate understanding of the most important rock forming minerals, where they are found, their quality and how they are formed
Demonstrate insight to the most important processes that leads to the formation of the different types rocks
Understand the processes that control mineral reactivity and stability under environmentally-relevant conditions.
Understand the earth processes which control the abundance and distribution of minerals at the earth’s surface under a range of spatial and temporal scales.
Their survey and bibliographic work will promote free, creative and inductive thinking.

**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
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Search, analysis and synthesis of data and information, by using the proper technologies
- Promoting free, creative and inductive thinking
- Be able to integrate theoretical concepts with their practical applications. Effectively read and critically review scientific literature
- Assess rigorously and critically scientific debates and environmental issues

**(3) SYLLABUS**

Differentiation of and cosmic abundance of elements
Composition of the earth
Geochemistry of igneous rocks, geochemistry of sedimentary rocks, geochemistry of metamorphic rocks
Crystal chemistry – environmental mineralogy- solution-mineral equilibria
The water envelope: oceans
Weathering and soils
Sedimentation and diagenesis

**(4) TEACHING and LEARNING METHODS - EVALUATION**

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
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<tr>
<td>TEACHING METHODS</td>
<td>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>
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<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>Lectures</td>
<td>48</td>
</tr>
<tr>
<td>Written assignment</td>
<td>26</td>
</tr>
<tr>
<td>Not guided study</td>
<td>52</td>
</tr>
<tr>
<td>Course total</td>
<td>126</td>
</tr>
</tbody>
</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 examination (80%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  Introduction to Geochemistry. K. Krauskopf, D. Bird

- Related academic journals:
  Applied Geochemistry, Elsevier
  Geochimica Cosmochimica Acta, Pergamon press
  Geochemistry Exploration Environment Analysis, Lyell collection
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
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</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td></td>
</tr>
<tr>
<td>SEMESTER</td>
<td>7th</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Polymer Chemistry</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>general background, special background, specialised general knowledge, skills development</td>
<td></td>
</tr>
</tbody>
</table>

PREREQUISITE COURSES:

No

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS:

No

COURSE WEBSITE (URL):

No

(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 will gain basic knowledge on polymer chemistry, classes of polymers and industrial production of polymers. They will also gain knowledge on properties of polymers in solid state and polymer solutions, polymer blends and copolymers. They will learn how to search in literature and analyze data using new technologies. They will also be taught to respect the environment. Their survey and bibliographic work will promote free, creative and inductive thinking.

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, analysis and synthesis of data and information, by using the proper technologies.
Autonomous work
Respect of natural environment
Promoting free, creative and inductive thinking

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
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<tr>
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<td>48</td>
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<td>Written assignment</td>
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<tr>
<td>Not guided study</td>
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</tr>
<tr>
<td>Course total</td>
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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.

Written examination (80%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Χημεία πολυμερών Καραγιαννίδης Γεώργιος Π., Σιδερίδου Ειρήνη 2006, Ζήτη Πελαγία & Σια Ο.Ε. ISBN 960-431-991-4


- Related academic journals:
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
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<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
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<tr>
<td>COURSE CODE</td>
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</tr>
<tr>
<td>SEMESTER</td>
<td>7th</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Statistical Data Treatment and Quality Control in Chemical Analysis</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>4</td>
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</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>General background, specialization, skills development</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREREQUISITE COURSES:</td>
<td>No</td>
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<tr>
<td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td>
<td>Greek</td>
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<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>Yes</td>
</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td>No</td>
</tr>
</tbody>
</table>

(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 will gain basic knowledge on analytical chemistry topics relevant to chemometrics, quality control and quality assurance. Scientists who wish to design and conduct their experiments properly and extract as much information from the results will obtain such skills and will be benefitted. The course is intended to be of value to the rapidly growing number of students specializing in analytical chemistry, and to those who use analytical methods routinely in everyday laboratory work. Students will develop competences on new ‘chemometric’ tools and procedures, all of them made practicable by improved computing facilities. The course will give the student a flavour of the potential of these newer statistical methods in practical applications such as environmental, food, pharmaceutical, biological analysis, metabolomics etc. Overall the course will offer substantial understanding of the new chemometric methods and further data interpretation, and will promote free, creative and inductive thinking.

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
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  
......  
......

Search, analysis and synthesis of data and information, by using the proper technologies  
Working independently  
Team work  
Promoting free, creative and inductive thinking  
Understanding analytical science, statistics, chemometrics and demonstrate a coherent understanding of these practises  
Inquiry and problem solving, critically analyse and solve problems in analytical chemistry, food chemistry, environmental chemistry, pharmaceutical analysis, etc  
Personal and professional responsibility, be accountable for individual learning and scientific work

(3) SYLLABUS

Introduction and terminology, Descriptive statistics, Normal (Gaussian) distribution, lognormal distribution, null hypothesis – significance test, identification and rejection of outliers (Q-test), calibration methods, regression analysis, analysis of variance (ANOVA), control charts, interlaboratory testing-Youden plot, uncertainty assessment, introduction to experimental design

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>Activity</td>
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<tr>
<td>Lectures</td>
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<tr>
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<tr>
<td>Not guided study</td>
<td>43</td>
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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.

Written examination in Greek, with multiple choice questionnaires and short-answer questions.

(5) ATTACHED BIBLIOGRAPHY
Suggested bibliography:
- ΣΤΑΤΙΣΤΙΚΗ ΕΠΕΞΕΡΓΑΣΙΑ ΚΑΙ ΔΙΑΣΦΑΛΙΣΗ ΠΟΙΟΤΗΤΑΣ ΣΤΗ ΧΗΜΙΚΗ ΑΝΑΛΥΣΗ
  Κ. ΣΤΑΛΙΚΑΣ, Β. ΣΑΚΚΑΣ, ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΟΑΝΝΙΝΩΝ (ΣΗΜΕΙΩΣΕΙΣ)

Related academic journals:
- Analytical Chemistry
- Journal of Chromatography
- Analytica Chimica Acta
- Journal of Chemometrics
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
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<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
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<tr>
<td>COURSE CODE</td>
<td>ΧΗΕ 212 (7.1.1)</td>
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<tr>
<td>SEMESTER</td>
<td>7th</td>
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<tr>
<td>COURSE TITLE</td>
<td>Analytical techniques for the characterization of solids and applications</td>
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</table>

<table>
<thead>
<tr>
<th>INDEPENDENT TEACHING ACTIVITIES</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>4</td>
<td>5</td>
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</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>general background, special background, specialised general knowledge, skills development</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>PREREQUISITE COURSES:</th>
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</thead>
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<table>
<thead>
<tr>
<th>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</th>
<th>Greek</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>IS THE COURSE OFFERED TO ERASMUS STUDENTS:</th>
<th>Yes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>COURSE WEBSITE (URL)</th>
<th>No</th>
</tr>
</thead>
</table>

(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 will gain basic knowledge on analytical techniques for the characterization of solids and applications (Introduction to solid catalysts and surface catalysis. Determination of physical and chemical characteristics of solid catalysts and supports. Zeolitic materials and applications: structure and composition, physical-chemical properties and applications, synthesis-modification, acidity, methods for chemical analysis and characterization of zeolitic materials). They will learn how to search in literature and analyze data using new technologies. Their survey and bibliographic work will promote free, creative and inductive thinking.

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?

- 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...
- Others...
- Others...
Search, analysis and synthesis of data and information, by using the proper technologies.
Working independently
Team work
Respect of natural environment
Promoting free, creative and inductive thinking

(3) SYLLABUS

Introduction to solid catalysts and surface catalysis. Determination of physical and chemical characteristics of solid catalysts and supports. Zeolitic materials and applications: structure and composition, physical-chemical properties and applications, synthesis-modification, acidity, methods for chemical analysis and characterization of zeolitic materials.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
</tbody>
</table>

Use of PowerPoint in lectures. Communication via email.

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Written assignment</td>
<td>25</td>
<td></td>
</tr>
<tr>
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<td>50</td>
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<td>Course total</td>
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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.

Written examination (80%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1.  Α. Σ. Λυκουργιώτης, Εισαγωγή στην κατάλυση επαφής, επιλογή, σύνθεση και χαρακτηρισμός της υφής των στερεών καταλυτών, Τόμος 1, εκδόσεις Α. Σταμούλης, 1987.

### Related academic journals:
1. Analytical Chemistry (ACS Publications)
2. Studies in Surface Science and Catalysis (Elsevier)
3. Industrial & Engineering Chemistry Research (ACS)
4. Microporous and Mesoporous Materials (Elsevier)
5. Journal of Catalysis (Elsevier)
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
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<tr>
<td>COURSE CODE</td>
<td>ΧΗΕ 219</td>
</tr>
<tr>
<td>(8.1.2)</td>
<td>SEMESTER</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Applied Electrochemistry. Development of Chemical Sensors and Biosensors</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>4</td>
<td>5</td>
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</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>General background, specialization, skills development</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREREQUISITE COURSES:</td>
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<tr>
<td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td>
<td>Greek</td>
</tr>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>Yes</td>
</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td>No</td>
</tr>
</tbody>
</table>

(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 will gain basic knowledge on the following topics: Cyclic Voltammetry, Chrono-coulometry and Electrochemical Impedance Spectroscopy. Principle and applications of the most widely used electrochemical methods in the development of chemical sensors and biosensors. Small molecules and Enzyme Immobilization onto electrodes or other platforms. This is the most important step at the construction of a sensor, as (bio)molecules induce specific recognition/catalytic properties. Development of a chemical amperometric sensor. A detailed study. Development of an enzyme amperometric biosensor. Different types of biosensors. Glucose commercial biosensors. Impedimetric sensors and immunosensors. Capacitive and faradic impedimetric (bio)sensors.

**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
- Decision-making
- Adapting to new situations
- Working independently
- Team work
- 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
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

Production of free, creative and inductive thinking

Search, analysis and synthesis of data and information, by using the proper technologies.

