COURSE OUTLINES

Table of Contents

FIELD I

ANALYTICAL CHEMISTRY, ENVIRONMENTAL AND FOOD CHEMISTRY AND TECHNOLOGY

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IAO1**	**SEMESTER**	**1st**
COURSE TITLE	**MODERN TECHNIQUES AND APPLICATIONS OF ANALYTICAL CHEMISTRY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
		6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		6

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	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*

Postgraduate students will gain knowledge on advanced instrumental analytical techniques,data domains, non-electric and electric data domains, analog signals, frequency signals, digital signals, detectors, transducers and sensors, electrical circuits and circuit elements, semiconductor diodes, power supplies and stabilizers, principles of surface plasmon resonance techniques and quartz crystal microbalance, development of biosensors, applications to various areas of chemical analysis, basic concepts and principles governing mass spectrometry, mass spectrometry instrumentation, hyphenated techniques, ion sources, mass analyzers, detectors, conjugated or sequential mass spectrometry systems, tandem MS modes, applications.

This course introduces information about modern techniques and applications of chemical analysis, such as operational amplifiers in chemical instrumentation, circuits of operational amplifiers, amplification and signal transduction, applications of operational amplifiers, atomic absorption spectrometry (instrumentation, principles, applications), X-Ray spectroscopy (instrumentation, principles, applications), molecular luminescence spectrometry (instrumentation, principles, applications), flow Injection analysis (instrumentation, principles, applications). NMR spectroscopy and applications in analytical chemistry.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

Search, 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

Analytical instruments. Data domains. Non-electric and electric data domains. Analog signals. Frequency signals. Digital signals. Detectors, transducers and sensors. Electrical Circuits and Circuit Elements. Semiconductor diodes. Power supplies and stabilizers.
Principles of surface plasmon resonance techniques (SPR) and quartz crystal microbalance (QCM). Development of SPR, QCM biosensors. Applications to various areas of chemical analysis.
Mass spectrometry instrumentation. Basic concepts governing mass spectrometry.Mass spectrometry hyphenated techniques. Ion sources, mass analyzers, conjugated or sequential mass spectrometry systems, applications.
Operational amplifiers in chemical instrumentation. Circuits of Operational amplifiers. Amplification and signal transduction. Applications of Operational amplifiers. Atomic Absorption spectrometry (Instrumentation, Principles, Applications). X-Ray spectroscopy (Instrumentation, Principles, Applications). Molecular luminescence spectrometry (Instrumentation, Principles, Applications). Flow Injection Analysis (Instrumentation, Principles, Applications).

(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 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.*	

Activity	***Semester workload***
Lectures	42
Presentations by the students	15
Homework and preparation	40
Study and analysis of bibliography	50
Exams	3

<table>
<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><table>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Written examinationin Greek, with multiple choice questionnaires and short-answer questions.
Essay writing</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

ΑΡΧΕΣ ΑΝΑΛΥΤΙΚΗΣ ΧΗΜΕΙΑΣ SKOOG ΚΩΣΤΑΡΑΚΗΣ Α.Ε.
ΕΝΟΡΓΑΝΗ ΑΝΑΛΥΣΗ Θ. ΧΑΤΖΗΪΩΑΝΝΟΥ, Μ. ΚΟΥΠΠΑΡΗΣ, ΕΛΕΝΗ ΧΑΤΖΗΪΩΑΝΝΟΥ
ΑΡΧΕΣ ΕΝΟΡΓΑΝΗΣ ΑΝΑΛΥΣΗΣ SKOOG ΚΩΣΤΑΡΑΚΗΣ Α.Ε.

-*Related Scientific Journals:*
Journal of Chemical Education
Analytical Chemistry
Analytica ChimicaActa
Talanta
Microchimica Acta
Analytical Methods
Analyst
Trends in Analytical Chemistry
Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy
Spectrochimica Acta Part B: Atomic Spectroscopy
Journal of Analytical Atomic Spectrometry
Journal of Luminescence
Journal of Fluorescence

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IA02**	**SEMESTER**	**1**
COURSE TITLE	**ENVIRONMENTAL SCIENCE AND TECHNOLOGY**		

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(ECTS)*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Total	39	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized knowledge / skills development
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.

- *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.*
- *Guidelines for writing Learning Outcomes .*

After the successful completion of the course, descriptive level 7 of the European Qualifications Framework for Lifelong Learning, the students will be capable to:

• Understand deeply physical and chemical processes taking place in environmental media, pollutants fate and transport, impacts, environmental protection technologies and their applications.

• to use their knowledge and skills in applications and problem-solving, within an interdisciplinary context, relevant to their field of knowledge.

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
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
……

Production of new research ideas	*Others…* *…….*

• Application of knowledge dealing with advanced methods, techniques and technologies for environmental protection and materials characterization and applications.
• 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
• Inquiring the necessary learning skills that allow them to continue their studies in a largely self-reliant or even autonomous manner.
• Possesses specialized problem-solving skills, which are required in research and/or innovation in order to develop new knowledge and processes and integrate knowledge from different fields.
• 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

Environmental Pollutants, Categories (conventional, emerging, priority), Physicochemical properties, Toxicity, Transport and degradation processes in environmental systems, Adsorption in soils and environmental materials, Runoff, Leaching, Volatilization-Drift, Hydrolysis, Oxidation-Reduction, Photolysis, Biodegradation, Dissipation kinetics and mechanisms, Transformation and degradation products, Metabolism, Bioconcentration and biomagnification, Environmental risk assessment, Residues in environmental systems, Nutrients, Eutrophication, Advanced treatment technologies, Photochemical methods (UV/O_3, H_2O_2, Fenton, etc), Ultrasonics, Environmental Catalysis, Applications of membranes, Pyrolysis, Biofilters, In-situ remediation technologies (Biochars, biobeds, bioremediation, phytoremediation, constructed wetlands), Green chemistry and Technology.

(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 Technologies of Information and communications in teaching and 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*	

Activity	*Semester workload*
Lectures	39
Written essay	46
Essay presentation	15
Bibliography study	50

	Course total	**150**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written essay/project Evaluation criteria: (a) Plenitude of essay (25%), (b) quality and treatment, interpretation of data (30%), (c) oral presentation (25%) (d) short questions during oral presentation (20%)	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (in Greek):
Notes/Presentations of professors, Review papers

- Related academic journals:
1) Science of the Total Environment
2) Environmental Science and Technology
3) Environmental Pollution
4) Chemosphere
5) Environmental Science and Pollution Research
6) Journal of Environmental Chemical Engineering

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	Postgraduate studies Field: Analytical Chemistry, Environmental and Food Chemistry and Technology		
COURSE CODE	**IA03**	**SEMESTER**	**A**
COURSE TITLE	**ADVANCED COURSES IN FOOD CHEMISTRY AND BIOCHEMISTRY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised knowledge
PREREQUISITE COURSES:	NO
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 completion of the course, postgraduate students will be able to understand special topics of food chemistry and biochemistry as well as advanced analysis techniques so that they can deal with their daily working life based on the knowledge they have acquired. They will be able to better understand the chemistry and biochemistry of food as well as the chemical and biochemical processes during food production, such as the development of their organoleptic characteristics (aroma, taste, color), the use of enzymes and microorganisms, etc.
In addition, they will be familiar to advanced analysis techniques for the identification and characterization of food ingredients.
Graduate students will be asked to study through the literature topics related to the thematic units of the course as well as to solve and/or compare corresponding topics and problems.
In addition, they will be able to search the literature using modern technologies for topics related to food chemistry and biochemistry.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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

(3) SYLLABUS

The main topics of this course are:

A. Study of the development of organoleptic characteristics of food (aroma, taste, color)
B. Food additives (flavor, taste, color)

C. Enzymes in the food industry
D. Food toxicology data
E. Analytical techniques for food ingredients (DSC, LC/MS, ICP/OES-MS etc.)

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-pace</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Power point for lectures.
Communication with graduate students via email and video conference</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>70</td></tr>
<tr><td>Project</td><td>40</td></tr>
<tr><td>Personal study</td><td>40</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of</td><td>The language is Greek.
Individual bibliographic project on a specific topic within the scope of the course (50%).
Written exam with development, multiple choice and judgment questions (50%).
The grade of the written exam should be at least 5/10 to pass the course.</td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

Suggested Bibliography:
ΣΗΜΕΙΩΣΕΙΣ ΠΑΡΑΔΟΣΕΩΝ των διδασκόντων, Παν/μιο Ιωαννίνων
(Teachers' Course Notes, University of Ioannina)

Chemistry and Biochemistry of Food, Jose Perez-Castineira, Walter de Gruyter GmbH & Co KG, 2020.
Food Biochemistry and Food Processing, 2nd edition, B.K. Simpson, Willey-Blackwell, 2012.
Food Chemistry. Belitz, H.D, Grosch, W., Schieberle, P. Springer-Verlag, Berlin, Germany, 2009.
Advanced in Food Biochemistry, F. Yildiz, CRS Press, 2010.
Enzymes in Food Technology, R.J. Whitehurst, B.A. Law, CRC press, 2002.
Food Analysis, Nielsen, S.S., Springer, New York, USA, 2010.
Chemical Analysis of Food: Techniques and Applications, Y. Pico, CRC press, 2012.

Related Scientific Journals:
Food Chemistry
Foods
Food Research International
European Food Research and Technology
Food Biotechnology and nutrition
Food Chemistry and Toxicology
Food and Bioprocess technology

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IAO4**	**SEMESTER**	**1st**
COURSE TITLE	**ADVANCED LABORATORY OF INSTRUMENTAL ANALYSIS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Laboratory exercises		12
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		12

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*

Following the successful completion of the course, students should be able to
I) Understand and apply the basic principles governing chemical analysis by instrumental analytical techniques.
Ii) Understand the basic principles in the design of integrated electrochemical cells, their operation and use in field measurements in conjunction with portable measurement devices. In addition, they understand the basic principles of screen printing and the influence of various parameters on the texture/viscosity of the printing inks and the printing conditions on the quality of printed sensors.

Knowledge
• Knowledge and correct understanding of the specific and advanced concepts, principles and theories related to the chemical analysis with liquid and gas chromatography.
• Knowledge of screen printing technique and the production of disposable sensors.
• Knowledge of advanced software design and casting techniques with photosensitive materials.
• Knowledge and understanding of the individual parts of the analytical instrumentation.
• Knowledge and understanding of the applications of electroanalytical, spectrometric, chromatographic and separation 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 analytical chemistry problems
• Development of analytical methods, adapted to the matrix requirements of the sample, for the determination of the analytes.
• Advanced problem-solving skills through data analysis of international literature

Abilities
• Ability to analyze bibliographic sources and utilize the appropriate analytical technique to solve specific problems
• 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
• Ability to interact with other postgraduate students or researchers in chemical analysis
• Ability to work together as well as to the independent way of working
• Work opportunities in an international environment• 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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

Search, analysis and synthesis of data and information, 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

Design of printing screens. Composition and preparation of various printing inks in aqueous or non-aqueous dispersion media. Screen printing of single or triple electrochemical cells. Quality control.
Gas chromatographic analysis with mass detector. Sample preparation.
Liquidchromatographic analysis diode array and light dispersion detectors. Sample preparation.
Laboratory instrumentation: basic principles. Determination by kinetic methods of analysis. Determination via chemiluminescence system. Nanoparticles synthesis and characterization for the determination of inorganic ions. Determination of metals by atomic absorption spectrometry (AAS). Determination of natural water pollutants by gas chromatography with solid-phase microextraction (SPME), Differential Pulse Stripping Voltammetry.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face in groups of 5 students

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

Activity	***Semester workload***
Lectures	25
Laboratory practice	75
Writing individual report	25
Non directed study	25
Course total	**150**

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

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

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

Student evaluation is done
A) by written and oral examination during the laboratory exercise (30%) concerning the degree of 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 (70%) including:

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

	So the Written Examination Grade (WEG) level resulted.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Ενόργανη Ανάλυση. Θ.Π. Χατζηιωάννου, Μ.Α. Κουππάρης. Πανεπιστήμιο Αθηνών, Αθήνα 2000.

Αρχές της Ενόργανης Ανάλυσης. D.A. Skoog, F.J. Holler, T.A. Nieman. Μετάφραση στα Ελληνικά: Μ. Καραγιάννης, Κ. Ευσταθίου, Ν. Χανιωτάκης. Εκδόσεις Κωσταράκης, Αθήνα, 2002.

Modern Analytical Chemistry. Editor: D. Harvey, 1st edn, McGraw-Hill, USA, 2000.