Working independently
Team work
Respect of natural environment
Promoting free, creative and inductive thinking
Understanding analytical science, demonstrate a coherent understanding of analytical chemistry

Depth and breadth of analytical chemistry knowledge
Inquiry and problem solving, critically analyse and solve problems in analytical chemistry
Personal and professional responsibility, be accountable for individual learning and scientific work in analytical chemistry

(3) SYLLABUS

Introduction in electrochemistry. Cyclic Voltammetry, Chrono-coulometry and Electrochemical Impedance Spectroscopy. Principle and applications of the most widely used electrochemical methods in the development of chemical sensors and biosensors. Small molecules and Enzyme Immobilization onto electrodes or other platforms. This is the most important step at the construction of a sensor, as (bio)molecules induce specific recognition/catalytic properties. Development of a chemical amperometric sensor. A detailed study. Development of an enzyme amperometric biosensor. Different types of biosensors. Glucose commercial biosensors. Impedimetric sensors and immunosensors. Capacitive and faradic impedimetric (bio)sensors.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
</table>

| USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY | Use of PowerPoint in lectures.
Communication via email. |

| 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. |

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>50</td>
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<tr>
<td>Written assignment</td>
<td>25</td>
</tr>
<tr>
<td>Not guided study</td>
<td>50</td>
</tr>
</tbody>
</table>

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.

Written examination (80%) in Greek.
Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY
M.I. Prodromidis “Electrochemical Sensors and Biosensors”, KOSTARAKI, ATHENS 2014 (In Greek)

-Web sources:
http://www.news-medical.net/health/What-are-Biosensors.aspx
http://www1.lsbu.ac.uk/water/enztech/biosensors.html
http://www.gwent.org/presentations/biointro.pdf
http://www.powershow.com/view/1/224724-ZDc1Z/BIOSENSOR_powerpoint_ppt_presentation

-Related literature:

Introduction to Biosensors

Biosensors : Properties, Materials and Applications,

Chemical Sensors : Properties, Performance and Applications

Implantable Sensor Systems for Medical Applications

Biosensors Nanotechnology

-Journals:
Analytical Chemistry
Sensors and Actuators
Biosensors and Bioelectronics
Lab-on-a-chip
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Chemistry</td>
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<td>LEVEL OF STUDIES</td>
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<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
<td>CHEMISTRY OF NANOMATERIALS AND APPLICATIONS</td>
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INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

| Scientific field / Skill development |

PREREQUISITE COURSES:

Knowledge of Physical Chemistry and basic aspects of Inorganic and Organic Chemistry

LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek (All material in powerpoint is in english)

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

After completion of this course, the students should be able to:

- Understand the basic principles of Chemistry and Materials Science in molecular and supramolecular level
- Understand the optical/electrical/structural properties of either organic or inorganic nanostructures
- Understand the basic principles of light-matter interaction and mainly the photophysical/photochemical processes
- Interpret UV-Vis, fluorescence, phosphorescence spectra, excited states of molecular systems and correlate spectral data with energy differences between ground and excited states
- Apply the appropriate photophysical technique in various research related problems.

Knowledge
• Knowledge and understanding of the basic principles and theories which are related with the field of chemistry and materials science.

• Knowledge and understanding of the basic principles and theories which are related with the field of molecular photochemistry.

• Knowledge and understanding of applied spectroscopic techniques, such as UV-Vis, fluorescence, phosphorescence to assess energy parameters in molecular systems.

• Knowledge in utilization of spectroscopic data from international literature.

Skills
• Skills concerning the understanding and elaboration of UV-Vis, fluorescence, phosphorescence spectra.

• Utilization of appropriate spectroscopic method for solving photophysical and photochemical problems

• Complex skills of resolving problems through data analysis of international literature.

Capabilities
• Capability to implement the knowledge to solve problems, which belong to the fields of chemistry and materials science.

• Capability to interact with colleagues or researchers in issues concerning chemistry and materials science.

• Capability to implement the knowledge to solve problems, which belong to the fields of photophysics and photochemistry.

• Capability to interpret the spectral data from UV-Vis, fluorescence, phosphorescence spectra and extract various energy parameters.

• Capability to interact with colleagues or researchers in issues concerning photophysics and photochemistry.

• Capability to choose and apply the most appropriate spectroscopic methods to sole a specific problem

• Capability in team work as well as an individual person.

• Capabilities of working in an international professional environment.

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

The general capabilities which should be obtained by the student are:
• Theoretical thinking and the ability to convert the knowledge of theory into calculation of experimental parameters.
• Ability to implement knowledge obtained during study into related lessons taught in the department.
• Ability to search, analyze and synthesize data and information from international literature and utilization of appropriate technologies related to the presentation of research results.
• Obtaining the appropriate practical background of knowledge in order to be able to follow lessons in postgraduate level.
• Work in multidisciplinary environment.
• Ability to collaborate as a team for managing the aforementioned goals.

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Auditorium</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td>➢ Utilization of power point for lectures.</td>
<td></td>
</tr>
<tr>
<td>➢ projects.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>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>Lectures</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Individual projects</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Study, preparation</td>
<td>25</td>
</tr>
</tbody>
</table>

| Course total (15 work hours per credit unit) | 75 |

| STUDENT PERFORMANCE EVALUATION | The evaluation of students is done by combining: I. Written/oral final exam (60%) which contains: |
| Description of the evaluation procedure | |

I. Written/oral final exam (60%) which contains:
<table>
<thead>
<tr>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
</tr>
</tbody>
</table>

- Problem development
- Short response questions
- Critical questions
- Problem solving.

Preparation of personal report (40%)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>XHE814</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8th</td>
</tr>
</tbody>
</table>

COURSE TITLE: Valorization of natural resources and energy

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE: Specialization

PREREQUISITE COURSES: No

LANGUAGE OF INSTRUCTION and EXAMINATIONS: Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS: No

COURSE WEBSITE (URL): No

(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 will gain basic knowledge in issues of Natural Resources, unit operations applied in ore enrichment and metallurgy but mainly on issues of Fossil Fuels, Renewable Energy resources, Green Chemistry and Green Chemical Technology and Sustainability. The students will learn to search in literature and analyze data using new technologies. They will also be taught to respect the environment. Their survey and bibliographic work will promote free, creative and inductive thinking.

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, analysis and synthesis of data and information, by using the proper technologies.

Respect of natural environment

Promoting free, creative and inductive thinking

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>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>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>48</td>
</tr>
<tr>
<td>Written assignment</td>
<td>24</td>
</tr>
<tr>
<td>Not guided study</td>
<td>52</td>
</tr>
</tbody>
</table>

| Course total | 124 |

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</td>
</tr>
</tbody>
</table>

| Written examination (80%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (20%). |

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Related academic journals:
(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>School of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td></td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8ο</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Basic Elements of Economics</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>3</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE
Field of Science

PREREQUISITE COURSES:

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS

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

In the Basic Elements of Economics, is analyzed the way of organizing and operating the markets and the usual business practices. In particular, the subject is analyzed in three sections. The first section concerns financial accounting and financial statement analysis. The second module concerns the introduction of economic theory and analyzes concepts related to microeconomic analysis (demand theory, supply theory, consumer theory, production theory and market models). The third section analyzes agricultural policy, agricultural cooperatives as well as key elements of the European Union.

After the successful completion of the course, the student will be able to:
1. Understand the basic principles of financial accounting
2. Use the basic accounting tools and prepare financial statements
3. Understand consumer and business behavior issues through the application of fundamental economic concepts and laws.
4. Approach and analyze the causes for the creation of demand and supply of economic units and the formation of the market.
5. Analyze in depth the European agricultural policies.
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...

Searching, analysis and synthesis of facts and information, as well as using the necessary technologies

Adaptation to new situations
Decision making
Autonomous (Independent) work
Group work
Exercise of criticism and self-criticism
Promotion of free, creative and inductive thinking

(3) SYLLABUS

I. Introduction to Financial Statement analysis.
II. Need, development, and definition of accounting; Book-keeping and accounting; Persons interested in accounting; Disclosures; Branches of accounting; Objectives of accounting
III. Balance sheet-assets, liabilities.
IV. Accounting transactions
V. Introduction: Incentives, What is Economics?
VI. Specialization and Trade, Production Possibility Frontier (PPF), Comparative Advantage
VII. Markets, Supply and Demand, Elasticity
VIII. Consumers, Producers, and Surplus
IX. Cost of Production to Firms, Cost Curves, Economies of Scale
X. Types of Competition: Perfect Competition, Monopolies, and Oligopolies
XI. Cooperatives
XII. Common Agricultural Policy.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>USE OF INFORMATION AND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
<td>Lectures, face to face</td>
</tr>
<tr>
<td>COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td>---------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lectures (3 conduct hours per week x 13 weeks)</td>
<td>39</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
<th>Written examination (100%)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Description of the evaluation procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>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>
</tr>
</tbody>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

Χρηματοοικονομική Λογιστική, Γεώργιος Κοντός
Χρηματοοικονομική Λογιστική, Μπαλάς Απόστολος, Χεβάς Δημοσθένης
Μικροοικονομική Μια σύγχρονη προσέγγιση, Varian Hal R
Μικροοικονομική, Besanko David A., Braeutigam Ronald R
Παγκοσμιοποίηση, ΟΝΕ και οικονομική προσαρμογή, Αργείτης Γιώργος
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>XHE 403</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8</td>
</tr>
</tbody>
</table>

### 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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

### COURSE TYPE

- Specialization, skills development

### PREREQUISITE COURSES:

- No

### LANGUAGE OF INSTRUCTION AND EXAMINATIONS:

- Greek

### IS THE COURSE OFFERED TO ERASMUS STUDENTS:

- Yes

### COURSE WEBSITE (URL)

- No

### (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, descriptive level 6 of the European Qualifications Framework, students should be able to:

Understand the basic principles of Biopolymers, in particular properties and levels of structures of biological protein macromolecules, Polysaccharides and lipids.

**Knowledge**

- Knowledge and understanding of the basic concepts, principles and theories governing biopolymers.
- Knowledge and understanding of chemistry and structure of biological macromolecules of proteins, polysaccharides and lipids.
- Knowledge of the use of international literature.

**Skills**
- Skills solving problems related to Biopolymers.
- Skills solving problems through data analysis of international bibliography.

Abilities
Ability to apply his / her knowledge in dealing with problems related to Biopolymers 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?

<table>
<thead>
<tr>
<th>Ability</th>
<th>General Competence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for, analysis and synthesis of data</td>
<td>Project planning and management</td>
</tr>
<tr>
<td>and information, with the use of the</td>
<td>Respect for difference and multiculturalism</td>
</tr>
<tr>
<td>necessary technology</td>
<td>Respect for the natural environment</td>
</tr>
<tr>
<td>Decision-making</td>
<td>Showing social, professional and ethical responsibility</td>
</tr>
<tr>
<td>Working independently</td>
<td>sensitivity to gender issues</td>
</tr>
<tr>
<td>Team work</td>
<td>Criticism and self-criticism</td>
</tr>
<tr>
<td>Working in an international environment</td>
<td>Production of free, creative and inductive thinking</td>
</tr>
<tr>
<td>Working in an interdisciplinary environment</td>
<td>Others...</td>
</tr>
</tbody>
</table>

Theoretical thinking and ability to translate theory into practice.
• Ability to apply knowledge acquired during the study period and related curriculum subjects of the Department of Chemistry.
• Ability to search, analyze and synthesize data and information from international bibliography and use of the necessary technologies related to the presentation of research results.
• Acquiring the appropriate theoretical and practical knowledge base to allow further education at postgraduate level of specialization and doctorate.
• Working in an interdisciplinary environment. Ability to collaborate at team level to achieve these goals.

(3) SYLLABUS

Introduction to Biophysical Chemistry, levels of structures in biological macromolecules, primary, secondary, tertiary, quaternary structure. Examples of myoglobin, hemoglobin. Key questions related to Biophysical Chemistry, sample quality, structural prediction, stability or flexibility of the structure, differentiation of the properties of the structural components of a macromolecule, how to achieve the natural structure of the biopolymers, Structure / biological activity relationship. Protein structure, amino acid properties, side chain ionization, side chain amino acid polarity. Amino acid composition of proteins, predicting properties of a protein by its amino acid composition, complementary protein components. Primary structure, disulfide bonds and crosslinks, primary structure and analysis of the secondary and tertiary structure, primary structure and prediction of the secondary and tertiary structure, primary structure and function. Secondary structure, β sheet structure and other secondary structures, polyproline and collagen helix, tertiary structure, general structure of the peptide backbone, flexibility and stability of the tertiary structure. Quaternary structure. Other biological polymers, polysaccharides and levels of their structures, polymers composed of different types of macromolecules, polysaccharides with peptides, proteins or lipids in bacterial cell walls, glycoproteins in animal cell membranes. Lipids in biological membranes, lipid components of the membranes, lipid bilayers. Proteins in biological membranes. Conformation analysis and interactions that define the protein structure. Polypeptide chain Geometry,

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>The student’s study hours</td>
<td>73</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

Written examination (100%) in Greek, with open-ended questions and problem solving

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
<table>
<thead>
<tr>
<th>BIOPOLYMERS</th>
<th>M. ΣΑΚΑΡΕΛΛΟΥ</th>
<th>ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ (ΣΗΜΕΙΩΣΕΙΣ)</th>
</tr>
</thead>
</table>

- Related academic journals:
  BIOPOLYMERS
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΧΗΕ406</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8th</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Biotechnology</td>
</tr>
</tbody>
</table>

**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.

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<tr>
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<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

**COURSE TYPE**

Specialization/ skills development

**PREREQUISITE COURSES:**

No

**LANGUAGE OF INSTRUCTION and EXAMINATIONS:**

Greek

**IS THE COURSE OFFERED TO ERASMUS STUDENTS:**

Yes

**COURSE WEBSITE (URL)**

http://ecourse.uoi.gr/course/view.php?id=866

### (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
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- Guidelines for writing Learning Outcomes

After successfully completing the course, students should be able to:

Understand the basic principles governing Biotechnology such as:

- methods of genetic improvement of micro-organisms for the purpose of their biotechnological exploitation
- the basic principles of biotechnological product production
- ability to recognize how to design the process of producing biotechnology products
- to use the knowledge for suggesting ways to genetically improve micro-organisms for the production of biotechnology products
- ability to formulate judgments that include reflection on scientific or ethical issues related to the cognitive content of biotechnology

**Knowledge**

- Knowledge and understanding of the basic concepts, principles and theories governing Microbial Biotechnology
- Knowledge and understanding of biotechnology applications.
Knowledge that will imply the ability to critically understand the theories and principles of biotechnology.
• Knowledge of the use of international literature.

Skills
• Skills in solving biotechnology problems

Abilities
• Ability to apply his / her knowledge in dealing with problems related to Biochemistry issues
• Ability to interact with other biotechnology students or researchers.
• Ability to choose and apply the most appropriate methods to solve a specific research problem.
• Promoting free, creative and inductive thinking

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

Theoretical thinking and ability to translate theory into practice.
• Ability to apply knowledge acquired during the study period and related courses of the curriculum of the Department of Chemistry.
• Ability to search, analyze and synthesize data and information from international bibliography and use the necessary technologies related to the presentation of research results.
• Acquiring the appropriate theoretical and practical knowledge base to allow further education at postgraduate level of specialization and doctorate.
• Working in an interdisciplinary environment.
• Ability to work together at team level to achieve these goals.

(3) SYLLABUS

Introduction to biotechnology, substrates for cell growth, substrates as carbon and nitrogen sources for biotechnological products.
Mutagenesis, mutants isolation, Molecular and chemical basis of mutagenesis, DNA damaging, kind of mutants, mutagens (chemical, physical), radiations, DNA repair mechanisms. Recombinant DNA technology, lysogenic cycle, bacterial conjugation, transduction, transformation.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, Distance learning, etc.</td>
</tr>
<tr>
<td>Face to face</td>
</tr>
</tbody>
</table>
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Use of ICT in teaching, laboratory education, communication with students:

- Use of PowerPoint in lectures.
- Communication via email.

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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>Educational visits</td>
<td>10</td>
</tr>
<tr>
<td>Not guided study</td>
<td>63</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure:

- Written examination (100%) in Greek, with open-ended questions and problem solving

ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  - ΒΙΟΤΕΧΝΟΛΟΓΙΑ ΚΥΡΙΑΚΙΔΗΣ ΔΗΜΗΤΡΙΟΣ Α. ΖΗΤΗ ΠΕΛΑΓΙΑ ΚΑΙ ΣΙΑ Ο.Ε.
  - ΕΝΖΥΜΙΚΗ ΒΙΟΤΕΧΝΟΛΟΓΙΑ ΙΩΑΝΝΗΣ ΙΤΕ - ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ
  - ΜΟΡΙΑΚΗ ΒΙΟΛΟΓΙΑ ΤΟΥ ΓΟΝΙΔΙΟΥ JAMES WATSON, TANIA BAKER, STEPHEN BELL, ALEXANDER GANN, MICHAEL LEVINE, RICHARD LOSICK

- Related academic journals:
  - J. Bacteriology
  - Applied Microbiology and Biotechnology
  - Nature Biotechnology
  - Journal of Biotechnology
(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Physical Sciences</th>
</tr>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΧΗΕ804</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Catalysis by metallic complexes - Mechanisms</td>
</tr>
</tbody>
</table>

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>4</td>
</tr>
<tr>
<td>Laboratory</td>
<td>0</td>
</tr>
</tbody>
</table>

WEEKLY TEACHING HOURS and CREDITS

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Special background

PREREQUISITE COURSES

Inorganic Chemistry III

LANGUAGE OF INSTRUCTION

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS

No

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

After the successful completion of course of Level 6 descriptor, student will be able to:

- Understand the basic principles of the Inorganic Reactions Mechanisms and their relation to basic inorganic reactions.
- Have a deep perception some of the most important catalytic reactions of chemistry and how do these are related to stoichiometric inorganic reactions and at the same time to deeper understand the determining steps.

Knowledge

- Knowledge and understanding of the basic principles, meanings and theories related to inorganic reaction mechanisms.
- Knowledge and understanding of the basic principles and meanings of catalytic reactions with industrial importance.

Skills

- Skills in solving problems related to inorganic reaction mechanisms as well as predicting the molecular structure of reaction products of catalytic processes of industrial interest.
- Skills in solving problems related to intermediate reactions, molecular structures and
oxidation states of catalytic reactions.

- Skills in data analysis in order to explain and/or propose the most probable catalytic cycle taking place.
- Complex skills of solving problems by employing data analysis acquired from literature.

### Abilities

- Ability to interact with other students or researchers on topics related to catalytic reaction mechanisms.
- Ability for team work and at the same time autonomous work.
- Ability to work in an international environment.
- Ability to employ its knowledge to deal with problems related to catalytic reactions.
- Ability to combine experimental data with those obtained from literature in order to propose a possible reaction mechanism.
- Ability to choose and employ a certain methodology to solve a specific issue of a reaction mechanism related to the metallic center.

### 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
- Production of free, creative and inductive thinking
- Project planning and management
- Respect for difference and multiculturalism
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking
- Others...

The general skills acquired by the students after attending the course are the following:

- Theoretical conception and ability to transform this theory to practice.
- Ability to employ the acquired knowledge after completed the course as well as of all the related courses taught in earlier semesters.
- Acquire the most suitable theoretical and practical knowledge background to give the opportunity to attend further training in the framework of postgraduate MSs or even PhD studies.
- Ability to cooperate at a team level in order to achieve the above targets.

### (3) SYLLABUS


### (4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Face to face</td>
</tr>
</tbody>
</table>
Use of ICT in teaching, laboratory education, communication with students

Communication with the students via e-mail
Use of Power Point to support teaching
Teaching with projects 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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>28</td>
</tr>
<tr>
<td>Personal study and preparation</td>
<td>52</td>
</tr>
<tr>
<td>Writing small personal thesis</td>
<td>45</td>
</tr>
</tbody>
</table>

Course total: 125

### Student Performance Evaluation

Description of the evaluation procedure

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

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

Students evaluation is performed via:

(i) written final exam (50%) in Greek language comprising:
   - Answering questions
   - Questions with short answers
   - Answering critical thinking questions
   - Solving problems

(ii) Small thesis oral presentation (50%)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:

|---------------------------------------------------|--------------------------------------------------|


-Συναφή επιστημονικά περιοδικά:

ACS: JACS Inorganic Chemistry, Organometallics, ACS Catalysis
RSC: Dalton Transactions
Wiley: European Journal of Inorganic Chemistry
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>XHE807</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>H'</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Contemporary spectroscopic methods for the identification of organic molecules</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TRACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LECTURES</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Specialized knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>general background, special background, specialised general knowledge, skills development</td>
<td></td>
</tr>
</tbody>
</table>

PREREQUISITE COURSES: According to the curriculum of the Department of Chemistry there are no prerequisites, but it is not possible to monitor effectively without the required knowledge of Organic Chemistry I and II

LANGUAGE OF INSTRUCTION and EXAMINATIONS: Greek (possibility of teaching in English). All the power point curriculum is in English.