Ηλεκτροχημικοί Αισθητήρες και Βιοαιασθητήρες, Μ. Προδρομίδης, Εκδόσεις Κωσταράκη, Αθήνα 2014

Thick film technology and applications, M. Haskard and K. Pitt, Electrochemical Publications Ltd., 1997

- Related academic journals:

Journal of Chemical Education
Analytical Chemistry
Electrochimica Acta
Journal of Chromatography A
Analytica Chimica Acta
Sensors and Actuators B chemical
Electroanalysis

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IB01**	**SEMESTER**	**2nd**
COURSE TITLE	**APPLICATIONS OF NANO-MATERIALS IN ANALYTICAL CHEMISTRY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
		6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background, 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

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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*

This course introduces information about the basic principles of nanotechnology, the general classification and properties of nanomaterials, the methods for the synthesis of nanomaterials such as noble metal nanomaterials, magnetic nanomaterials, carbon nanotubes and quantum-carbon dots, the characterization techniques of nanomaterials, such as SPM, STM, AFM, XRD, XRF, Raman Spectroscopy, FT-IR, UV-Vis, TEM, SEM and applications of nanomaterials on the separation, preconcentration and determination of chemical substances with interest in clinical chemistry, food chemistry and environmental chemistry.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

Search, 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, synthesis and characterization of nanomaterials and demonstrate a coherent understanding of these practises

(3) SYLLABUS

1. Introduction to nanotechnology
1.1 Introduction
1.2. Historical view
1.3. The “Size” effect
1.4 Synthesis
1.5 Techniques
1.6 Technological development and applications
1.7 Nano-electronics

2. General classification and applications of nanomaterials.
2.1. Introduction
2.2. The effect of nanomaterial size on their properties
2.3. Properties of nano-materials
2.3.1. Mechanical Properties

2.3.2. Electrical Properties
2.3.3. Magnetic Properties
2.3.4. Optical Properties
2.3.5. Chemical Properties
2.4. Zero-dimension nanostructures- Nanoparticles
2.4.1. Gold nanoparticles
2.4.2. Silver nanoparticles
2.4.3. Noble metal nanoparticles
2.4.4. Metal oxide nanoparticles
2.5. Quantum dotsç
2.6. One dimensional nanostructures-Nanowires
2.7. Two-dimensional nanostructures – Films
2.8 Three-dimensional nanostructures

3. Synthesis and Characterization of nanomaterials
3.1. Introduction
3.2 Synthesis of gold nanoparticles
3.3 Synthesis of silver nanoparticles
3.4 Noble metal nanoparticles
3.5 Magnetic nanoparticles
3.6. Characterization of nanomaterials
3.6.1. Scanning Probe Microscopy-SPM
3.6.2. Atomic Force Microscopy-AFM
3.6.3. SFA/AFM
3.6.4. Magnetic Force Microscopy-MFM
3.6.5. Auger Electron Spectroscopy-AES
3.6.6. XPS
3.6.7. Raman
3.6.8. X Ray Diffraction- XRD
3.6.9. SEM / TEM
3.6.10. UV/Vis

4. Applications of nanomaterials in Analytical Chemistry
4.1 Introduction
4.2. Sensors based on nanoparticle aggregation / de-aggregation
4.2.1 Direct aggregation / de-aggregation
4.2.2 Aided aggregation
4.2.3 Aided de-aggregation
4.2.4 Indirect aggregation
4.2.5. Reversed de-aggregation
4.2.6. Competitive de-aggregation
4.3. Sensors based on analyte-mediated formation or decomposition of nanoparticles
4.3.1. Analyte mediated Etching/decomposition of nanoparticles
4.3.2. Analyte mediated reduction of gold ions to gold nanoparticles
4.3.3. Analyte mediated reduction of gold ions to gold nanoparticles and aggregation of nanoparticles
4.3.4. kinetically controlled analyte-mediated nanoparticle assays
4.3.5. Analyte-mediated shape-controlled formation of nanoparticles
4.4. Sensor Arrays

4.5 Fluorescence methods based on nanoparticles 4.5.1. Fluorescence emission by replacing nanoparticle surface coating 4.5.2. Fluorescnece emission/quenching via the inner filter effect 4.5.3. Ratiometric fluorescence nano-sensors / probes of constant emission wavelength 4.5.4. Ratiometric fluorescence nano-sensors / probes of variable emission wavelength 4.6. Imaging applications 4.6.1. Tissue/organ/bone imaging 4.6.2. Cell imaging 4.7. Immunoassays 4.7.1. Optical immunoassays 4.7.2. Chemiluminescence immunoassays 4.8. Electrochemical methods 4.9. Surface-enhanced Raman spectroscopy (SERS) 4.10. Magnetic solid phase extraction

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Power Point in lectures.
Communication via email.
Laboratory education</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>42</td></tr>
<tr><td>Presentations by the students</td><td>15</td></tr>
<tr><td>Homework and preparation</td><td>50</td></tr>
<tr><td>Study and analysis of bibliography</td><td>40</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure</td><td></td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

SUGGESTED BIBLIOGRAPHY: :

- Nanomaterials. An Introduction to Synthesis, Properties and Applications Second Edition. D. Vollath, Wiley-VCH, 2013.
- Chemistry of Nanomaterials. Fundamentals and Applications, T.I. Awan, A. Bashir, A. Tehseen, Elsevier, 2020.
- Nanomaterials. The original product of nanotechnology, M. Benelmekki, Morgan & Claypool Publishers, 2019.

RELATED ACADEMIC JOURNALS:

- *PROGRESS IN MATERIALS SCIENCE*
- *NANO LETTERS*
- *ADVANCED MATERIALS*
- *MICROCHIMICA ACTA*
- *ANALYTICA CHIMICA ACTA*
- *ANALYTICAL CHEMISTRY*
- *ACS SENSORS*
- *ACS APPLIED MATERIALS AND INTERFACES*
- *JOURNAL OF MATERIALS CHEMISTRY*

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	Graduate studies Field: Analytical Chemistry, Environmental and Food Chemistry and Technology		
COURSE CODE	**IBO2**	**SEMESTER**	**B**
COURSE TITLE	**ADVANCED COURSES IN FOOD PROCESSING AND FOOD PACKAGING**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised knowledge
PREREQUISITE COURSES:	NO
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 the course, graduate students will be able to understand special issues of food processing and packaging so that they can deal with their daily working life based on the knowledge they have acquired. They will be able to understand the developments of food processing, and packaging. Developments in the food industry aim to produce high quality, safe and less processed foods. To achieve this, the food production and packaging processes must be properly selected and managed. In addition, better management of resources, packaging materials and the environment (through recycling) is required.
Postgraduate students will be asked to study through the literature topics related to the thematic units of the course as well as to solve and/or compare corresponding topics and problems.
In addition, they will be able to search the literature using modern technologies for topics related to food processing and packaging.

General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

Search for, analysis and synthesis of data and information, with the use of the necessary technology. Working independently. Production of new research ideas. Respect to natural environment. Practice criticism and self-criticism. Promoting free, creative and inductive thinking.

(3) SYLLABUS

The main topics of the course are:

A. Packaging materials (metal, glass, paper-cardboard, plastics) - Chemistry, shaping, properties. High barrier materials in food packaging (laminated, bonded, metallized).
B. Interaction of packaging materials with food (migration, permeability, flavor scalping).

C. Intelligent and active food packaging (definition, types, applications in food)
D. Modified Atmosphere Food Packaging
E. Aseptic packaging and packaging for microwaves
F. New and emerging methods of food processing and preservation (Irradiation, High Hydrostatic Pressure, Ohmic and Dielectric Heating, Pulsed Electric and Magnetic Fields, Ultrasound, etc.)
G. Packaging - Environmental Performance (Green consumerism and modern trends, Types of green packaging and necessity of use, Principles of alternative packaging management, Application of techniques "for a world without waste").

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Power point for lectures.
Communication with graduate students via email and video conference</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>70</td></tr>
<tr><td>Project</td><td>40</td></tr>
<tr><td>Personal study</td><td>40</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-</td><td>The language is Greek.
Individual bibliographic project on a specific topic within the scope of the course (50%).
Written exam with development, multiple choice and judgment questions (50%).
The grade of the written exam should be at least 5/10 to pass the course.</td></tr>
</table>

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:

ΣΗΜΕΙΩΣΕΙΣ ΠΑΡΑΔΟΣΕΩΝ των διδασκόντων, Πανεπιστήμιο Ιωαννίνων
(Professors' notes of course, University of Ioannina)

Food Processing Technology, P. Fellows, CRC Press, 2000
Food Packaging Science and Technology, D.S. Lee, K.L. Yam, L. Piergiovanni, CRC Press, 2008.
Food Packaging, Principles and Practice, G.L. Robertson, Marcel Dekker, 1993.
Structure – Property Relationships in Polymers, R.B. Seymour & C.E. Carraher, Jr., Plenum Press, 1984.
Packaging Design and Performance, F. Paine, Pira, 1990.
Mechanical Properties of Polymers and Composites, L. E. Nielsen, Marcel Dekker, 1984.

Related Scientific Journals:
Food Chemistry
Food Research International
European Food Research and Technology
Food Packaging and shelf life

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate: FIELD: Analytical Chemistry, Environmental and Food Chemistry and Technology		
COURSE CODE	**IB03**	**SEMESTER**	**2nd**
COURSE TITLE	**SPECIAL SUBJECTS ON FOOD QUALITY AND SAFETY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialization
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*

Upon successful completion of the course, level 6 of the European Qualifications Framework, students will be able to understand special issues of food quality, safety and entrepreneurship so that they can deal with their daily working life better after their studies. Thus, they can better understand the procedures that a food company is required to implement to ensure continuous and uninterrupted high-level safety and quality of the food products it produces, combined with an understanding of general issues of sound business operation and development in order to have an overall picture of the relevant operations, decisions and strategies in said matters.
Students will be able to solve problems and exercises related to the topics of the course. In addition, they will be able to search the literature 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	*……*
Production of new research ideas	*Others…*
	…….

Search, analysis and synthesis of data and information, by using the proper technologies.
Autonomous work
Practice criticism and self-criticism.
Promoting free, creative and inductive thinking

(3) SYLLABUS

The main sections of the course are the following:
. TOTAL QUALITY MANAGEMENT (Basic principles – historical review – quality control tools).
. FOOD QUALITY CONTROL (Introduction – quality control methods – ISO 9000 and ISO 22000 quality management standards)
. FOOD SAFETY MANAGEMENT SYSTEMS (HACCP systems – good agricultural practices (GAPs) – good manufacturing practices (GMPs)
. ENVIRONMENTAL MANAGEMENT SYSTEMS (ISO 14000) (Introduction – environmental management standard ELOT EN ISO 14001:2015 – European ecological management and control system

. ENTREPRENEURSHIP (the concept of business and its environment – business management) . BUSINESS PLAN (definition – utility – creation)

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of PowerPoint in lectures.
Communication via email.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>70</td></tr>
<tr><td>Study and analysis related literature</td><td>40</td></tr>
<tr><td></td><td>40</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</td><td>Written examination (50%) in Greek, with either multiple choice questionnaires and or answer questions.
Written work on special project submitted (50%).</td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography (in Greek):*
«INTRODUCTION TO MANAGEMENT» Kate Williams, Bob Johnson, ΕΚΔΟΣΕΙΣ ΚΡΙΤΙΚΗ
ISBN: 960-218-446-9 (1η έκδοση 2005)
«BUSINESS ADMINISTRATION» Brian Williams, Angelo Kinicki, ΕΚΔΟΣΕΙΣ ΕΠΙΚΕΝΤΡΟ
ISBN: 978-960-458-702-5 (1η έκδοση 2017)
«BUSINESS PROGRAMMING» James Taylor, ΕΚΔΟΣΕΙΣ ΚΡΙΤΗΡΙΟΝ
ISBN: 960-7433-10-6
«HACCP – THE QUALITY PROCESS WITH APPLIED EXAMPLES» Ευάγγελος Ευμορφόπουλος, ΕΚΔΟΣΕΙΣ ΕΥΔΟΞΟΣ
ISBN: 978-6185-2521-82
«ISO 9000 και ISO 14000 ΤΟ THE FOOD AND DRINK INDUSTRY» Ευστρατιάδης Μ.Μ., Μπουντουρόπουλος Ι.Δ., ΕΚΔΟΣΕΙΣ UNIVERSITY STUDIO PRESS
ISBN: 960-7433-10-6
«ANALYSIS OF DANGER AT THE CRITICAL POINTS OF CHECKING IN THE FOOD INDUSTRY (HACCP) ΣΤΗ ΒΙΟΜΗΧΑΝΙΑ ΤΡΟΦΙΜΩΝ» Τζιά Κωνσταντάντίνα, Αλέξανδρος Τσιαπούρης
ISBN: 978-9607-5103-58

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	Postgraduate studies Field: Analytical Chemistry, Environmental and Food Chemistry and Technology		
COURSE CODE	**IB04**	**SEMESTER**	**B**
COURSE TITLE	**ADVANCED LABORATORY IN FOOD ANALYSIS AND TECHNOLOGY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	5	12
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised knowledge, skills development
PREREQUISITE COURSES:	NO
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*

The graduated students will be trained and will use instrumental analytical techniques regarding the food safety, quality, food characterization and authentication, food packaging etc. In addition, they are trained in organoleptic evaluation and assessment of food.