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

After successfully completing the course, level descriptor 6 of the European Qualifications Framework, students should be able to:
- Understand the basic principles of spectroscopy of organic compounds, especially infrared-visible spectroscopy, vibrational spectroscopy, nuclear magnetic resonance and mass spectrometry, and how they can be used for the identification and solution of structures of unknown organic compounds.
- Explain UV-visible, infrared, nuclear magnetic resonance and mass spectra, identify characteristic spectral peaks, evaluate spectral data by identifying and solving structures of organic compounds.
- Choose and apply the appropriate spectroscopic technique or combination of spectroscopic techniques to solve research problems.

Knowledge
- Knowledge and understanding of the basic concepts, principles and theories related to spectroscopy of organic compounds.
- Knowledge and understanding of applications of UV / Vis spectroscopic methods, IR,
NMR and MS in identifying and solving structures of organic compounds.

- Knowledge of the combined use of UV / Vis, IR, NMR and MS techniques in identifying and solving structures of organic compounds.
- Knowledge of the use of spectroscopic data in the international literature.

**Skills**

- Skills to solve and evaluate UV / Vis, IR, NMR and MS spectra.
- Use of the appropriate spectroscopic method or a combination of methods to solve complex problems of Organic Chemistry.
- Advanced problem solving skills through data analysis of international literature.

**Competences**

- Ability to apply knowledge in dealing with problems related to spectroscopy of organic compounds.
- Ability to interpret spectral data with the use of one or more techniques and to determine the structure of organic compounds.
- Ability to analyze spectroscopic data and investigate structural and conformational properties of the molecules.
- Ability to interact with other students or researchers in solving spectroscopic problems of organic compounds.
- Ability to select and apply the most appropriate spectroscopic methods and relevant methodology to solve specific research problem.
- Ability to work in a team but also individually.
- Job opportunities in an international environment.

**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 | ..... |

The general competences are:

- Theoretical thinking and ability to translate theory into practice.
- Ability to apply knowledge acquired during the study period in related courses of the curriculum of the Department of Chemistry.
- Ability to search, analyze and synthesize data and information from international literature and use the necessary technologies related to the presentation of research results.
- Acquiring the appropriate theoretical and practical knowledge to be able to follow further education at postgraduate and doctoral level.
- Working in an interdisciplinary environment.
- Ability to collaborate at a team level.

**(3) SYLLABUS**

**UV-VIS spectroscopy**

- Introduction to spectroscopic methods of analysis of organic compounds.
- Electromagnetic radiation
- UV radiation and electronic excitation
- Electronic transitions and selection rules
- Spectra and instrumentation - Beer-Lambert Law
- Chromophoric groups
- Visible spectroscopy
- Exercises - Interpretation of UV-VIS spectra

**IR spectroscopy**
- Basic concepts of infrared spectroscopy
- Masses, atoms and springs
- Frequency of infrared vibrations of diatomic molecules
- Absorption bands
- Symmetrical vibration, anti-symmetrical vibration, bending vibration
- Simple harmonic oscillator - Non-harmonic oscillator - Factors influencing infrared vibrational frequencies
- Exercises - Interpretation of infrared spectra of a representative number of organic compounds

**NMR spectroscopy**
- Introduction to NMR spectroscopy - The NMR phenomenon
- Chemical shift
- Characteristic $^1$H NMR chemical shifts
- Integration of $^1$H NMR signals
- Spin-spin coupling constants - Analysis of conformation of organic compounds
- Instrumentation – The NMR spectrometer
- $^{13}$C NMR spectroscopy
- Fourier Transform NMR Spectroscopy
- Relaxation processes
- NMR time scale - Study of chemical exchange phenomena
- Principles of two-dimensional NMR spectroscopy
- Exercises - interpretation of NMR spectra of a representative number of organic compounds

**MS mass spectrometry**
- Principles of MS spectrometry
- Ionization energies of valence electrons
- Basic instrumentation of mass spectrometers
- Peaks of molecular ions
- The mass spectrum
- Isotopes
- Ion production methods
- Peaks M + 2 and M + 1
- High resolution mass spectrometry
- Fission fragments
- Exercises - interpretation of MS spectra of a representative number of organic compounds
Combined exercises
- Exercises for combined use of UV / Vis, IR, NMR and MS spectroscopic methods.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to Face</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Practical application and demonstration at the NMR Center of the University of Ioannina</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</th>
<th>Use of Technologies of Information and communications in teaching and communication with students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teaching with the project method.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEACHING METHODS</th>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lectures</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Written assignment</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Individual study, preparation</td>
<td>25</td>
</tr>
<tr>
<td>Course total</td>
<td></td>
<td>125</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written examination (80%) in Greek with a combination of open-ended questions, multiple choice questionnaires, short-answer questions and written work with public presentation (20%).</td>
</tr>
</tbody>
</table>

The evaluation of the students is done by written final examination (evaluation) in Greek which includes:

I. Written / oral final examination (60%) comprising:
- the development of topics
- short answer questions
- answers to crisis questions
- a problem solving.

II. Atomic Work Presentation (Concluding Assessment) (40%).

(5) ATTACHED BIBLIOGRAPHY

- Proposed Electronic Bibliography:
  1. http://www.rsc.org/learn-chemistry/collections/spectroscopy/introduction#IRSpectroscopy
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>5.</td>
<td><a href="https://www.utdallas.edu/~scortes/ochem/OChem_Lab1/recit_notes/ir_Presentation.pdf">https://www.utdallas.edu/~scortes/ochem/OChem_Lab1/recit_notes/ir Presentation.pdf</a></td>
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<td>6.</td>
<td><a href="https://drive.google.com/folderview?id=0B3uVX4mPJSC1WFVuWkloUUVyMU0&amp;usp=preview&amp;tid=0B3uVX4mPJSC1Y3hOLWh0VUNBbzA#list">https://drive.google.com/folderview?id=0B3uVX4mPJSC1WFVuWkloUUVyMU0&amp;usp=preview&amp;tid=0B3uVX4mPJSC1Y3hOLWh0VUNBbzA#list</a></td>
</tr>
<tr>
<td>10.</td>
<td><a href="https://www.youtube.com/watch?v=NuIH9-6Fm6U">https://www.youtube.com/watch?v=NuIH9-6Fm6U</a></td>
</tr>
<tr>
<td>12.</td>
<td><a href="https://www.youtube.com/watch?v=tOGM2gOHKpC">https://www.youtube.com/watch?v=tOGM2gOHKpC</a></td>
</tr>
<tr>
<td>13.</td>
<td><a href="http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/maspec.html#c1">http://hyperphysics.phy-astr.gsu.edu/hbase/magnetic/maspec.html#c1</a></td>
</tr>
</tbody>
</table>

- **Books:**

- **Scientific Journals:**
  1) Journal of Chemical Education
  2) Concepts in Magnetic Resonance
  3) Magnetic Resonance in Chemistry
  4) Journal of Molecular Structure.
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
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<td>COURSE CODE</td>
<td>8.2.2</td>
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<tr>
<td>SEMESTER</td>
<td>8th</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>BIOINORGANIC APPLICATIONS</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOR THE WHOLE COURSE</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE

Scientific area, special background, specialised general knowledge

PREREQUISITE COURSES:

NONE

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

The aim of the course is to teach and embody the most common applications in the field of Bioinorganic Chemistry and in the field of Biological Inorganic Chemistry.

Upon successful completion of the course, students should be able to,
1. recognize the contribution of metallobiomolecules in the development of chemistry and other related disciplines,
2. evaluate the applications of metallobiomolecules as metallotherapeutics,
3. recognize and understand the applications of metallobiomolecules as photo-activated drugs,
4. recognize and understand the applications of metallobiomolecules as diagnostics,
5. recognize and understand the applications of metallobiomolecules in toxicology
6. recognize and understand the applications of metallobiomolecules as bio-mimetic catalyst and materials
Knowledge
Knowledge and understanding of the basic concepts, principles and theories related to applied Bioinorganic Chemistry.

Skills
Skills in the relationship of theory-application, in the field of the Bioinorganic Chemistry.

Abilities
Ability to apply the provided knowledge for the development novel Bioinorganic applications.
Ability to accurately assess - selects the data provided to solve complex problems.
Ability to work independently and to interact with other students.

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?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>Individual study, preparation</td>
<td>73</td>
</tr>
</tbody>
</table>

The general competencies that the student should have acquired and to which the course is aimed are:
Search, analyze and evaluate data-information and make decisions.
Conversion of theory into practice.
Promote free, creative and inductive thinking.
Autonomous and teamwork as well.
Acquiring the appropriate theoretical background knowledge to enable further education both at a theoretical level (in more specific topics of Inorganic Chemistry) and in a laboratory.

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>e-mail communication with the students Additional notes-exercises websites.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>Individual study, preparation</td>
<td>73</td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>Course total</th>
<th>125</th>
</tr>
</thead>
<tbody>
<tr>
<td>(25 hours of workload per credit unit)</td>
<td></td>
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</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.

Students are evaluated (in Greek) by presenting to the teaching committee and individual public audience of a project and/or by final written examination. The exams include questions and problems (multiple choice, short response, problem solving)

---

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (most in Greek):

–Related journals:
  Journal of Biological Inorganic Chemistry
  Journal of Inorganic Biochemistry
  Bioinorganic Chemistry & Applications
  Inorganic Chemistry
  Dalton Transactions
  Inorganica Chimica Acta
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>DEPARTMENT OF CHEMISTRY</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>UNDERGRADUATE</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>XHE 611</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>FOOD BIOCHEMISTRY AND BIOTECHNOLOGY</td>
</tr>
</tbody>
</table>

#### INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Specialized general knowledge, skills development</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PREREQUISITE COURSES:</th>
<th>No</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</th>
<th>Greek</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>IS THE COURSE OFFERED TO ERASMUS STUDENTS</th>
<th>Yes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>COURSE WEBSITE (URL)</th>
</tr>
</thead>
</table>
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, level 6 of the European Qualifications Framework students will be able to comprehend the basic principles of the biochemistry of raw foods, of food indigenous enzymes, of the use of enzymes in food technology, of activities of food indigenous microorganisms, of the use of microorganisms in food technology, health-related properties of food constituents, and of functional foods.