This training provides them with knowledge, experience and skill development in food analysis, evaluation of results, troubleshooting during analysis, comparison with literature data and writing a final opinion.
Searching the literature using modern technologies is necessary for the final writing of the laboratory report of analysis and evaluation of the food samples given to them

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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

(3) SYLLABUS

The training on the laboratory includes:

Structure identification of multilayer packaging materials (identification, measurement of contribution layers, mechanical properties, permeability measurement).
Determination of volatile compounds by the SPME/GC-MS technique.
Determination of sugars in food by HPLC-RI.
Determination of organic acids in food by HPLC-UV/Vis.

Measurement of mechanical properties of food with an Instron dynamometer (puncture, texture profile analysis). Measurement and evaluation of food color (HunterLab colorimeter). Measurement and evaluation of food viscosity. Organoleptic evaluation of food (aroma, taste, color, evaluation and assessment of preference).

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face, laboratory training</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Power point for laboratory courses.
Communication with graduate students via email and video conference</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Tutorial preparation lectures</td><td>20</td></tr>
<tr><td>Laboratory practise</td><td>140</td></tr>
<tr><td>Report writing</td><td>70</td></tr>
<tr><td>Personal study</td><td>70</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Total</td><td>300</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination,</td><td>Greek language.
Average performance in the Laboratory through oral examination and reports (50%).
Writing evaluation (short answers, problem-solving, open-ended questions, judgement questions) (50%).
The grade of the written exam should be at least 5/10 to pass the course.</td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

ΕΡΓΑΣΤΗΡΙΑΚΕΣ ΣΗΜΕΙΩΣΕΙΣ, Μπαδέκα, Αναπλ. Καθ., Πανεπιστήμιο Ιωαννίνων (Laboratory instructions and notes, A. Badeka, Assi. Prof. University of Ioannina)

Food Analysis, Nielsen S., Springer 2010.
Handbook of Food Analysis. Nollet L.M.L., Marcel Dekker 2004.

Related Scientific Journals:

Food Chemistry
Food Research International
Journal of Agricultural and Food Chemistry
Journal of Food composition and Analysis
Food Research International
Food Control

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IB02**	**SEMESTER**	**2**
COURSE TITLE	**LABORATORY OF ENVIRONMENTAL POLLUTION CONTROL**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
LABORATORY EXERCISES	6	12
TOTAL	78	
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 knowledge / skills development
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 7 of the European Qualifications Framework for Lifelong Learning, the students will be capable to:

• Understand deeply methods, techniques and instrumentation used in pollution control and environmental analysis.

• to use their knowledge and skills in applications and problem-solving, within an interdisciplinary context, relevant to their field of knowledge.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

• Application of knowledge dealing with advanced methods, techniques and technologies for environmental analysis and pollution control.
• 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 instrumentation
• Inquiring the necessary learning skills that allow them to continue their studies in a largely self-reliant or even autonomous manner.
• Possesses specialized problem-solving skills, which are required in research and/or innovation in order to develop new knowledge and processes and integrate knowledge from different fields.
• 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

Standards methods for the examinations of physicochemical parameters of water and wastewaters (pH, conductivity, dissolved oxygen, total solids, turbitity, etc), Determination of Biochemical Oxygen Demand, Chemical Oxygen Demand, Total Organic carbon, Elemental analysis, Determination of total phenols by UV-Vis, Determination of Chromium (VI), Determination of anions and cations by ion chromatography, Characterization of natural waters by spectrophotometry and fluorescence, QuEChERS extraction and liquid-solid extraction of pesticides and organic contaminants from environmental and food matrices coupled by gas and liquid chromatography, Mass spectrometry, Toxicity bioassay (*Vibrio Fisheri*), Scanning Electron microscopy (SEM) of environmental particles.

(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 Technologies of Information and communications in teaching of the theoretical part and communication with students.
TEACHING METHODS *The manner and methods of teaching are described in detail.*	

Activity	***Semester workload***
Laboratory practice	78
Laboratory essay	117

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*	Bibliography study: 105 Course total: ***300***
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 team (2 or 3 students) essay/project for every laboratory exercise Evaluation criteria: (α) Plenitude of essay (30%), (β) quality of experimental results (30%), (γ) treatment and interpretation of data (40%)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (in Greek):

1) Notes/Presentations of Instructors

2) Instrumental Environmental Analysis, I. Deliginnakis, D. Hela, I. Konstantinou, Eds. Tziola. *ISBN:* 978-960-418-233-6

- Related academic journals:

1) Modern Environmental Analysis Techniques for Pollutants, 2020, ISBN 978-0-12-816934-6
2) Trends in Environmental Analytical Chemistry
3) International Journal of Environmental Analytical Chemistry
4) Environmental Pollution
5) Environmental Science and Pollution Research

FIELD II

CHEMISTRY, PHYSICAL CHEMISTRY AND MATERIALS TECHNOLOGY - EPISTEMOLOGY

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIA01**	**SEMESTER**	**1**
COURSE TITLE	**SURFACE PHENOMENA, HETEROGENEOUS CATALYSIS, PHOTOCATALYSIS**		

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(ECTS)*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Total	39	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized knowledge / skills development
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.

- *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.*

- *Guidelines for writing Learning Outcomes .*

After the successful completion of the course, descriptive level 7 of the European Qualifications Framework for Lifelong Learning, the students will be capable to:

• Understand deeply principles and develop skills related to surface science and applications of materials in adsorption and catalytic technologies in the industry and the environmental protection

• to use their knowledge and skills in applications and problem-solving, within an interdisciplinary context, relevant to their field of knowledge.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

• Application of knowledge dealing with advanced methods, techniques and technologies for environmental protection and materials characterization and applications.

• 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

• Inquiring the necessary learning skills that allow them to continue their studies in a largely self-reliant or even autonomous manner.

• Possesses specialized problem-solving skills, which are required in research and/or innovation in order to develop new knowledge and processes and integrate knowledge from different fields.

• 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

Heterogeneous catalysis, kinetics of heterogeneous catalytic reactions, acid-base and redox reactions, determination of acidic and basic surface sites, mechanisms of acid-base reactions of dehydration of alcohols, isomerization of alkenes and decomposition of hydrocarbons, redox reactions: conductivity of materials and application of redox heterogeneous catalysis in antipollution technologies for mobile and stationary sources (Three-way catalysts and Selective Catalytic Reduction), Fuel cells, membranes of ceramic materials, structure and characteristics of the main types of cells, Fractal dimension of surfaces, fractal surfaces in nature and shapes with fractal dimension, determination of fractal dimension of ceramic surfaces of materials, Colloidal systems, Classification of dispersion systems, Preparation and purification of dispersion systems, Brownian motion, Osmosis, Diffusion, Sedimentation, and Properties of dispersion systems (optical, electrical, etc) – Potential (measurement,

applications, etc.), DLVO theory of colloids stability, Aggregation-Thrombosis-Flocculation, The importance of colloids (Industry, Biology, Medicine, Agriculture,), Surfactant or surface-active compounds (characteristics, categories, structures), Micelle formation mechanism, Critical micelle concentration (cmc), Decontamination, Foaming agents, Anti-fogging agents, Ore enrichment, Preparation of ceramics for special uses, Emulsions-Microemulsions, factors affecting the structure of emulsions, Adsorption on technological and natural materials, Properties of adsorbent materials (activated carbons, zeolites, etc.), Applications in the removal of pollutants and the recovery of valuable materials, Basic principles of Photocatalysis, Homogeneous Photocatalysis (photo-Fenton, etc.), Heterogeneous photocatalysis, Principles- Mechanisms, Modification of catalysts (doping with metals, non-metals), Composite photocatalysts (Types I, II, biomimetic z-schemes), Oxidant activation catalysts (persulfate, peroxymonosulfate, etc), Applications in pollutant degradation and energy production.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to Face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of Technologies of Information and communications in teaching and communication with students.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Written essay</td><td>45</td></tr>
<tr><td>Bibliography study</td><td>66</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
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<tr><td></td><td></td></tr>
<tr><td>Σύνολο Μαθήματος</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination,</td><td>Written essay/project
Evaluation criteria: (a) Plenitude of essay (25%), (b) quality and treatment, interpretation of data (30%), (c) oral presentation (25%) (d) short questions during oral presentation (20%)</td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography (in Greek):*
Notes/Presentations of professors, Review papers

- *Related academic journals:*
1) Colloids and Surfaces A: Physicochemical and Engineering Aspects
2) Applied Surface Science
3) Applied Catalysis B:Environmental
4) Catalysis Today
5) Chemical Engineering Journal
6) Industrial and Engineering Chemistry

COURSE OUTLINE

GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	IIA02	SEMESTER	A
COURSE TITLE	Synthesis of advanced and nanostructured materials		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits	WEEKLY TEACHING HOURS	CREDITS
	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE general background, special background, specialised general knowledge, skills development	Special background, specialized general knowledge
PREREQUISITE COURSES:	NONE
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	

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, graduate students should be able to: Understand basic principles of synthetic chemistry of nanostructured materials and especially non-classical synthetic techniques. Solve synthetic problems and be able to propose alternative synthetic pathways when classic solutions that are related to the above principles fail.

More specifically:
1. Familiarize themselves with the chemical strategies towards the synthesis of chalcogenic materials, halogenated perovskites, graphitic allotropes, metal-organic frameworks (MOF), materials based on covalent organic frameworks (COFs), ceramic materials and inorganic oxides.
2. Familiarize themselves with hydrothermal / solvothermal techniques of chemical functionalization or doping of the lattice of nanostructured materials
3. Familiarize themselves with protocols related with hydrolysis/condensation schemes in sol-gel processes.
4. Know specific safety measures for dangerous synthetic procedures.
5. Familiarize themselves with either bottom up (chemical vapor deposition, laser ablation, arc discharge) or top-down (sonication-assisted exfoliation) techniques.
Knowledge
Deepening the basic concepts of synthesis in variable synthetic conditions and distinct knowledge on principles and theories related to the synthesis of nanostructured materials.
Skills
Advanced problem-solving skills through careful analysis of the provided data.
Abilities
Ability to apply the provided knowledge to the problems (theoretical and synthetic) related to synthetic chemistry of nanostructured materials.
Ability to propose synthetic pathways and safety measures for the synthesis of nanomaterials.
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
Adapting to new situations	Respect for difference and multiculturalism
Decision-making	Respect for the natural environment
Working independently	Showing social, professional and ethical responsibility and sensitivity to gender issues
Team work	Criticism and self-criticism
Working in an international environment	Production of free, creative and inductive thinking
Working in an interdisciplinary environment	……
Production of new research ideas	Others…
	…….

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

Pay respect to environment by employing green precursor substances and store any reaction wastes
Capability of survey, analysis of data and details taken form international literature as well as utilization of appropriate tools related to the presentation of research results.

SYLLABUS

Chalcogenic materials - Halogenated perovskites - Graphitic allotropes – Chemical functionalization of graphitic nanostructures – Metal-organic frameworks (MOF) – Materials based on covalent organic framework (COFs) – Sol-gel synthesis of inorganic oxides – Synthesis of ceramic materials – Synthesis of supported catalysts – Chemistry of precursor substances for materials fabrication – Surface chemical functionalization of advanced and nanostructured matrices

TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>- Use of ICT in teaching
- Email communication with students</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Essay writing</td><td>45</td></tr>
<tr><td>Non-directed study</td><td>66</td></tr>
<tr><td></td><td></td></tr>
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<tr><td></td><td></td></tr>
<tr><td>Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation,</td><td>Students are evaluated (in Greek) in a combined mode, by presenting to the teaching committee and individual public audience of a project (essay) as well as by final written examination. The latter exam includes questions and problems (multiple choice, short response, problem solving).</td></tr>
</table>

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 written examination and the presentation of the essay have equal impact to the final grade (50% : 50%)

ATTACHED BIBLIOGRAPHY

Nanomaterials Synthesis, Design, Fabrication and Applications, 2019 (1η έκδοση), Elsevier, Editors: Yasir Beeran Pottathara, Sabu Thomas, Nandakumar Kalarikkal, Yves Grohens, Vanja Kokol, Paperback ISBN: 9780128157510
Synthesis of Nanomaterials, Mechanisms, Kinetics and Materials Properties, 2020, Springer, Author: S. Noor Mohammad, Hardcover ISBN: 978-3-030-57584-7

Introduction to Reticular Chemistry Metal-Organic Frameworks and Covalent Organic Frameworks, Omar M Yaghi, Markus J Kalmutzki, Christian S Diercks — Wiley-Vch (2019) Print ISBN: 978-3-527-34502-1

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	POST-GRADUATE		
COURSE CODE	**IIA03**	**SEMESTER**	**A**
COURSE TITLE	**COMPUTATIONAL CHEMISTRY – STATISTICAL MECHANICS – STRUCTURE AND PROPERTIES**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background, specialized 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*

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

• To understand basic principles of Computational Chemistry and Statistical Engineering.