Moreover, they will be able to solve problems and exercises related to the subjects of the course, and to correlate activities of enzymes, microorganisms and bioactive compounds with properties and characteristics of foods.

They will be able to conduct a literature search using modern technologies.

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. Working independently. Criticism and self-criticism. Production of free, creative and inductive thinking.

(3) SYLLABUS

## (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.

Use of power point in lectures. Use of ICT technologies in communication with students.

### 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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures, seminars, educational visits</td>
<td>26</td>
</tr>
<tr>
<td>Study and analysis of bibliography, essay writing</td>
<td>34</td>
</tr>
<tr>
<td>Not guided study</td>
<td>65</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

### STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

- The language of evaluation is Greek. The total evaluation consists of a) written examination (65 %), with open-ended questions, short-answer questions and multiple choice questionnaires, and b) written work, public presentation (35 %).

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.
### (5) ATTACHED BIBLIOGRAPHY

<table>
<thead>
<tr>
<th>- Suggested bibliography:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FOOD BIOCHEMISTRY</strong></td>
</tr>
<tr>
<td><strong>FOOD BIOTECHNOLOGY</strong></td>
</tr>
<tr>
<td><strong>FOOD BIOCHEMISTRY AND BIOTECHNOLOGY</strong></td>
</tr>
</tbody>
</table>

- Related academic journals:
  1. Journal of Food Biochemistry
  2. Food Biotechnology
  4. Food Technology and Biotechnology

- Related books:
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
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</table>

**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.

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<th>WEEKLY TEACHING HOURS</th>
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<td>4</td>
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</tbody>
</table>

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:**

No

**LANGUAGE OF INSTRUCTION**

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.

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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. Criticism and self-criticism. Production of free, creative and inductive thinking.

(3) SYLLABUS

## DELIVERY

Face-to-face, Distance learning, etc.

## USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

Use of ICT in teaching, laboratory education, communication with students.

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<tr>
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<td></td>
</tr>
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</table>

Course total 125

## STUDENT PERFORMANCE EVALUATION

The language of evaluation is Greek. The total evaluation consists of a) written examination (65 %), with open-ended questions, short-answer questions and multiple choice questionnaires, and b) written work, public presentation (35 %).

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**- Suggested bibliography:**

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<th>Subject</th>
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<th>Publisher</th>
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<tbody>
<tr>
<td>FOOD BIOCHEMISTRY</td>
<td>VAFOPOLLOU-MASTROGIANNAKI A.</td>
<td>Ziti Publishing, 2003</td>
</tr>
<tr>
<td>FOOD BIOTECHNOLOGY</td>
<td>ROUKAS T.</td>
<td>Giachoudis Publishing 2009</td>
</tr>
<tr>
<td>FOOD BIOCHEMISTRY AND BIOTECHNOLOGY</td>
<td>ROUSSIS I.</td>
<td>UNIVERSITY OF IOANNINA (ΖΗΜΕΙΩΣΕΙΣ)</td>
</tr>
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**- Related academic journals:**
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**- Related books:**
# COURSE OUTLINE

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<tr>
<td>COURSE CODE</td>
<td>ΧΗΥ 844</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8th</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>MODERN TECHNIQUES OF QUANTUM AND STATISTICAL MECHANICS</td>
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### INDEPENDENT TEACHING ACTIVITIES

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<td></td>
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</tr>
</tbody>
</table>

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:

The Department’s curriculum does not require any prerequisite courses. However, the essential attendance and participation in the course lectures presupposes the assimilation of basic mathematical, thermostatistical and quantum-mechanical coursework knowledge taught in the first, second and third years of studies (Calculus I & II, Physical Chemistry I, II and III) of the Chemistry Department.

### LANGUAGE OF INSTRUCTION and EXAMINATIONS:

Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS: Yes (in English)

### COURSE WEBSITE (URL)

http://users.uoi.gr/melissas/notes/lecture%20notes.htm
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
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- Guidelines for writing Learning Outcomes

The course is one of the optional compulsory courses in the direction of Physical and Theoretical Chemistry aiming to theoretically investigate chemical reactions using modern methodologies of quantum and statistical mechanics.

The course material aims at introducing students to the following subjects:
- the understanding of molecular collisions,
- the detailed explanation of molecular collisions,
- using scattering as a mechanism for detecting molecular collisions,
- the perception of the multi-atomic approach of chemical dynamics,
- the application of molecular reaction dynamics to reactions,
- familiarization with molecular energy transfer and
- the emergence of chemical activity through reaction dynamics.

After successful completion of the course, students should be able to:
- realize the importance of time in chemical and physico-chemical phenomena,
- write correctly equations describing the time course of a chemical system,
- propose reaction mechanisms compatible with experimental data,
- understand parameters affecting the speed of chemical reactions,
- accept the coexistence of wave and particle-like nature of particles and electromagnetic radiation,
- establish and solve Schrödinger equation for a series of problems,
- easy to use operators' tools to visualize physical sizes,
- clearly describe simple particle problems in square potential wells,
- easily handle the harmonic oscillator approach and
- solve for the states of hydrogen atom.

Knowledge of:
- what is molecular reaction dynamics,
- why molecular reaction dynamics,
- a simple model of energy partitioning,
- molecular collisions and free-path phenomena,
- dynamics of elastic molecular collisions,
- the reaction cross-section,
- the reaction probability,
- elastic scattering as a probe of the interaction potential,
- intermolecular potentials from experiment and theory,
- angular distribution in direct reactive collisions,
- energy and chemical change,
- three-body potential energy functions and chemical reactions,
- the classical trajectory approach to reaction dynamics,
- from microscopic dynamics to macroscopic kinetics,
- molecules, radiation and laser interactions,
- molecular and ion beam scattering,
- the collisional method,
- quantum reaction dynamics,
- a macroscopic description of energy transfer,
- simple models of energy transfer,
- state-to-state inelastic collisions,
- collisions of molecules with surfaces,
- bimolecular spectroscopy,
- electronic energy transfer,
- collision complexes: their formation and decay (RRKM and Transition State Theory methods),
- multiphoton dissociation,
- Van der Waals molecules and clusters,
- molecular reaction dynamics of gas-surface reactions, and
- stereospecific reaction dynamics.

Skills:
- rapid application of the principles of molecular reaction dynamics in the system under study (particle size, angular distribution of elastic and reactive trajectories, energy and chemical change, application of molecular reaction dynamics, energy transfer collisions),
- skill in the calculation of the energy threshold of the reaction-reactions without energy threshold,
- evaluation of the chemical reaction translational energy requirements,
- the ability to define the dividing surface between reactants and products,
- skill to select the most appropriate potential functions for a proper description of the reaction under study,
- a direct perception of the distribution and consumption of energy in the process of chemical change,
- the ability to study the reaction mechanism using lasers and molecular beams,
- possible application of quantum molecular reaction dynamics methods,
- easy implementation of simple models of energy transfer,
- dealing with state-to-state inelastic collisions,
- ability to study collisions of molecules with surfaces,
- recognition and application of bimolecular spectroscopy methods and
- application of electronic energy transfer.

Abilities:
- ability to understand chemical activity and solve reaction dynamics problems,
- ability to handle unimolecular reaction rates via the RRKM method,
- ability to calculate bimolecular reaction rates with Transition State Theory,
- extension of the Transition State Theory to Variational Transition State Theory and incorporation of tunneling effect calculation,
- ability to measure chemical reactivity of Van der Waals molecules and clusters,
- ability to study adsorption and desorption gas-surface reactions,
- successful treatment of heterogeneous chemical reactivity.
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 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

The course aims students to acquire special knowledge in physical chemistry necessary to cope with the latest developments in chemical science. It also aims to develop critical thinking and familiarization of students with contemporary subjects in the theoretical and experimental fields of science.

In particular, the areas of focus and realization of the above concepts are aimed at developing the following abilities:
- understand chemical reactivity and analyze molecular chemical dynamics problems,
- calculate unimolecular reaction rates with the RRKM method,
- calculate bimolecular reaction rates with Transition State Theory,
- expand Transition State Theory to Variational Transition State Theory and incorporate calculation of tunneling effect,
- include chemical reactivity of Van der Waals complexes,
- compute yields of adsorption and desorption reactions,
- effectively treat gas-surface reactions,
- incorporate heterogeneous chemical reactivity,
- advance collaboration between students to understand each subject and discover ways to cope with,
- search for complementary solutions and evaluate critical thinking for a proper choice between available “tools” and
- plan and deal with a sufficient number of problems to better gain self-reliance and confidence with the "modern" way of thinking.
<table>
<thead>
<tr>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition of molecular reaction dynamics.</td>
</tr>
<tr>
<td>Purposes of molecular reaction dynamics.</td>
</tr>
<tr>
<td>A simple model of energy partitioning.</td>
</tr>
<tr>
<td>Molecular collisions and free-path phenomena.</td>
</tr>
<tr>
<td>Dynamics of elastic molecular collisions.</td>
</tr>
<tr>
<td>The reaction cross-section.</td>
</tr>
<tr>
<td>The reaction probability.</td>
</tr>
<tr>
<td>Elastic scattering as a probe of the interaction potential.</td>
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<tr>
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</tr>
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<td>Collision complexes: their formation and decay (RRKM and Transition State Theory methods).</td>
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<td>Stereospecific chemical dynamics.</td>
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</tbody>
</table>
(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>In class lecturing, encouraging students to participate with comments and questions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Support of the learning process through a variety of short explanatory video projections and the use of specialized web pages. Fruitful discussions with the audience on selected topics form the literature.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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>
</tr>
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<td>Activity</td>
<td>Semester workload</td>
</tr>
<tr>
<td>-----------</td>
<td>------------------</td>
</tr>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>Series of group presentations-discussions for the preparation of the final project defence</td>
<td>32</td>
</tr>
<tr>
<td>Interactive teaching</td>
<td>10</td>
</tr>
<tr>
<td>Independent Study</td>
<td>31</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</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.