• Solve synthetic problems and be able to propose relationships between the structure and properties of materials in all phases.

More specifically:

1) Calculation of equilibrium constants of chemical reactions from molecular characteristics and Calculation of thermodynamic properties using the Monte Carlo method.

2) Familiarity with the basic algorithms of molecular dynamics and the Computational methodologies for determining structure, spectroscopic constants and energy parameters of molecular systems.

3) Correlation of crystal structure with the activity of solids.

4) Correlation of crystal structure with adsorption phenomena.

5)Fluorescence phenomena in the solid state.

Skills

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

Abilities

Ability to apply the provided knowledge to solving problems (theoretical and synthetic) related to Computational Chemistry and Statistical Engineering.

Ability to both work independently and interact with other students on course topics.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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 capability.

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

Pay respect to environment by employing green precursor substances and store any reaction wastes

Capability of survey, analysis of data and details taken form international literature as well as utilization of appropriate tools related to the presentation of research results.

(3) SYLLABUS

Summary of basic concepts of Statistical Thermodynamics. The concept of the statistical set in the description of the macroscopic system. Calculation of equilibrium constants of chemical reactions from molecular characteristics. The Metropolis Monte Carlo method. Calculation of thermodynamic properties using the Monte Carlo method. Basic molecular dynamics algorithms. The Verlet algorithm. Periodic boundary conditions. Temperature control. Correlations of electronic structure and properties of molecules Isobolic Ratio Model Computational methodologies for determining structure, spectroscopic constants and energy parameters of molecular systems. Brief description of computational algorithms and what they can calculate. The concept of the dynamic surface of a molecular system. Energy barriers and minima and the importance of surface dynamics in Chemical Kinetics. Correlation of crystal structure with the activity of solids. Regiochemical reactions in solids. Correlation of crystal structure with activity of pharmaceutical solids. Amorphous, polymorphic and eutectic forms. Molecular Porous solids. Correlation of crystal structure with adsorption phenomena. Fluorescence phenomena in the solid state. Applications to molecular thermometers.

(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 ICT in teaching - Email 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-*	

Activity	***Semester workload***
Lectures	39
Essay writing	45
Non-directed study	66
Total	**150**

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.*	Students are evaluated (in Greek) in a combined mode, by presenting to the teaching committee and individual public audience of a project (essay) as well as by final written examination. The latter exam includes questions and problems (multiple choice, short response, problem solving). The written examination and the presentation of the essay have equal impact to the final grade (50% : 50%)

(5) ATTACHED BIBLIOGRAPHY

Μοριακές Κβαντικές Καταστάσεις και Στατιστική Θερμοδυναμική, 2018 (1η έκδοση), Εκδόσεις Συμμετρία, Α. Μυλωνά-Κοσμά, Α. Γ. Καλαμπούνιας, ISBN: 978-960-266-473-5

Exploring Chemistry with Electronic Structure Methods, 1996, Gaussian Inc. Pittburgh, PA, Authors: James N. Foresman, Aellen Frisch ISBN: 0-9636769-3-8

RELATED JOURNALS

JOURNAL OF CHEMICAL PHYSICS
JOURNAL OF PHYSICAL CHEMISTRY
PHYSICAL CHEMISTRY CHEMICAL PHYSICS

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIA04**	**SEMESTER**	**1st**
COURSE TITLE	**TECHNOLOGY OF MATERIALS FROM OIL AND BIOMASS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	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*

After successfully completing the course, descriptive marker 7 of the European Qualifications Framework, students should be able to:

- Understand the basic princiles of 4th and 5th industrial revolutions, of sustainability, of Circular Economy and Bioeconomy, of Sustainable Unit Operations and Chemical Processes applied in Petrochemical Industry and Biomass refineries (Biorefineries).

Solve problems of Chemical Product Design, Green Chemistry and Green Chemical Technology. **Knowledge**

Deepening the basic concepts of industrial Unit Operations and Chemical Processes, energy and fossil fuels, petrochemicals, biofuels, materials and chemicals from Biomass, Green Chemical Technology.

Skills

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

Abilities

Ability to apply the provided knowledge to the design of industrial processes and chemical product design.

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

Ability to search for data, data analysis, using new technologies, to respect the environment.

Students will gain basic knowledge in issues of fossil fuels, unit operations applied in petroleum refinery and in petrochemicals, their properties and uses, in Green Chemical Technology and production of green chemicals and fuels from biomass by using the biorefinery. 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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

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

(3) SYLLABUS

Industrial Chemistry in Industry 4.0 and Industry 5.0. Natural resources. Raw materials in Chemical Industry. Energy forms. Energy in chemical industry. Mass and energy balances. Basic unit operations and chemical processes in chemical industry. Industry 4.0 and Industry 5.0. Properties of fuels – calorific value. Non-renewable fossil-based fuel materials. Carbon, crude oil, natural gas – origin, reserves, composition, properties, uses. Petrochemical industry, petroleum refinery as the basic unit, oil refinement, basic unit operations in oil refinery, pyrolysis, catalytic processes in refinery. Gas, liquid, solid product from atmospheric distillation column and from vacuum distillation column. Naphtha, diesel, - production, properties, uses, gasoline – properties, composition, properties, production, additives, synthetic gasoline, kerosene, liquified petroleum gas (LPG). Chemical product design. Chemical industry, petrochemicals – basic chemicals, chemical intermediates, consumer products, largest-volume polymer products, elastomers, textile fibers, surfactants and detergents, solvents, asphaltic materials, lubricants, colorants, adhesives, sealings, materials for pharmaceutical applications and medicine, materials for applications in waste treatment. Fossil resources depletion. Petroleum and petrochemicals as pollutants. Sustainability. Circular economy and Bioeconomy. Green chemistry and green chemical technology. Principles of green chemistry and principles of green engineering. Sustainable processes in Industrial Chemistry. Green solvents, green catalysts. Sustainable – green materials. Biorefineries – raw materials, processes, and products. Biomass. Natural polymers, starch-cellulose-hemicellulose-plant oils-algae as raw materials for sustainable materials, biorefinery processes, chemical intermediates, customer products, biofuels – biodiesel, bioethanol, biogas, biomethanol, biodimethylether, bio-ETBE, bio-MTBE, synthetic biofuels, pure plant ois- sustainable biomass derived polymeric materials, biodegradable and biocompatible polymers, ‘drop in bioplastics’ (substituents of petrochemical plastics) – biopolyethyene, biopropylene, bio-PET, novel polymers from renewable resources, chemicals, green solvents, other biomass based materials. Materials form carbon dioxide.

(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 PowerPoint in lectures. Communication via email.	
TEACHING METHODS	***Activity***	***Semester workload***
	Lectures	39

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*	Individual study, preparation	66
	Written assignment	45
	Course total (25 hours of workload per credit unit)	**150**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Students are evaluated (in Greek or in English) 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 Literature :
Notes/Presentations of the Instructor.
Sustainable Industrial Chemistry, Fabrizio Cavani, Gabriele Centi, Siglinda Perathoner, Ferruccio Trifiró, Wiley-VCH Verlag GmbH & Co. KGaA, 2009, Print ISBN:9783527315529, Online ISBN:9783527629114, DOI:10.1002/9783527629114.

-Related scientific journals:

ACS Sustainable Chemistry and Engineering
Industrial and Engineering Chemistry Research
Green Chemical Engineering
Bioresource Technology
Green Chemistry
Biomass
Fuel Processing Technology
ACS Energy and Fuels
Polymer

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Graduate		
COURSE CODE	**IIA05**	**SEMESTER**	**1st**
COURSE TITLE	**HISTORY OF CHEMISTRY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	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*

After successfully completing the course, descriptive marker 7 of the European Qualifications Framework, students should be know the milestones in History of Science and also in History of Chemistry and should be able to understand the importance of them for the progress of Science and Chemistry.
In specific the students will gain knowledge of the main issues of History of Science and Historiographic Strategies, in History of Chemistry in the 17th Century, the Phlogiston Theory, the Chemical Revolution (Lavoisier), of the strategy of Lavoisier and the strategy of Priestly, the Foundation of chemical element, and the chemical Nomeclature.

Knowledge

Deepening the basic concepts of History of Science and History of Chemistry.

Skills

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

Abilities

Ability to work independently and to interact with other students on the subject.
Ability to search for data, data analysis, using new technologies, 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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

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

(3) SYLLABUS

HISTORY OF SCIENCE. HISTORIOGRAFICAL STRATEGIES, HISTORY OF IDEAS OR HISTORY OF CONCEPTS;
HISTORY OF CHEMISTRY IN 17th CENTURY: MECHANICAL CHEMISTRY, BOYLE, LEMERY. THE NEWTONIAN CHEMISTRY. TABLES OF CHEMICAL AFFINITY-GEOFFROY
1700-1750. PHLOGISTON THEORY. CHEMISTRY OF GASES. THE ANALYTICAL IDEAL. THEORY OF SALTS. HOMBERG, RUELLE, BOERHAAVE, HALES, MACQUER
1750-1800. BLACK, BERGMAN, CAVENDISH, KIRWAN, PRISTLEY, BERTHOLLET, FOURCROY
THE EMERGENCE OF CHEMICAL QUESTIONS. THE END OF PHLOGISTON THEORY CHEMICAL REVOLUTION (LAVOISIER).
PHILOSOPHICAL ASSUMPTIONS IN LAVOISIER'S WORK. DIFFERENCES IN STRATEGIES BETWEEN LAVOISIER AND PRIESTLEY
THE FOUNDATION OF CHEMICAL ELEMENT. ANALYSIS OF 'TRAITE ELEMENTAIRE'.
CHEMICAL NOMENCLATURE. THE FOUNDATION OF CHEMICAL NOMENCLATURE

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of PowerPoint in lectures.
Communication via email.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Individual study, preparation</td><td>66</td></tr>
<tr><td>Written assignment</td><td>45</td></tr>
<tr><td></td><td></td></tr>
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<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total
(25 hours of workload per credit unit)</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>Students are evaluated (in Greek) by presenting to the teaching committee and individual public audience of a project and by final written</td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

-Suggested Literature : *-Related scientific journals:*

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
DEPARTMENT	CHEMISTRY		
STUDY LEVEL	GRADUATE		
COURSE CODE	**IIA06**	**SEMESTER**	**1**
COURSE NAME	**LABORATORY OF SYNTHESIS AND CHARACTERIZATION OF MATERIALS**		

TEACHING ACTIVITIES if credits are awarded in separate parts of the course eg Lectures, laboratory practicals, etc. If credits are awarded the same for the entire course, they should indicate the hours per week and the total of credits	**WEEKLY LECTURE HOURS**	**CREDITS**
	6	12

TYPE OF COURSE general background, special background, specialization, general knowledge, developing skills	Scientific area / Developing skills
PREREQUISITE COURSES:	There are no prerequisites. However, the knowledge of basic principles of inorganic chemistry with emphasis on coordination compounds (complexes) is desirable.
LANGUAGE TEACHING and EXAMINATION:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	It does not exist

(2) LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course the specific knowledge, skills and abilities appropriate level 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.

- *Summary writing Guide of Learning Outcomes*

• The aim of the course is to teach and consolidate principles of Materials Chemistry through appropriate laboratory exercises and to train students in synthesis and characterization techniques of inorganic compounds

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

1. To recognize the contribution of Materials Chemistry to the development of chemistry and other related branches of science.
2. To be able to synthesize materials using appropriate synthetic methods.
3. Be able to isolate materials in pure form using appropriate purification methods.
4. Interpret infrared and visible-UV spectroscopic, fluorescence and X-ray diffraction data of inorganic and organic materials, etc.
9. To be able to estimate and evaluate biological, biochemical, mechanical ,catalytic properties of materials and their technological importance.