Group presentations-discussions on related topics during semester and presentation of the final project by the end of the semester.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:
## (1) GENERAL

<table>
<thead>
<tr>
<th>ΣΧΟΛΗ</th>
<th>SCHOOL OF SCIENCES</th>
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</thead>
<tbody>
<tr>
<td>ΤΜΗΜΑ</td>
<td>CHEMISTRY</td>
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<tr>
<td>ΕΠΙΠΕΔΟ ΣΠΟΥΔΩΝ</td>
<td>UNDERGRADUATES</td>
</tr>
<tr>
<td>ΚΩΔΙΚΟΣ ΜΑΘΗΜΑΤΟΣ</td>
<td>ΧΗΕ 808</td>
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</tr>
<tr>
<td>ΤΙΤΛΟΣ ΜΑΘΗΜΑΤΟΣ</td>
<td>PHOTOCHEMISTRY OF ORGANIC COMPOUNDS AND POLYMERS</td>
</tr>
</tbody>
</table>

### ΑΥΤΟΤΕΛΕΙΣ ΔΙΔΑΚΤΙΚΕΣ ΔΡΑΣΤΗΡΙΟΤΗΤΕΣ

<table>
<thead>
<tr>
<th></th>
<th>HOURS PER WEEK</th>
<th>CREDIT POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LECTURES</td>
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Προσθέστε σειρές αν χρειαστεί. Η οργάνωση διδασκαλίας και οι διδακτικές μέθοδοι που χρησιμοποιούνται περιγράφονται αναλυτικά στο (δ).

### ΤΥΠΟΣ ΜΑΘΗΜΑΤΟΣ

General Background / General Background of Specialized Topics and Skills Development

### ΠΡΟΑΠΑΙΤΟΥΜΕΝΑ ΜΑΘΗΜΑΤΑ:

According to the current curriculum there are no prerequisites; however for an effective attending of the lecture, knowledge of the Organic Chemistry courses I, II and Physical Chemistry II is suggested.

### ΓΛΩΣΣΑ ΔΙΔΑΣΚΑΛΙΑΣ και ΕΞΕΤΑΣΕΩΝ:

GREEK

The entire lecture in power point

### ΤΟ ΜΑΘΗΜΑ ΠΡΟΣΦΕΡΕΤΑΙ ΣΕ ΦΟΙΤΗΤΕΣ ERASMUS

YES

### ΗΛΕΚΤΡΟΝΙΚΗ ΣΕΛΙΔΑ ΜΑΘΗΜΑΤΟΣ (URL)
(2) LEARNING OUTCOMES

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.

Συμβουλεύετε 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

After successful completion of the course, descriptive index 6 of the European Qualifications Framework, students should be able to:

- Understand the principles of quantization as well as the dual nature of light (particle-wave) and its interaction with matter.
- To understand the relationship between the wavelength of the absorbed radiation and the corresponding energy.
- To understand how the interaction light-molecule leads to absorption, emission, and often to photochemical reaction. A prerequisite for this is the understanding of the atomic and molecular orbital description of matter.
- To understand the nature of the excited states formed, their life time, the variety of their decay pathways and the concept of photonic yield (quantum yield).
- To get familiarized with a number of basic photochemical reactions and the corresponding interpretations.
- To relate the whole theoretical framework with a variety of biological and photochemical processes (photosynthesis, photomimetics, vision, photodynamic therapy, sun protection etc.), as well as with many technological applications (photovoltaics, photointaging systems, phototreatment of waste and toxic pollutants, green Photochemistry etc.).
- To understand the concept of polymers and their characteristics (molecular weights distribution and its determination).
- To learn the methods of preparation and characterization.
- To understand the concept of the photopolymerization and the properties of the photoinitiators needed for.
- To be able to understand the applications of polymers in new technologies (photopolymers, plastic screens, new generation photovoltaics, integrated circuits, etc.).

Knowledge

- Knowledge and understanding of basic concepts, principles and theories related to photochemistry and especially those related to the photochemistry of organic compounds.
- Knowledge and understanding of basic concepts, principles and theories related to polymerization.
- Knowledge and understanding of the applications of spectroscopic methods UV / Vis, fluorescence, laser pulse photolysis.

Skills

- Skills in measuring and analyzing spectra UV / Vis, fluorescence, pulse photolysis, gel chromatography.

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 αποσκοπεί το μάθημα;.

Αναζήτηση, ανάλυση και σύνθεση δεδομένων και Σχεδιασμός και διαχείριση έργων
The general skills that should be acquired by the student are:

- **Widening the concept of thermal chemical reaction by its photochemical extension, i.e., the chemistry using light (Photochemistry).** Awareness of differences and similarities.
- **Correlation of the above concept with a host of natural, technological and biological processes.**
- **Awareness of the multitude of applications and technologies arising from the use of light.**
- **Ability of a fruitful correlation of knowledge acquired by core-courses of the Chemistry Department curriculum to Photochemistry.**
- **Ability to search, analyze and evaluate data from the international literature.**
- **Preparation and presentation of a short study that promotes independent work, forces to take decisions, as well as to be creative.**
- **Acquisition of the appropriate theoretical and practical background to allow for further education at the postgraduate and doctoral studies.**
- **Ability to engage in team work in order to achieve the above goals.**
(3) CONTENT OF THE LECTURE

(4) ΤΕΑΧΩΣ ΠΑΡΑΔΟΣΗΣ

Πρόσωπο με πρόσωπο, Εξ αποστάσεως εκπαίδευση κ.λπ.

➢ Ex cathedra
➢ Demonstration in the Photochemistry and Polymer Laboratory

(ΧΡΗΣΗ ΤΕΧΝΟΛΟΓΙΩΝ ΠΛΗΡΟΦΟΡΙΑΣ ΚΑΙ ΕΠΙΚΟΙΝΩΝΙΩΝ)

Χρήση τ.π.ε. στη διδασκαλία, στην Εργαστηριακή Εκπαίδευση, στην Επικοινωνία με τους φοιτητές

➢ Support the learning process using power point
➢ Project-base teaching

(ΟΡΓΑΝΩΣΗ ΔΙΔΑΣΚΑΛΙΑΣ)

Περιγράφονται αναλυτικά ο τρόπος και μέθοδοι διδασκαλίας.

Diaλέξεις, Σεμινάρια, Εργαστηριακή Λακκηστήση, Λακκηστήση Πεδίου, Μελέτη & ανάλυση Διαγνωστικής, Φυσικής (Πολυτελής), Κλινική Λακκηστήση, Καλλιτεχνικά Εργαστήρια, Διαδραστική Διδασκαλία, Εκπαιδευτικές επισκέψεις, Εκπόνηση μελέτης (project), Συγγραφή εργασίας / εργασιών, Καλλιτεχνική δημιουργία, κ.λπ.

Anαγράφονται οι ώρες μελέτης του φοιτητή για κάθε μαθησιακή δραστηριότητα καθώς και οι ώρες μη καθοδηγούμενης μελέτης σύμφωνα με τις αρχές του ECTS

(ΑΞΙΟΛΟΓΗΣΗ ΦΟΙΤΗΤΩΝ)

Περιγράφεται της διαδικασίας αξιολόγησης

Γλώσσα Αξιολόγησης, Μέθοδοι αξιολόγησης, Διαμορφωτική ή Συμπερασματική, Διαγνωστική Παλλαδιατές Επιλογής, Ερωτήσεις Σύντομης Απάντησης, Ερωτήσεις Ανάπτυξης Δικτύων, Επικοινωνίας Προβλημάτων, Ανάλυση Εργασία, Εκθέσεις / Αναφορά, Προφορική Εξέταση, Δημόσια Παρουσίαση, Εργαστηριακή Εργασία, Κλινική Εξέταση Ασθενών, Καλλιτεχνική Ερμηνεία, Αλλη / Άλλη

Αναφέρονται ρητά προσδιορισμένα κριτήρια αξιολόγησης και εάν και που είναι προσβάσιμα από τους φοιτητές.

The student assessment is made by a final examination (evaluation) in Greek, which includes:

I. Written / oral final exam that includes
➢ development of some aspects
➢ short-answer questions
➢ answers to critical questions

II. Presentation of the written individual work

(ΣΥΝΙΣΤΩΜΕΝΗ - ΒΙΒΛΙΟΓΡΑΦΙΑ)

-Προτεινόμενη Βιβλιογραφία:

<table>
<thead>
<tr>
<th>ΣΗΜΕΙΩΣΕΙΣ ΟΡΓΑΝΙΚΗΣ ΦΩΤΟΧΗΜΕΙΑΣ</th>
<th>ΣΗΜΕΙΩΣΕΙΣ ΔΙΔΑΣΚΟΝΤΑ</th>
<th>ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ (ΣΗΜΕΙΩΣΕΙΣ)</th>
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</thead>
<tbody>
<tr>
<td>ΟΡΓΑΝΙΚΗ ΦΩΤΟΧΗΜΕΙΑ</td>
<td>Απόστολος Ι. Μαρούλης</td>
<td>Θεσσαλονίκη 1991</td>
</tr>
<tr>
<td>ΧΗΜΕΙΑ ΠΟΛΥΜΕΡΩΝ</td>
<td>Γιώργος Π. Καραγιαννίδης, Ειρήνη Δ. Σιδερίδου</td>
<td>Εκδόσεις Ζήτη, Θεσσαλονίκη, 2006</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------</td>
<td>-------------------------</td>
</tr>
</tbody>
</table>

- Συναφή επιστημονικά περιοδικά:

- Photochemistry Photobiology Sciences
- J. Photochemistry and Photobiology
- Macromolecules
- Polymer Chemistry
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>8.4.1</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8th</td>
</tr>
</tbody>
</table>

COURSE TITLE: Polymer Science

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE: Specialization

PREREQUISITE COURSES: No

LANGUAGE OF INSTRUCTION: Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS: No

COURSE WEBSITE (URL): No

(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 will gain basic knowledge on polymer chemistry, classes of polymers and industrial production of polymers. They will also gain knowledge on properties of polymers in solid state and polymer solutions, polymer blends and copolymers. They will learn how to search in literature and analyze data using new technologies. They will also be taught to respect the environment. Their survey and bibliographic work will promote free, creative and inductive thinking.

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...
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Search, analysis and synthesis of data and information, by using the proper technologies.
Autonomous work
Respect of natural environment
Promoting free, creative and inductive thinking

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td><strong>TEACHING METHODS</strong></td>
<td><strong>Activity</strong></td>
</tr>
<tr>
<td>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.</td>
<td>Lectures</td>
</tr>
<tr>
<td>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>Written assignment</td>
</tr>
<tr>
<td></td>
<td>Not guided study</td>
</tr>
<tr>
<td></td>
<td>Course total</td>
</tr>
</tbody>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>SEMESTER 8th</td>
</tr>
<tr>
<td>COURSE TITLE</td>
<td>Polymeric and Composite Materials</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INDEPENDENT TEACHING ACTIVITIES</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>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</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Specialization</th>
</tr>
</thead>
<tbody>
<tr>
<td>general background, special background, specialised general knowledge, skills development</td>
<td>No</td>
</tr>
</tbody>
</table>

PREREQUISITE COURSES: No

<table>
<thead>
<tr>
<th>LANGUAGE OF INSTRUCTION and EXAMINATIONS</th>
<th>Greek</th>
</tr>
</thead>
</table>

IS THE COURSE OFFERED TO ERASMUS STUDENTS: No

<table>
<thead>
<tr>
<th>COURSE WEBSITE (URL)</th>
<th>No</th>
</tr>
</thead>
</table>

(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 will gain basic knowledge materials' technology, polymer classes, polymer composites and nanocomposites' technology. Students will also gain knowledge on polymers with special technological importance and on polymer application in pharmaceutical technology and medicine. They will learn how to search in literature and analyze data using new technologies. They will also be taught to respect the environment. Their survey and bibliographic work will promote free, creative and inductive thinking.

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, analysis and synthesis of data and information, by using the proper technologies.
- Autonomous work

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...

……
Respect of natural environment
Promoting free, creative and inductive thinking

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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<tbody>
<tr>
<td>Lectures</td>
<td>48</td>
</tr>
<tr>
<td>Written assignment</td>
<td>24</td>
</tr>
<tr>
<td>Not guided study</td>
<td>52</td>
</tr>
<tr>
<td>Course total</td>
<td>124</td>
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</tbody>
</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, etc.

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

Written examination (80%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:


- Related academic journals:
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>NATURAL SCIENCES</th>
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<td>ACADEMIC UNIT</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
<td>GRADUATION PROJECT I and II</td>
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</tbody>
</table>

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

<table>
<thead>
<tr>
<th>WINTER SEMESTER (Graduation project I)</th>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>SPRING SEMESTER (Graduation project II)</td>
<td>10</td>
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</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>general background, special background, specialised general knowledge, skills development</th>
</tr>
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<tbody>
<tr>
<td>PREREQUISITE COURSES:</td>
<td>NONE</td>
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<tr>
<td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td>
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</tr>
<tr>
<td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td>
<td>YES</td>
</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td>NONE</td>
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</tbody>
</table>

(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 aim of the course is to practice students in bibliographic research methods, to design and execute experiments or theoretical calculations to investigate or solve a chemical problem, evaluate the results and rationalize their written and oral presentation. Finally, it aims to transmit and cultivate love for research.
- After completing the course students should:
  1. Be aware of the use of databases to find appropriate bibliography for a specific research object.
  2. Be able to understand the results of published scientific papers related to their project.
  3. Have been trained in experimental techniques (synthesis, spectroscopic characterization etc) or methods of theoretical calculations, depending on the subject of their project.
  4. Be able to design some new experiments or calculations with knowledge of the bibliography of the particular research object.
  5. Understand the theoretical background of their dissertation work.
  6. Be able to produce understandable and clear research results in writing.
  7. Be able to make an oral presentation of research results to a satisfactory degree.
  8. Understand to a considerable extent the importance of research for the development of chemistry as a science and its importance for practical applications.
9. Have developed interest in contemporary research topics.
10. Have critical thinking about research problems.
11. Have a first contact with the whole process of research concerning literature knowledge, design of experiments or calculations, their realization, use of corresponding techniques, interpretation of results, draw conclusions, design of new experiments or calculations based on previous results, written presentation of results, oral presentation of the results to the public.

Knowledge
Knowledge and understanding of the basic concepts, principles and theories related to the project work and the research process in general (search bibliography, design-execution of experiments or calculations, evaluation of results, written and oral presentation of results).

Skills
Skills in synthetic methods or theoretical calculations, use of instruments, interpretation of experimental results, written and oral presentation of research results.

Advanced problem solving skills through careful analysis of the provided data.

Abilities
Ability to apply the knowledge provided to address issues related to research topics in various fields of Chemistry
Ability to apply modern experimental techniques or calculations.
Ability to interpret experimental data.
Ability to create an integrated scientific text in a specific field of knowledge with conclusions based on the literature and the experiment
Ability to write and present results.
Ability to work independently and to interact with other students on subject matter

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 | Showing social, professional and ethical responsibility and sensitivity to gender issues |
| Working independently | Criticism and self-criticism |
| Team work | Production of free, creative and inductive thinking |
| Working in an international environment | Others... |
| Working in an interdisciplinary environment | Others... |
| Production of new research ideas | Others... |

The general competencies that the student should have acquired and to which the course is aimed are:

Search, analyze and synthesize data and information and make decisions.
Conversion of theory into practice.
Promote free, creative and inductive thinking.
Autonomous but also teamwork.
Acquiring the appropriate theoretical knowledge base to enable further education both at a theoretical level (in more specific topics of Inorganic Chemistry) and in a laboratory.

(3) SYLLABUS

The graduation project I and II includes the completion of the experimental process in the 7th and 8th semesters and the completion of the relevant scientific work which will include (a) introduction, (b) discussion of results, (c) conclusions, (d) experimental part, (e) bibliography.
This work will be titled "Graduation Project"
### DELIVERY
- Face-to-face
- Distance learning, etc.

### USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students

### 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

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>winter GP I</td>
</tr>
<tr>
<td>Literature search and study</td>
<td>25</td>
</tr>
<tr>
<td>Experimental work</td>
<td>50</td>
</tr>
<tr>
<td>Not guided study</td>
<td>50</td>
</tr>
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</table>

**Course total**: 125

### STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

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

After the completion of the graduation project (GP) and the correction of the original text by the supervising professor, it is printed in its final form. Copy of GP is submitted to the Secretariat of the Department in electronic form. The Secretariat grants the supervising lecturer a scorecard in which he scores separately (on the 0-10 score scale) the following evaluation points:

- Quality of content and written text of GP
- Quality of oral presentation
- Knowledge in the specific subject of the GP and bibliographic information on the subject
- Knowledge in the wider subject of the subject of the GP
- Consistency of work and good laboratory practice during the elaboration of the GP

The form is completed, signed and returned to the Secretariat of the Department. The average score of all individual points for each student, rounded to the nearest unit, is the grade of the GP. Which is recorded in the analytical score of each student.

### ATACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
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<td>LEVEL OF STUDIES</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
<td>8th</td>
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<tr>
<td>COURSE TITLE</td>
<td>Valorization of natural resources</td>
</tr>
</tbody>
</table>

### 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:

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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<tbody>
<tr>
<td>4</td>
<td>5</td>
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</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>Specialization</th>
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<tbody>
<tr>
<td>PREREQUISITE COURSES:</td>
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<td>LANGUAGE OF INSTRUCTION</td>
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<td>and EXAMINATIONS:</td>
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<td>IS THE COURSE OFFERED TO</td>
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<tr>
<td>ERASMUS STUDENTS:</td>
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</tr>
<tr>
<td>COURSE WEBSITE (URL)</td>
<td>No</td>
</tr>
</tbody>
</table>

### (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 will gain basic knowledge in issues of Natural Resources, unit operations applied in ore enrichment and metallurgy but mainly on issues of Fossil Fuels, Renewable Energy resources, Green Chemistry and Green Chemical Technology and Sustainability. The students will learn to search in literature and analyze data using new technologies. They will also be taught to respect the environment. Their survey and bibliographic work will promote free, creative and inductive thinking.

**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, analysis and synthesis of data and information, by using the proper technologies.
Autonomous work
Respect of natural environment
Promoting free, creative and inductive thinking

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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>
</tr>
<tr>
<td>Activity</td>
<td>Semester workload</td>
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<tr>
<td>Lectures</td>
<td>48</td>
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<tr>
<td>Written assignment</td>
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<tr>
<td>Not guided study</td>
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</tr>
<tr>
<td>Course total</td>
<td>124</td>
</tr>
</tbody>
</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.

Written examination (80%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
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<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
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<tr>
<td>LEVEL OF STUDIES</td>
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<td>COURSE CODE</td>
<td>XHE 719 8.6.4</td>
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<td>SEMESTER</td>
<td>8th</td>
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COURSE TITLE: Environmental Geochemistry-Mineralogy

INDEPENDENT TEACHING ACTIVITIES

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE: Specialization

PREREQUISITE COURSES: No

LANGUAGE OF INSTRUCTION and EXAMINATIONS: Greek

IS THE COURSE OFFERED TO ERASMUS STUDENTS: No

COURSE WEBSITE (URL): No

(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

Consolidate knowledge of chemical concepts in environmental geochemistry-mineralogy. Provide students with a firm foundation of the application of chemistry onto the natural world

Engender in students a deeper understanding of the earth and our surface environment from a chemical perspective.

The students will:

- Be able to describe geochemical data in the context of environmental processes
- Demonstrate a basic understanding of what controls the concentration of elements in a range of physical environments
- Demonstrate understanding of the most important rock forming minerals, where they are found, their quality and how they are formed
- Demonstrate insight to the most important processes that leads to the formation of the different types rocks
- Understand the processes that control mineral reactivity and stability under environmentally-relevant conditions.
- Understand the earth processes which control the abundance and distribution of minerals at the earth’s surface under a range of spatial and temporal scales.
- Their survey and bibliographic work will promote free, creative and inductive thinking.
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, analysis and synthesis of data and information, by using the proper technologies
Promoting free, creative and inductive thinking
Be able to integrate theoretical concepts with their practical applications. Effectively read and critically review scientific literature
Assess rigorously and critically scientific debates and environmental issues

(3) SYLLABUS

Differentiation of and cosmic abundance of elements
Composition of the earth
Geochemistry of igneous rocks, geochemistry of sedimentary rocks, geochemistry of metamorphic rocks
Crystal chemistry – environmental mineralogy - solution-mineral equilibria
The water envelope: oceans
Weathering and soils
Sedimentation and diagenesis

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
</tr>
<tr>
<td>Activity</td>
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</tr>
<tr>
<td>----------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Lectures</td>
<td>48</td>
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<tr>
<td>Written assignment</td>
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<tr>
<td>Not guided study</td>
<td>52</td>
</tr>
<tr>
<td>Course total</td>
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</tr>
</tbody>
</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.