Knowledge

Knowledge and understanding of basic concepts, principles and theories related to the synthesis and physicochemical characterization of coordination compounds.

Skills

Skills in the synthesis and purification of materials, use of UV-Vis, IR spectrometers, fluorimeters and single crystal-powder X-ray diffractometers.

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 Materials Chemistry.

Ability to prepare materials in pure form.

Ability to use spectrometers.

Ability to interpret spectroscopic data.

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) what / which of these skills the course is aimed ?

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 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 Materials Chemistry) and in laboratory.

(3) COURSE SYLLABUS

Instructor Professor M. Siskos (4X6 hours) Synthesis of organic materials and their spectroscopic characterization and study of fluorescence properties. Instructor Assoc. Prof E Manos (5x6 hours) Synthesis and characterization of metal organic frameworks Instructor Professor A Tsipis (4X6 hours) Synthesis and characterization of inorganic materials-LED.

(4) TEACHING and LEARNING METHODS - EVALUATION

LECTURE DELIVERY METHOD *Face to Face, distance learning κ.λπ.*	Face to Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Using ICT in Teaching , Laboratory Training and in Communication with the students*	Electronic communication with students. Post-exercise additional notes etc. on the websites of teachers
ORGANIZING THE TEACHING *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 creation etc.* *Enter the hours of study for each student learning activity and hours of Non-guided study in accordance with the principles of ECTS*	

ACTIVITY	***SEMESTER WORK LOAD***
Lectures	16
Laboratory exercise	62
Tutorial	50
Writing work	60
Individual study and preparation	60
Oral presentations of assignments	52
TOTAL *(25 hours of work load per credit)*	***300***

STUDENT EVALUATION *Description of the evaluation process* *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* *Indicate clearly defined evaluation criteria and whether and which are accessible to students.*	The students are graded based on their assignments-oral presentation of 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.

(5) SUGGESTED LITERATURE

-SUGGESTED LITERATURE :

EYDOXOS

INORGANIC CHEMISTRY- ISSUE B
EYDOXOS NUMBER: 102070044
AUTHORS: WELLER MARK, ROURKE JONATHAN, OVERTON TINA, ARMSTRONG FRASER

OTHERS

1. K. Nakamoto, “Infrared and Raman Spectra of Inorganic and Coordination Compounds, 5th edition, Parts A and B”, Willey-Interscience
Pubs, 1997.
2. A. R. West, “Basic Solid State Chemistry”, Wiley, 2001
3. A.B.P. Lever, “Inorganic electronic spectroscopy (second edition), Elsevier, 1984
4. Zvi Szafran, Ronald M. Pike, Mono M. Singh, “Microscale Inorganic Chemistry”,
J. Wiley (1991).
5. B. Valeur, Prof. M. N. Berberan Santos(auth.)-«Molecular Fluorescence: Principles and Applications», (Second Edition), Wiley, 2012
6. Joseph R. Lakowicz, «Principles of Fluorescence Spectroscopy» 3rd Edition, Springer, (2006)

-Related Scientific Journals:
Inorganic Chemistry
Chemistry of Materials
Journal of Materials Chemistry A
Advanced Materials

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	CHEMISTRY		
LEVEL OF STUDIES	GRADUATE		
COURSE CODE	**IIA07**	**SEMESTER**	1st
COURSE TITLE	**COMPUTATIONAL CHEMISTRY & MOLECULAR SIMULATION LAB (I)**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Exercises-Lectures	10	12
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge
PREREQUISITE COURSES:	Essential attendance and participation in the lab course requires knowledge of basic mathematics, thermostatistics and quantum mechanics coursework taught in the first, second, third and fourth years of undergraduate studies (Calculus I & II, Physical Chemistry I, II & III, Applications of Quantum Chemistry) 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

(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 lab is included in the compulsory optional courses of the thematic unit of Chemistry, Physical Chemistry and Materials Technology-Epistemology, aiming at training of the student with modern methods of Computational Chemistry for the calculation of physical and chemical properties of various atomic and molecular systems.

The subject matter of the lab aims at the specialization of students in the following subjects:
-familiarization with methods for i) integral evaluation, ii) solution of self-consistent equations, iii) evaluation of the energy gradient, iv) integral transformation, v) exploitation of molecular symmetry and vi) for generation of three-dimensional molecular orbital and total electron density plots,
-selection of a model (Hartree-Fock methods, atomic basis sets of Gaussian functions, electron correlation methods {limited configuration interaction, Möller-Plesset perturbation treatments, etc}),
-molecular geometry, input: the Z-matrix, output,
-equilibrium geometries, vibrational frequencies and thermodynamic properties, molecular conformations and barriers to rotation and inversion, thermochemical stabilities of molecules, electric dipole moments and molecular charge distributions.

After successful completion of the lab, students should be able to:
-successfully evaluate computational chemistry integrals, to set up and solve self-consistent equations, to understand and evaluate the energy gradient vector, to easily manipulate integral transformations, to make a thorough use of the existing molecular symmetry and to generate, via available software, three-dimensional molecular orbital and total electron density plots,
-select between available levels of theory (Hartree-Fock methods, electron correlation methods {limited configuration interaction, Möller-Plesset perturbation treatments, etc}) and atomic basis sets of Gaussian functions,
-set up the molecular geometry and prepare the input information with the corresponding Z-matrix and all appropriate keywords, and later to read and realize all output info (graphs and plots included),
-calculate equilibrium and stationary geometries (minima, transition states, saddle points), vibrational frequencies (which confirm the geometry type) and thermodynamic properties, molecular conformations and barriers to rotation and inversion, thermochemical stabilities of molecules, electric dipole moments and molecular charge distributions.

Knowledge:
-to acquire knowledge i) for the evaluation of computational chemistry integrals, ii) for the set up and solvation of self-consistent equations, iii) for a thorough understanding and evaluation of the energy gradient vector, iv) for a comfortable manipulation of integral transformations, v) for a thorough use of the existing molecular symmetry and vi) for the generation, via available software, of three-dimensional molecular orbital and

total electron density plots,
-basic knowledge of selecting between available levels of theory (Hartree-Fock methods, electron correlation methods {limited configuration interaction, Möller-Plesset perturbation treatments, etc}) and atomic basis sets of Gaussian functions,
-assimilation of setting up the molecular geometry and preparing the input information with the corresponding Z-matrix and all appropriate keywords, and furthermore reading and realizing all output info (graphs and plots included),
-complete knowledge of calculating equilibrium and stationary geometries (minima, transition states, saddle points), vibrational frequencies (which confirm the geometry type) and thermodynamic properties, molecular conformations and barriers to rotation and inversion, thermochemical stabilities of molecules, electric dipole moments and molecular charge distributions.

Skills:
-skills in i) evaluating computational chemistry integrals, ii) setting up and solving self-consistent equations, iii) understanding and evaluating the energy gradient vector, iv) manipulating integral transformations, v) taking advantage of the existing molecular symmetry and vi) generating, via available software, three-dimensional molecular orbital and total electron density plots,
-skills in selecting between available levels of theory (Hartree-Fock methods, electron correlation methods {limited configuration interaction, Möller-Plesset perturbation treatments, etc}) and atomic basis sets of Gaussian functions,
-skills in setting up the molecular geometry and preparing the input information with the corresponding Z-matrix and all appropriate keywords, and furthermore reading and realizing all output info (graphs and plots included),
-skills in calculating equilibrium and stationary geometries (minima, transition states, saddle points), vibrational frequencies (which confirm the geometry type) and thermodynamic properties, molecular conformations and barriers to rotation and inversion, thermochemical stabilities of molecules, electric dipole moments and molecular charge distributions.

Abilities:
-ability to successfully evaluate computational chemistry integrals, to set up and solve self-consistent equations, to understand and evaluate the energy gradient vector, to easily manipulate integral transformations, to make a thorough use of the existing molecular symmetry and to generate, via available software, three-dimensional molecular orbital and total electron density plots,
-ability to select between available levels of theory (Hartree-Fock methods, electron correlation methods {limited configuration interaction, Möller-Plesset perturbation treatments, etc}) and atomic basis sets of Gaussian functions,
-ability to set up the molecular geometry and prepare the input information with the corresponding Z-matrix and all appropriate keywords, and later to read and realize all output info (graphs and plots included) and
-ability to calculate equilibrium and stationary geometries (minima, transition states, saddle points), vibrational frequencies (which confirm the geometry type) and thermodynamic properties, molecular conformations and barriers to rotation and inversion, thermochemical stabilities of molecules, electric dipole moments and

molecular charge distributions.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

The course aims at acquiring high level knowledge of computational chemistry and experience in employing various related software packages, necessary for calculating physical and chemical properties of various atomic and molecular species. In particular, the areas of focus and understanding of the above concepts are aimed at developing the following abilities:

-evaluate computational chemistry integrals, set up and solve self-consistent equations, understand and evaluate the energy gradient vector, easily manipulate integral transformations, make a thorough use of the existing molecular symmetry and generate, via available software, three-dimensional molecular orbital and total electron density plots,
-apply critical thinking in selecting between available levels of theory (Hartree-Fock methods, electron correlation methods {limited configuration interaction, Möller-Plesset perturbation treatments, etc}) and atomic basis sets of Gaussian functions,
-set up the molecular geometry and prepare the input information with the corresponding Z-matrix and all appropriate keywords, and later read and realize all output info (graphs and plots included) and
-calculate equilibrium and stationary geometries (minima, transition states, saddle points), vibrational frequencies (which confirm the geometry type) and thermodynamic properties, molecular conformations and barriers to rotation and inversion, thermochemical stabilities of molecules, electric dipole moments and molecular charge distributions and
-manage an appraisal number of atomic and molecular problems in order to gain self-reliance and self-confidence about the "computational chemistry" way of acting.

(3) SYLLABUS

-Advanced methods for i) integral evaluation, ii) solution of self-consistent equations, iii) evaluation of the energy gradient, iv) integral transformation, v) exploitation of molecular symmetry and vi) for generation of three-dimensional molecular orbital and total electron density plots,
-Level of theory selection (Hartree-Fock methods, atomic basis sets of Gaussian

functions, electron correlation methods {limited configuration interaction, Möller-Plesset perturbation treatments, etc}),
-Definition of molecular geometry, input: the Z-matrix, output,
-Calculation of equilibrium geometries and stationary points, vibrational frequencies and thermodynamic properties, molecular conformations and barriers to rotation and inversion, thermochemical stabilities of molecules, electric dipole moments and molecular charge distributions and
-Managing an appraisal number of related problems in order to gain self-reliance and self-confidence about the "computational chemistry" way of thinking.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>In the computational chemistry lab, encouraging students to participate in theoretical experiments/exercises.</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Support of the learning process through the e-cource electronic platform, a variety of short explanatory video projections and the use of specialized web pages.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>20</td></tr>
<tr><td>Laboratory practice</td><td>200</td></tr>
<tr><td>Tutorial</td><td>45</td></tr>
<tr><td>Writing work</td><td>20</td></tr>
<tr><td>Individual study and preparation</td><td>15</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>TOTAL</td><td>300</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-</td><td>The completion of thirteen (13) computational exercises on preselected topics, upon consultation with the instructor, after the completion of the laboratory exercises.</td></tr>
</table>

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: *- Related academic journals:* *-Suites of programs: Gaussian09, GAMESS-US και NWChem, "Ab Initio Molecular Orbital Theory", W. J. Hehre, L. Radom, P. v.R. Schleyer and J. A. Pople, J. Wiley & Sons, Inc., 1985. Related scientific journals: Journal of Chemical Physics, Journal of Physical Chemistry A, B, C, Chemical Physics, Chemical Physics Letters, Journal of the American Chemical Society, Nature Chemistry, Computational and Theoretical Chemistry, Physical Chemistry Chemical Physics, ChemPhysChem.*

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department Of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIB01**	**SEMESTER**	**2nd**
COURSE TITLE	**FUNCTIONAL AND CATALYTIC MOLECULAR MATERIALS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
CLASSROOM	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	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*

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

- Understand the basic categories of functional materials.
- Understand the technological applications of these materials

More specifically:
1. Familiarize themselves with the advanced synthetic techniques for the preparation of inorganic and inorganic-organic hybrid materials.
2. Familiarize themselves with the advanced characterization methods of molecular materials
3. Familiarize themselves with studies of materials properties such as catalytic, luminescence etc.
4. Familiarize themselves with the applications of molecular materials in the field of energy, such as photovoltaics.
5. Familiarize themselves with the correlation of structure-property of materials.
6. Be able to predict possible properties of new compounds

Knowledge

Deepening the basic concepts of synthesis of advanced materials and their technological applications.

Skills

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

Abilities

Ability to apply the provided knowledge to the problems (theoretical and synthetic) related to molecular materials chemistry.

Ability to propose synthetic pathways for the synthesis of molecular materials with specific properties.

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*
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 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 subjects of synthetic chemistry) and in a laboratory.

(3) SYLLABUS

1. Metal Organic Frameworks. Structures and topological analysis.
2. Luminescence properties of Molecular Materials
3. Luminescence sensors
4. Catalytic Molecular Materials
5. Correlation of structure and catalytic activity of molecular materials.
6. Molecular materials for photovoltaic applications
7. Lanthanide molecular materials.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>e-mail communication with the students, Power point presentations.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Individual study, preparation</td><td>66</td></tr>
<tr><td>Writing a paper t o present</td><td>45</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total
(25 hours of workload per credit unit)</td><td>150</td></tr>
<tr><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and</td><td>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)</td></tr>
</table>

where they are accessible to students.	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (first in Greek):

1. Solid state chemistry and its applications, Anthony R. West, Wiley, 2013.
2. Molecular Materials, Inorganic Materials Series, D. W. Bruce, D. O'Hare and R. I. Walton (Editors), Wiley, 2010.
3. Materials Chemistry, Bradley D. Fahlman, Springer, 2007.
4. Metal-Organic Frameworks for Photonics Applications, B. Chen and G. Qian (Editors), Springer, 2014.
5. Functional Metal-Organic Frameworks: Gas Storage, Separation and Catalysis, Martin Schroder, Springer, 2010.
6. Organic-Inorganic Halide Perovskite Photovoltaics, From Fundamentals to Device Architectures, N.-G. **Park**, M. **Grätzel**, T. **Miyasaka** (Editors), Springer, 2016.

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIB02**	**SEMESTER**	**B**

COURSE TITLE	**SPECTROSCOPIC AND PHYSICOCHEMICAL CHARACTERIZATION METHODS**	
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background, specialized 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*

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

• To understand basic principles of Spectroscopy.

• To understand the basic principles of Physicochemical methods of characterization of materials in all phases of matter

More specifically:

1) Development of basic principles and equations for microwave, photoelectron (XPS) and Vibrational Spectroscopy.
Development of basic principles and equations for Electron Microscopy (transmission and scanning, TEM/SEM) and Atomic Force Microscopy (AFM)
2) Familiarity with special techniques, Steady-state and Time-resolved Spectroscopy, its Applications? Spectroscopy in the sciences of Chemistry, Biochemistry, Biology and Medicine, Industrial applications.
3) Familiarity with crystal structure resolution from single crystal X-ray diffraction and the small angle XRD technique in the characterization of sheet-like materials and MCM-type materials.
4) Familiarity with Thermal Analysis techniques, Dynamic Mechanical Analysis, Kinetic study with Thermal Analysis techniques.

Knowledge

Deepening the basic concepts of synthesis in variable synthetic conditions and distinct knowledge on principles and theories related to the synthesis of materials.

Skills

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

Abilities

Ability to apply the provided knowledge to solving problems (theoretical and synthetic) related to Spectroscopy and characterization methods, in general.
Ability to both work independently and interact with other students on course topics.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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 capability.
Acquiring the appropriate theoretical and practical knowledge base to enable further education both at a theoretical level (in more specific subjects of Materials Chemistry) and in a laboratory.
Pay respect to environment by employing green precursor substances and store any reaction wastes
Capability of survey, analysis of data and details taken form international literature as well as utilization of appropriate tools related to the presentation of research results.

(3) SYLLABUS

Development of Basic Principles and Equations for Microwave Spectroscopy -
Examples of characterization of nano-materials with Raman - Electron microscopy (transmission and scanning, TEM/SEM.
Atomic force microscopy (AFM) .
Introduction to photoelectron spectroscopy (XPS).
Basic theory of Vibrational Spectroscopy, Differences of Raman and IR Spectroscopies, Normal modes of vibration in a crystal, Raman spectra of liquids and amorphous materials, Analysis of normal modes of vibration, Organology and experimental techniques.
Special techniques, Steady-state and Time-resolved Raman Spectroscopy, its Applications? Raman spectroscopy in the sciences of Chemistry, Biochemistry, Biology and Medicine, Industrial applications. Crystal lattices, symmetry of crystalline solids, inverse lattice.
X-ray diffraction from crystalline solids, powder diagrams, structure factors and applications.
Crystal structure solution from single crystal X-ray diffraction.
Time-resolved crystallography and applications to the study of fast reactions in crystalline solids.
Thermal Analysis, Thermogravimetry, Differential Thermal Analysis, Differential Scanning Calorimetry, Thermomechanical Analysis.
Dynamic Mechanical Analysis, Kinetic study with Thermal Analysis techniques. Nitrogen dosimetry
Characteristic adsorption-desorption isotherms, Characterization of hysteresis loops of porous materials, “Standard” isotherm of non-porous materials and t-plots, Pore volume distributions of porous materials.
Small-angle XRD in the characterization of sheet-like and MCM-type materials.
Thermoprogrammable desorption (TPD) technique and determination of surface acidity and basicity in ceramic materials, Thermoprogrammable reduction (TPR) technique and its application to the characterization of simple and mixed oxides.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>- Use of ICT in teaching
- Email communication with students</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Essay writing</td><td>45</td></tr>
<tr><td>Non-directed study</td><td>66</td></tr>
<tr><td></td><td></td></tr>
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<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Students are evaluated (in Greek) in a combined mode, by presenting to the teaching committee and individual public audience of a project (essay) as well as by final written examination. The latter exam includes questions and problems (multiple choice, short response, problem solving).
The written examination and the presentation of the essay have equal impact to the final grade (50% : 50%)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

Μοριακές Κβαντικές Καταστάσεις και Στατιστική Θερμοδυναμική, 2018 (1η έκδοση), Εκδόσεις Συμμετρία, Α. Μυλωνά-Κοσμά, Α. Γ. Καλαμπούνιας, ISBN: 978-960-266-473-5

RELATED SCIENTIFIC JOURNALS
JOURNAL OF CHEMICAL PHYSICS
JOURNAL OF PHYSICAL CHEMISTRY
PHYSICAL CHEMISTRY CHEMICAL PHYSICS

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIB03**	**SEMESTER**	**2nd**
COURSE TITLE	**CHEMISTRY, PHYSICAL CHEMISTRY AND TECHNOLOGY OF POLYMERS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background, specialized general knowledge
PREREQUISITE COURSES:	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek or English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

(1) 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:

- Have knowledge of polymerization reactions and molecular characterization of polymers.
- Be able to understand basic models for description of polymeric chains.
- Have basic knowledge of thermal and mechanical properties, processes for industrial production of polymers, rheology and processing of polymers, additives, polymer matrix composites.

Knowledge

Basic knowledge of materials science, deepening the concepts of polymerization reactions, understanding of polymer theory, basic knowledge of thermal and mechanical properties of polymers, basic knowledge of industrial processes for polymer production and applications of polymers.

Skills

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

Abilities

Ability to apply the provided knowledge to the design of polymeric materials design. Ability to work independently and to interact with other students on the subject. 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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

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

(2) SYLLABUS

Polymer nomeclature. Polymer classification. Isomerism-stereochemistry. Molecular weights. Step growth reactions – kinetics of step growth polymerization. Main condensation polymers. Chain growth polymerization, free radical, anionic, cationic, coordination polymerization. Kinetics of chain growth polymerization. Main examples of chain growth polymers. Industrial polymerization processes – bulk polymerization, solution polymerization emulsion polymerization, suspension polymerization, specific polymerization processes. Thermal and mechanical properties of polymers. Polymer rheology. Additives in polymers. Polymer processing. Copolymers. Polymer blends. Polymer networks. Polymer classes by application. Conformational properties of polymers in dilute solutions: Kuhn length, excluded volume effect, the random walk model of the flexible chain, Two parameters theory, renormalization group theory scaling theory, Calculation of radius of gyration., Effects of polymer architecture on the conformational properties. Viscosity. Flory theory for polymer melts and blends. Microphase separation in diblock copolymer melts.

(3) 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 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*	

Activity	***Semester workload***
Lectures	39
Individual study, preparation	45
Written assignment	66
Course total (25 hours of workload per credit unit)	150

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Written examination (50%) in Greek, with multiple choice questionnaires and short-answer questions. Written work with public presentation (50%).

(4) ATTACHED BIBLIOGRAPHY

Suggested literature:

- Notes/Presentations of the instructors

Related scientific journals:

- Progress in Polymer Science
- Macromolecules
- Biomacromolecules
- Polymer Chemistry
- Polymer
- European Polymer Journal
- Macromolecular Materials and Engineering
- Macromolecular Bioscience
- Polymers

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIB04**	**SEMESTER**	**2nd**
COURSE TITLE	**EPISTEMOLOGY OF CHEMISTRY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Scientific area, special background, specialised general knowledge
PREREQUISITE COURSES:	None
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 successfully completing the course, descriptive marker 7 of the European Qualifications Framework, students should know the milestones in Philosophy of Science, in the emergence of the Epistemology of Chemistry and the reduction of Chemistry, and they should be able to understand the importance of them for the progress of Science and Chemistry.

Knowledge

Deepening the basic concepts of Philosophy of Science and Epistemology of Chemistry.

Skills

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

Abilities

Ability to work independently and to interact with other students on the subject.
Ability to search for data, data analysis, using new technologies, 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	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

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

(3) SYLLABUS

1. FILOSOPHY OF SCIENCE (LOGICAL POSITIVISM, FALSIFIABILITY, THEORY OF PARADIGM (KUHN), THEORY OF EPISTEMOLOGICAL OBSTACLE, SOCIOLOGY OF KNOWLEDGE

2. THE EMERGENCE OF EPISTEMOLOGY OF CHEMISTRY (INTERDISCOURSE RELATIONS: REDUCTION, SUPERVENIENCE AND EMERGENCE, CAUSAL THEORY OF REFERENCE, THE COGNITIVE TOOLS OF CHEMISTRY, FROM PERSONAL TO CONSENSUS PRACTICE (1700-1800), LAWS AND THEORIES IN CHEMISTRY
3. REDUCTION OF CHEMISTRY (CHEMICAL BOND, QUANTUM MECHANICS AND CHEMICAL BOND, EPISTEMOLOGICAL STRATECIES: RATIONALITY, EMPIRICISM-PRAGMATISM, QUANTUM MECHANICS AND PERIODIC TABLE

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of PowerPoint in lectures.
Communication via email.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Individual study, preparation</td><td>66</td></tr>
<tr><td>Written assignment</td><td>45</td></tr>
<tr><td></td><td></td></tr>
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<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total
(25 hours of workload per credit unit)</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work,</td><td>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)</td></tr>
</table>

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 Literature : *-Related scientific journals:*

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIA07**	**SEMESTER**	**2nd**
COURSE TITLE	**LABORATORY OF COMPUTATIONAL CHEMISTRY AND SIMULATIONS II**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	12
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*	Skills development, 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 advanced knowledge on Molecular Dynamics simulations. They will become able to understand and to choose the right type of simulation and force field for the description of different chemical systems. They will learn how to search in literature and analyze data. 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*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

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

(3) SYLLABUS

The course consists of a project, the topic of which is determined by the teacher. At the present stage it includes simulation of polymer solutions, polymer melts and polyelectrolytes.
Installation of LAMMPS and Open MPI open software on Windows. Installation of VMD and Vim. Introduction to the input file of the simulation. Creation of the initial configuration of the system. Design of the required simulations for the project. Molecular Dynamics trajectories. Post processing and properties calculations. Writing the final report

(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 Microsoft Ms Teams software.	
TEACHING METHODS	***Activity***	***Semester workload***

The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Lectures: 20 Laboratory practice: 200 Tutorial: 45 Writing work: 20 Individual study and preparation: 15 TOTAL: **300**
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 evaluation during the laboratory and evaluation of the final report.

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Υπολογιστική Χημεία – Μοριακές Προσομοιώσεις¨Θεωρίες μέθοδοι και εφαρμογές. Α. Κολοκούρης. Επιστημονικές Εκδόσεις Παρισιάνου 2021.

2. Computer Simulation of liquids. M. P. Allen and D.J. Tildesley. Clarendon Press-Oxford 2nd edition 2017.

3. Understanding Molecular Simulations: From Algorithms to Applications. D Frenkel and B. Smit. Academic Press 2002.
- *Related academic journals:*

(1) GENERAL

SCHOOL	NATURAL SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF CHEMISTRY		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIB06**	**SEMESTER**	**2nd**
COURSE TITLE	**LABORATORY OF CHEMICAL TECHNOLOGY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
LABORATORY EXERCISES	6	12
Total	78	
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 knowledge / skills development
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 7 of the European Qualifications Framework for Lifelong Learning, the students will be capable to:

• Understand deeply chemical technology principles and develop skills related to chemical industry, environmental protection technologies, materials science and technology and their applications.