Written examination (80%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (20%).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
  Introduction to Geochemistry . K.Krauskopf, D. Bird
- Related academic journals:
  Applied Geochemistry, Elsevier
  Geochimica Cosmochimica Acta , Pergamon press
  Geochemistry Exploration Environment Analysis, Lyell collection
COURSE OUTLINE

(1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
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<tr>
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<tr>
<td>COURSE TITLE</td>
<td>MOLECULAR MATERIALS</td>
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</table>

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

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

COURSE TYPE
Scientific field / Skill development

PREREQUISITE COURSES:
Basic knowledge of Physical, Inorganic and Organic Chemistry

LANGUAGE OF INSTRUCTION and EXAMINATIONS:
Greek (All material in powerpoint is in english)

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

After completion of this course, the students should be able to:
- Understand the basic principles of materials science in molecular and supramolecular level
- Interpret XRD spectra in crystalline and amorphous materials, calculate structural parameters and correlate the data with the structure of atoms in three dimensions
- Understand optical/electrical/structural properties of various chemical systems (inorganic/organic).

Knowledge
- Knowledge and understanding of the basic principles and theories which are related with the fields of materials chemistry and science.
- Knowledge and understanding of applied spectroscopic techniques, such as XRD.
- Knowledge in utilization of spectroscopic data from international literature.
Skills

- Skills concerning the understanding and elaboration of XRD spectra.
- Complex skills of resolving problems through data analysis of international literature.

Capabilities

- Capability to implement the knowledge to solve problems, which belong to the fields of materials chemistry and science.
- Capability to interpret the spectral data from XRD and extract various structural parameters.
- Capability to interact with colleagues or researchers in issues concerning materials chemistry and science.
- Capability in team work as well as an individual person.

Capabilities of working in an international professional environment.

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 | ..... |

The general capabilities which should be obtained by the student are:

- Theoretical thinking and the ability to convert the knowledge of theory into calculation of experimental parameters.
- Ability to implement knowledge obtained during study into related lessons taught in the department.
- Ability to search, analyze and synthesize data and information from international literature and utilization of appropriate technologies related to the presentation of research results.
- Obtaining the appropriate practical background of knowledge in order to be able to follow lessons in postgraduate level.
- Work in multidisciplinary environment.
- Ability to collaborate as a team for managing the aforementioned goals.

(3) SYLLABUS

Intermolecular forces in molecular solids. Synthesis and growt of crystals.
Characterization methods for molecular solids. Impurities and defects in crystals.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
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</tr>
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<tbody>
<tr>
<td></td>
<td>Face-to-face, Distance learning, etc.</td>
</tr>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Utilization of power point for lectures.</td>
</tr>
<tr>
<td></td>
<td>projects.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td></td>
<td>The manner and methods of teaching are described in detail.</td>
</tr>
<tr>
<td></td>
<td>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.</td>
</tr>
<tr>
<td></td>
<td>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>
</tr>
<tr>
<td></td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
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<tr>
<td></td>
<td>Utilization of power point for lectures.</td>
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<tr>
<td></td>
<td>projects.</td>
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</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
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</thead>
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<td>Lectures</td>
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<table>
<thead>
<tr>
<th>STUDENT PERFORMANCE EVALUATION</th>
<th>The evaluation of students is done by combining: I. Written/oral final exam (60%) which contains: o Problem development o Short response questions o Critical questions o Problem solving. Preparation of personal report (40%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description of the evaluation procedure</td>
<td>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>
</tr>
<tr>
<td>Specifi-ically-defined evaluation criteria are given, and if and where they are accessible to students.</td>
<td></td>
</tr>
</tbody>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:
  Advanced Materials, ACS Nano, Journal of American Chemical Society
## COURSE OUTLINE

### (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
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<td>COURSE CODE</td>
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<td>SEMESTER</td>
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<tr>
<td>COURSE TITLE</td>
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</table>

**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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
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</thead>
<tbody>
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<td>LECTURES</td>
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<td></td>
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</table>

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:**

- No

**LANGUAGE OF INSTRUCTION and EXAMINATIONS:**

- Greek

**IS THE COURSE OFFERED TO ERASMUS STUDENTS:**

- No

**COURSE WEBSITE (URL):**

- No

### (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 will gain basic knowledge on Environmental chemistry, will be introduced to the principles and factual basis of chemistry in an environmental context, will gain an appreciation of the scientific methodology in environmental chemistry, and will develop problem-solving and critical-thinking skills that are necessary to analyse and discuss chemical and physical phenomena in the environment.

**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 |
| Decision-making | Respect for difference and multiculturalism |
| Working independently | Respect for the natural environment |
| Team work | Showing social, professional and ethical responsibility and sensitivity to gender issues |
| Working in an international environment | Criticism and self-criticism |
| Working in an interdisciplinary environment | Production of free, creative and inductive thinking |
| Production of new research ideas | Others... |

This Course aims to promote:
• free, creative and inductive thinking
• understanding science, demonstrate a coherent understanding of environmental science
• scientific knowledge, exhibit depth and breadth of environmental science knowledge
• inquiry and problem solving, critically analyse and solve problems in environmental science
• communication, be an effective communicator of environmental science
• personal and professional responsibility, be accountable for individual learning and scientific work in environmental science

(3) SYLLABUS


(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face to face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of ICT in teaching, laboratory education, communication with students</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
</tr>
<tr>
<td>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></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>52</td>
</tr>
<tr>
<td>Study and analysis of bibliography</td>
<td>30</td>
</tr>
<tr>
<td>Not guided study</td>
<td>43</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

Written examination with multiple choice questionnaires and short-answer questions and essay/report (100%) in Greek.
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:

- Related academic journals:
  1) Journal of Chemical Education (American Chemical Society)
  2) Environmental Science and Technology (American Chemical Society)
  3) The Science of the Total Environment (Elsevier)
  4) Environmental Pollution (Elsevier)
# COURSE OUTLINE

## (1) GENERAL

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>Natural Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACADEMIC UNIT</td>
<td>Department of Chemistry</td>
</tr>
<tr>
<td>LEVEL OF STUDIES</td>
<td>Undergraduate</td>
</tr>
<tr>
<td>COURSE CODE</td>
<td>ΧΗΕ 219 (8.1.2)</td>
</tr>
<tr>
<td>SEMESTER</td>
<td>8th</td>
</tr>
</tbody>
</table>

**COURSE TITLE**

Applied Electrochemistry. Development of Chemical Sensors and Biosensors

**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.

<table>
<thead>
<tr>
<th>WEEKLY TEACHING HOURS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).

**COURSE TYPE**

General background, specialization, skills development

**PREREQUISITE COURSES:**

No

**LANGUAGE OF INSTRUCTION and EXAMINATIONS:**

Greek

**IS THE COURSE OFFERED TO ERASMUS STUDENTS:**

Yes

**COURSE WEBSITE (URL):**

No

## (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 will gain basic knowledge on the following topics: Cyclic Voltammetry, Chronocoulometry and Electrochemical Impedance Spectroscopy. Principle and applications of the most widely used electrochemical methods in the development of chemical sensors and biosensors. Small molecules and Enzyme Immobilization onto electrodes or other platforms. This is the most important step at the construction of a sensor, as (bio)molecules induce specific recognition/catalytic properties. Development of a chemical amperometric sensor. A detailed study. Development of an enzyme amperometric biosensor. Different types of biosensors. Glucose commercial biosensors. Impedimetric sensors and immunosensors. Capacitive and faradic impedimetric (bio)sensors.

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

Search, analysis and synthesis of data and information, by using the proper technologies.
Working independently
Team work
Respect of natural environment
Promoting free, creative and inductive thinking
Understanding analytical science, demonstrate a coherent understanding of analytical chemistry
Depth and breadth of analytical chemistry knowledge
Inquiry and problem solving, critically analyse and solve problems in analytical chemistry
Personal and professional responsibility, be accountable for individual learning and scientific work in analytical chemistry

(3) SYLLABUS

Introduction in electrochemistry. Cyclic Voltammetry, Chrono-coulometry and Electrochemical Impedance Spectroscopy. Principle and applications of the most widely used electrochemical methods in the development of chemical sensors and biosensors. Small molecules and Enzyme Immobilization onto electrodes or other platforms. This is the most important step at the construction of a sensor, as (bio)molecules induce specific recognition/catalytic properties. Development of a chemical amperometric sensor. A detailed study. Development of an enzyme amperometric biosensor. Different types of biosensors. Glucose commercial biosensors. Impedimetric sensors and immunosensors. Capacitive and faradic impedimetric (bio)sensors.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<thead>
<tr>
<th>DELIVERY</th>
<th>Face-to-face, Distance learning, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td>
<td>Use of PowerPoint in lectures. Communication via email.</td>
</tr>
<tr>
<td>TEACHING METHODS</td>
<td>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.</td>
</tr>
<tr>
<td>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></td>
</tr>
<tr>
<td>STUDENT PERFORMANCE EVALUATION</td>
<td>Written examination (80%) in Greek. Written work with public presentation (20%).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Semester workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>50</td>
</tr>
<tr>
<td>Written assignment</td>
<td>25</td>
</tr>
<tr>
<td>Not guided study</td>
<td>50</td>
</tr>
<tr>
<td>Course total</td>
<td>125</td>
</tr>
</tbody>
</table>

(5) ATTACHED BIBLIOGRAPHY
-Web sources:
http://www.news-medical.net/health/What-are-Biosensors.aspx
http://www1.lsbu.ac.uk/water/enztech/biosensors.html
http://www.gwent.org/presentations/biointro.pdf
http://www.powershow.com/view/1/224724-ZDc1Z/BIOSENSOR_powerpoint_ppt_presentation

-Related literature:

Introduction to Biosensors

Biosensors : Properties, Materials and Applications,

Chemical Sensors : Properties, Performance and Applications

Implantable Sensor Systems for Medical Applications

Biosensors Nanotechnology

-Journals:
Analytical Chemistry
Sensors and Actuators
Biosensors and Bioelectronics
Lab-on-a-chip