• to use their knowledge and skills in applications and problem-solving, within an interdisciplinary context, relevant to their field of knowledge.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

• Application of knowledge dealing with advanced methods, techniques and technologies for industrial applications, materials characterization and environmental protection.
• 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
• Inquiring the necessary learning skills that allow them to continue their studies in a largely self-reliant or even autonomous manner.
• Possesses specialized problem-solving skills, which are required in research and/or innovation in order to develop new knowledge and processes and integrate knowledge from different fields.
• 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

Study of the thermal transitions and the crystallization kinetics of polymeric materials under isothermal and dynamic conditions, Physicochemical characterization of dispersion systems and solid pharmacotechnical forms, Preparation and characterization of polymeric materials from renewable resources, Mass and energy balances in the processes of industrial chemistry, Determination of specific surface area and fractality dimension of materials, Determination of apparent activation energy in N_2O catalytic decomposition, Fix-Bed Column Adsorption of pollutants (dyes, etc), Coagulation-Sedimentation (Jar test), z-potential, Photo(catalytic) treatment of wastewaters, Determination of Semiconductors Band-gap, Thermochemical conversion of Biomass (Hydrothermal carbonization and/or pyrolysis), Surface Hydrophilicity/Hydrophobicity of materials (contact angle measurements), Porosimetry of Adsorbents or Catalysts, Scanning Electron Microscopy (SEM) of materials.

(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 Technologies of Information and communications in teaching of the theoretical part and communication with students.
TEACHING METHODS *The manner and methods of teaching are described in detail.*	***Activity*** / ***Semester workload*** Laboratory practice / 78

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*	Written essay: 117 study: 105 Course total: **300**
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 team (2 or 3 students) essay/project for every laboratory exercise Evaluation criteria: (a) Plenitude of essay (30%), (b) quality of experimental results (30%), (c) treatment and interpretation of data (40%)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (in Greek):

1) Notes/Presentations of professors, Review papers

- Related academic journals:

1) Chemical Engineering Journal
2) Industrial and Engineering Chemistry Research
3) Journal of Chemical Technology and Biotechnology
4) Applied Catalysis B:Environmental
5) ACS Sustainable Chemistry and Engineering
6) Polymer

FIELD III

SYNTHETIC CHEMISTRY, BIO-CHEMISTRY-BIOACTIVE COMPOUNDS

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Graduate		
COURSE CODE	**IIIA01**	**SEMESTER**	**1**
COURSE TITLE	**SYNTHETIC ORGANIC CHEMISTRY-STEREOCHEMISTRY-MECHANISMS-PHOTOCHEMISTRY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised General Knowledge
PREREQUISITE COURSES:	Organic Chemistry I, Organic Chemistry II, Organic Chemistry III
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*

- To understand
- Organic Chemistry I,
- Organic Chemistry II,
- Organic Chemistry III
- To understand the principles of quantization and the dual nature of light (particle-wave) and its interaction with matter.
- • To understand how the interaction of light with the various molecules results in their absorption, emission and often their photochemical decomposition. A prerequisite for this is an understanding of the atomic and molecular orbitals of atoms and molecules.
- • To understand the differences between singlet and triplet states and to become familiar with the concept of "conic sections" which nowadays is the interpretative tool of numerous photochemical processes.
- • Understand and interpret the short lifetime of excited states and relate it to the variety of different de-excitation pathways and the concept of photonic efficiency.
- • Become familiar with and try to interpret a series of basic photochemical reactions of the various functional groups and realize the utility of light as a "green" reagent.
- • To connect all the above theoretical framework with a variety of photochemical processes and technological applications (photovoltaics, photoimaging, green Photochemistry, photopolymers, plastic screens, new generation photovoltaics, integrated circuit etching, etc.)
- Knowledge
- • Knowledge and understanding of the basic concepts, principles and theories related to photochemistry and in particular to the photochemistry of organic compounds.
- • Knowledge and understanding of applications of UV/Vis, fluorescence spectroscopic methods.
-
- Skills
- • Skills in solving and evaluating UV/Vis, fluorescence spectra.
- • Use of the appropriate spectroscopic method or combination of methods to solve mechanistic problems in Organic Photochemistry.

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
- Theoretical thinking and ability to understand the application of theory to a range of chemical processes and applications of new technologies using light.
- Ability to apply knowledge acquired during the period of studies from their studies in the Department of Chemistry.

- Ability to search, analyze and synthesize data and information from the international literature and their use at the level of some applications.
- Acquisition of the appropriate theoretical and practical knowledge background to enable further training at a research level.
- Ability to collaborate at team level to achieve the above goals.

(3) SYLLABUS

- Investigation of mechanisms of organic reactions.
- Kinetic data and their interpretation. Uses of isotopes (kinetic and not). Study of reactive intermediates.
- Stereochemical criteria. Structure-activity relationship.
- Symmetry of Molecular Orbitals. Pericyclic Reactions.
- Stereochemistry of organic compounds. Molecular models and molecular imaging. Configuration Analysis. Stereoisomerism. Elements of Symmetry Groups. Dynamic Stereochemistry
- Mechanistic investigation of Organic Reactions.

- Kinetic data and their interpretation. Uses of isotopes (kinetic and not). Study of reactive intermediates.
- Stereochemical criteria. Structure-activity relationship.
- Symmetry of Molecular Orbitals. Pericyclic Reactions.
- Stereochemistry of organic compounds. Molecular models and molecular imaging. Configuration Analysis. Stereoisomerism. Elements of Symmetry Groups. Dynamic Stereochemistry

- Introductory Concepts of Photochemistry - Comparison with Thermal Chemistry
- Light Absorption and Electronic Excited States (*singlets, triplets, conical intersection*). Photophysical process . Light Emission. Radiative and non-radiative emission. Jablonski diagram. Energy and Electron Transfer Mechanisms
- Mechanistic Organic Photochemistry (Photochemistry of carbonyl compounds, alkenes, enones and dienones and Aromatic compounds.
- Polymers and Photochemistry, Photopolymerization, Information storage.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>NO</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures-Seminars</td><td>100</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Projects and presentations</td><td>50</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-</td><td>Wright Examinations
Oral examination
Projects and presentations</td></tr>
</table>

ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Mechanism and theory in Organic Chemistry των Lowry, T.H και Richardson, K.S.

2. *Advanced Organic Chemistry, 4th ed., part A: Structure and Mechanisms*, Carey, F.A.; Sundberg, R.J. Kluwer Academic/Plenum Publishers.

3. *Principles of General Chemistry*, 2nd ed. Silberberg, M.S., McGraw Hill.

4.*The Investigation of Organic Reactions and their Mechanisms*, Maskill, H.; Blackwell Publishing.

5. *The Physical Basis of Organic Chemistry*, Maskill, H. Oxford Science Publications.

6. *Principles of Chemical Kinetics*, House, J.E.

7. *Advanced Organic Chemistry*, Smith, M.B.; March, J. 5th ed. J. Wiley & sons

8. *Advanced Organic Chemistry, 5th ed., part A: Structure and Mechanisms*, Carey, F.A.; Sundberg, R.J. Kluwer Academic/Plenum Publishers.

9. *Γενική Οργανική Χημεία*, Αλεξάνδρου, Ν.Ε., εκδόσεις Ζητη 1985.

10) ΣΗΜΕΙΩΣΕΙΣ ΟΡΓΑΝΙΚΗΣ ΦΩΤΟΧΗΜΕΙΑΣ ΣΗΜΕΙΩΣΕΙΣ ΔΙΔΑΣΚΟΝΤΑ ΠΑΝΕΠΙΣΤΗΜΙΟ ΙΩΑΝΝΙΝΩΝ (ΣΗΜΕΙΩΣΕΙΣ)

11) Απόστολος Ι. Μαρούλης, ο, Θεσσαλονίκη 1990-91

12) Nicholas J. Turro, V. Ramamurthy, J.C. Scaiano «Modern Molecular Photochemistry of Organic Molecules», University Science Books, 2010

13) Martin Klessinger, Josef Michl " Excited States and Photochemistry of Organic Molecules" Wiley-VCH,1995

14) P. Suppan "Chemistry and Light" Royal Society of Chemistry, 1994

15) Axel G. Griesbeck, Jochen Mattay "Synthetic Organic Photochemistry" CRC Press,2004

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIIA03**	**SEMESTER**	**A (1st)**
COURSE TITLE	**BIO-ORGANIC AND BIO-INORGANIC CHEMISTRY-STRUCTURE OF PEPTIDES AND NUCLEIC ACIDS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge (post-graduate course)
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and 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*

Postgraduate students are taught current trends in Bio-organic and Bio-inorganic Chemistry-structure of peptides, proteins and nucleic acids. They familiarize themselves with the strategies of modern research. They deepen and understand information about the structures of biomolecules (peptides, proteins, nucleic acids) in 3 dimensions, how these can be used for the development of bioactive molecules. At the same time, the understanding of the 3D structure of nucleic acids and proteins contributes to the understanding of their function, their interactions with other molecules and the analysis of biometric analytical markers. Additionally, they understand how metal ions interact with peptides and how these interactions in biological systems (with proteins) can lead to toxicity-carcinogenesis phenomena.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision-making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Respect for difference and multiculturalism
- Criticism and self-criticism

(3) SYLLABUS

Section 1: Peptides-proteins as molecules for cell targeting

The purpose of this thematic unit is to acquaint students with the principles governing the structure of proteins and peptides and amino acids and how these molecules can be utilized for the construction of molecular conjugates for the targeted delivery of drugs to specific subcellular organelles. The basic principles of pharmacokinetics, pharmacodynamics and biodistribution are described and it is

illustrated how these can be altered by the use of proteins/peptides as transport vehicles and targeting cells.

Section 2: Metallotherapeutics
This section describes the role of metal in metalotherapeutic compounds. Evidence from the use of metals in Medicine is presented. A historical review is made of the antimicrobial properties of silver and copper compounds, the antiseptic properties of mercury compounds, and the arsenic compounds that were used as metal drugs against syphilis. Then the modern metalotherapeutics containing elements of the main groups such as tin, antimony, bismuth, silver and gold are presented. Their ex vivo, in vitro and in vivo mechanism of action is presented.

Section 3: Interaction of peptides with metal ions
In this section, the basic principles governing metal-peptides chemistry are presented. Emphasis is given in peptides that include histidine residues. Factors affecting the number, stoichiometry and thermodynamic stability of the complexes formed and especially those present at physiological pH value are also thoroughly discussed. Build on the knowledge already gained, the interaction of metal ions with peptide models of nuclear histones is investigated, and conclusions are drawn regarding metal ions induced toxicity-carcinogenesis.

Section 4. Structure of nucleic acids.
The use of crystallography in the structure of nucleic acids and oligonucleotides (fiber-single crystal) is described. The methodology of NMR spectroscopy to solve the structure of oligonucleotides and to modeling them in silico is also described. The flexibility of the nucleotide -glucosidic bond, sugar ring, phosphorodiester bond and its effect on the global DNA conformation is also examined. Geometric features of the various DNA conformations A, B, C, Z etc. Base pair mismatches, Hoogsten, hairpin structures etc. DNA-DNA interactions, triple helix, and guanine quadruplexes.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Teaching courses to small groups of students given by several instructors (academic personnel from different disciplines and research specialties).</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Powerpoint slides and videos are used in the lectures. The powerpoint slides and videos presented, as well as complementary teaching material (links to important research articles or related textbooks, etc.), are freely accessible to the students through teams. -email addresses of the teaching staff are made available to the students and are also freely used as a means of communication.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>60</td></tr>
<tr><td>Study</td><td>90</td></tr>
<tr><td></td><td></td></tr>
</table>
</td></tr>
</table>

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	<table><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>150</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language of evaluation: Greek and English ***Methods:*** Written exam (which contributes to their final grade) Each written exam may include: Open-ended questions Questions requiring combination of knowledge from different chapters Questions requiring critical thinking/interpretation

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:* Peer-reviewed articles from the literature and textbook chapters that are suggested by the academic teachers on the thematic chapter they teach. This bibliography is available to the students via teams

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**III04**	**SEMESTER**	**A (1st)**
COURSE TITLE	**ADVANCED BIOCHEMISTRY- MODERN TOPICS IN BIOCHEMISTRY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge (post-graduate course)
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	(https://ecourse.uoi.gr/course/view.php?id=989)

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

Students are taught the most current topics in Biochemistry including the principles of modern research strategies. Using appropriate paradigms and model study systems, students are taught the mechanisms that control and regulate the biochemical action(s) and metabolism of biomolecules at the level of single molecule, cell, organ and system.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision-making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Respect for difference and multiculturalism
- Criticism and self-criticism

(3) SYLLABUS

<u>Section 1: Cellular Biology</u>

This section covers the following thematic areas.

a. The intracellular localization of important biological functions.
b. The biochemistry and molecular biology of embryonic stem cells (ESCs) including the signaling pathways that control ESCs differentiation.
c. The biological chemistry of mitochondria. The emphasis is placed on the analysis of chemiosmotic theory, the transport of biomolecules and small molecules across the mitochondrial membranes. Novel concepts that expand the biological role of mitochondria are presented and discussed.

Section 2: Homeostatic mechanism

This section focuses on homeostatic mechanisms. Using classic and current peer-viewed articles the students become familiar with the biochemical and biological principles as well as the regulatory mechanisms that control

a. Glucose homeostasis.
b. Oxygen Sensing
c. Thermogenesis

Section 3: The era of -omics

This section focuses on the high throughput approaches that are used to study system biology. The students become familiar with the most current research strategies and the instrumentation that are used in genomics, transcriptomics, proteomics and metabolomics studies. Using selected peer-viewed articles the application of these strategies to address important biological questions is discussed

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Teaching courses to small groups of students given by several instructors (academic personnel from different disciplines and research specialties).
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Powerpoint slides and videos are used in the lectures. The powerpoint slides and videos presented, as well as complementary teaching material (links to important research articles or related textbooks, etc.), are freely accessible to the students through the e-course system of the University of Ioannina. The e-course system is also used for communication with the students (see https://ecourse.uoi.gr/course/view.php?id=989) E-mail addresses of the teaching staff are made available to the students and are also freely used as a means of communication.
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-*	

Activity	***Semester workload***
Lectures	40
Analysis of bibliography	30
Not-guided study	80
Course total	***150***

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.*	Language of evaluation: Greek and English ***Methods:*** (a)Evaluation of the students in the analysis and presentation of peer-reviewed articles that are assigned to them by the teaching staff: presentations are given at the end of the semester and the grades from these presentations contribute by 30% to their final grade (b) Written exam (which contributes to their final grade by 70%) Each written exam may include: Open-ended questions Questions requiring combination of knowledge from different chapters Questions requiring critical thinking/interpretation

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:* Peer-reviewed articles from the literature and textbook chapters that are suggested by the academic teachers on the thematic chapter they teach. This bibliography is available to the students in the corresponding webpage at e-course. - *Related academic journals:* See https://ecourse.uoi.gr/course/view.php?id=989

(1) GENERAL

SCHOOL	Natural SCIENCES		
ACADEMIC UNIT	Department Of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIIA05**	**SEMESTER**	**Aº**
COURSE TITLE	**BIOLOGICAL MEMBRANES: STRUCTURE, ARCHITECTURE AND FUNCTION. BIOSIGNALLING**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	3
Project preparation	1	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	**4**	**6**

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*Special background* *Specialised general knowledge*
PREREQUISITE COURSES:	Biochemistry I, Biochemistry II
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek or 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*

Students will be able to:

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

- 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 transductio.
- 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.
- Describe the signalling pathways through GPCRs, RTKs, Cytokines, TGF, TNF, Hedgehog, Notch, MAPKs, NF-kB and Wnt.

Describe the main steps, function and characteristics of Transcription factors, Apoptosis, Oncogenes and Cancer

- Review and combine data from original articles
- Resolve complex problems and questions

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

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

(3) SYLLABUS

Introduction in cell signalling. Basic concepts. Classification of membrane receptors.
Experimental techniques/approaches in cell signalling. Scatchard kinetics
Signalling pathways via receptors:

- GPCRs
- RTKs
- Κυτοκινών
- TGF
- TNF
- Hedgehog
- Notch
- Wnt

Second messenger systems
Protein kinases/phosphatases and GTPases
Transcription factors
Nuclear Receptors
Apoptosis
Oncogenes / Tumor suppressors / Cancer
Exploitation of cell signalling for pharmacological/chemical targeting in disease
Genetically modified animal models in cell signalling

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Use of PowerPoint in lectures.
• Projection and analysis of scientific videos
• Communication with the students via email.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.
The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Study and self preparation</td><td>55</td></tr>
<tr><td>Projects preparation and presentation</td><td>56</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure</td><td>Written examination (70%), with questions requiring analytical answers, multiple choice and short-answer questions.
Optional written projects with public presentation (30%).</td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Βιολογικές μεμβράνες. Από τη δομή στις λειτουργίες. Θεωρία και πειραματικές προσεγγίσεις ΜΕ Λέκκα, Γ Λεονταρίτης, Κ Γαλανοπούλου, Ει Κητσιούλη ISBN: 978-960-603-387-2, [ηλεκτρ. βιβλ.] Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. www.kallipos.gr. Inhttp://hdl.handle.net/11419/4307
- *Molecular cell biology , 2015, Lodish et al, 7th edition, Freeman Co, NY*

- Related academic journals:

- **Trends in Biochemical Sciences**
- **Nature**
- **Science**

(1) GENERAL

SCHOOL	Natural Sciences		
DEPARTMENT	Chemistry		
STUDY LEVEL	Postgraduate		
COURSE CODE	**IIIB04**	**SEMESTER**	**2**
COURSE NAME	**SYNTHESIS AND CHARACTERIZATION LABORATORY I**		

TEACHING ACTIVITIES **if credits are awarded in separate parts of the course eg Lectures, laboratory practicals, etc. If credits are awarded the same for the entire course, they should indicate the hours per week and the total of credits**	**WEEKLY LECTURE HOURS**	**CREDITS**
	5	5

TYPE OF COURSE **general background, special background, specialization, general knowledge, developing skills**	Scientific area / Developing skills
PREREQUISITE COURSES:	There are no prerequisites. However, the knowledge of basic principles of inorganic chemistry with emphasis on coordination compounds (complexes) is desirable.
LANGUAGE TEACHING and EXAMINATION:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	It does not exist

(2) LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course the specific knowledge, skills and abilities appropriate level 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.

- *Summary writing Guide of Learning Outcomes*

• The aim of the course is to teach and consolidate principles of inorganic chemistry through appropriate laboratory exercises and to train students in synthesis and characterization techniques of inorganic compounds

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

1. To recognize the contribution of inorganic chemistry to the development of chemistry and other related branches of science.
2. To be able to synthesize COMPLEXES compounds using appropriate synthetic methods.
3. Be able to isolate complexes compounds in pure form using appropriate purification methods.
4. To know some characteristic properties (geometry, mode of integration, etc.) of various metal ions.
4. Understand geometric isomerism (eg cis, trans) in inclusion compounds.
5. To know principles (stability of oxidation states, kinetics, etc.) regarding the chemistry of inclusion of transition metals and elements of main group groups, etc.
6. To recognize the different ways of incorporating substitutes (monodental, chelating, bridging, etc.).
7. Interpret infrared and visible-UV spectroscopic data of inorganic compounds and be led to conclusions about the way of inclusion of substituents, geometry, isomerism, symmetry, crystal field crossing energy, etc.
9. To be able to estimate and evaluate biological biochemical mechanical catalytic properties of compounds and their technological importance.

Knowledge

Knowledge and understanding of basic concepts, principles and theories related to the synthesis and physicochemical characterization of coordination compounds.

Skills

Skills in the synthesis and purification of coordination compounds, use of spectrometers and the magnetic balance, interpreting IR and visible-ultraviolet spectroscopic data, processing magnetic susceptibility data at room temperature.

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 Inorganic Chemistry.

Ability to prepare coordination compounds in pure form.

Ability to use spectrometers and magnetic balance.

Ability to interpret spectroscopic data.

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) what / which of these skills the course is aimed ?

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 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

Instructor Professor M Louloudi (2X5 hours)
Synthesis of hybrid materials, through surface chemical modification, for catalytic applications & their characterization.

Instructor Professor A. Garoufis (2X5 hours)
Synthesis of transition element polypyridine compounds. Characterization by Nuclear Magnetic Resonance (NMR) methods

Instructor Professor G Malandrinos (2X5 hours)
Spectroscopic and physicochemical characterization of the interaction of metal ions with peptide models

Instructor Professor Professor E Manos (2x5 hours)
Hydrothermal synthesis and characterization of semiconducting metal chalcogenides

Instructor Professor A Tsipis (2X5 hours)
Photocatalytic conversion of CO2 to CO.

Instructor Professor I. Plakatouras (2X5 hours)
Synthesis and improvement of mass transfer properties of precursor compounds for the fabrication of thin film ceramic materials

Teaching Professor S. Hadjikakou (2x5 hours)
Drug Activation (Non-Steroidal Anti-Inflammatory Drugs (NSAIDs), Antibiotics or Anti-Thyroids) with Principal Group Elements of the Periodic Table Composition and Characterization

(4) TEACHING and LEARNING METHODS - EVALUATION

LECTURE DELIVERY METHOD *Face to Face, distance learning κ.λπ.*	Face to Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Using ICT in Teaching , Laboratory Training and in Communication with the students*	Electronic communication with students. Post-exercise additional notes etc. on the websites of teachers
ORGANIZING THE TEACHING *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*	

ACTIVITY	***SEMESTER WORK LOAD***
Lectures	15
Laboratory exercise	70
Tutorial	15
Writing work	15
Individual study and preparation	35

<table>
<tr>
<td>Visits, Study (project), Writing job / work, Artistic creation etc.

Enter the hours of study for each student learning activity and hours of Non-guided study in accordance with the principles of ECTS</td>
<td>
<table>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>TOTAL
(25 hours of work load per credit)</td><td>150</td></tr>
</table>
</td>
</tr>
<tr>
<td>STUDENT EVALUATION

Description of the evaluation process

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

Indicate clearly defined evaluation criteria and whether and which are accessible to students.</td>
<td>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.</td>
</tr>
</table>

(5) SUGGESTED LITERATURE

-SUGGESTED LITERATURE :

EYDOXOS

1., "BIOINORGANIC CHEMISTRY, Vol. 2: Synthesis and Study of Coordination Compounds", Thessaloniki 2006.
2., «Synthesis and Study of metal complexes", Thessaloniki 1999.

OTHERS

1. K. Nakamoto, "Infrared and Raman Spectra of Inorganic and Coordination Compounds, 5th edition, Parts A and B", Willey-Interscience
Pubs, 1997.
2. Butler, Harrod, «Inorganic Chemistry: Principles and Application», 1994
3. A.B.P. Lever, "Inorganic electronic spectroscopy (second edition), Elsevier, 1984
4. Zvi Szafran, Ronald M. Pike, Mono M. Singh, "Microscale Inorganic Chemistry",
J. Wiley (1991).
5. http://orgchem.colorado.edu/hndbksupport/irtutor/tutorial.html
6.http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/infrared.htm
7. http://riodb01.ibase.aist.go.jp/sdbs/cgi-bin/direct_frame_top.cgi
8.http://symmetry.otterbein.edu/tutorial/index.html
9. http://chemistry.bd.psu.edu/jircitano/TSdiagram.pdf

-Related Scientific Journals:
Inorganic Chemistry
European Journal of Inorganic Chemistry
Journal of Chemical education
Polyhedron
Inorganic Synthesis

(1) GENERAL

SCHOOL	School of Sciences		
ACADEMIC UNIT	Chemistry		
LEVEL OF STUDIES	Post-graduate		
COURSE CODE	**IIIA07**	**SEMESTER**	**A (1st)**
COURSE TITLE	**LABORATORY OF BIOCHEMISTRY I**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	5	5
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*	Scientific area/ Developing Skills
PREREQUISITE COURSES:	There are no prerequisites. However, the knowledge of basic principles of inorganic chemistry with emphasis on coordination compounds (complexes) is desirable.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	It does not exist

(2) LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course the specific knowledge, skills and abilities appropriate level 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.

- *Summary writing Guide of Learning Outcomes*

The aim of the course is to teach and consolidate principles of biochemistry through appropriate laboratory exercises and to train students in synthesis and characterization techniques of inorganic compounds

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

1. To recognize the contribution of biochemistry to the development of chemistry and other sciences.
2. To understand the basic principles that govern bacterial cells growth and culture and be able to maintain and expand bacterial cells cultures
3. To understand the principles of mammalian cells culture, be able to maintain, expand and store mammalian cells.
4. To perform enzymatic reactions, calculate kinetic parameters and evaluate the results of these assays.
5. To isolate organelles, biomolecules and bioactive molecules from cells.
6. To test the purity of the isolated biomolecules/organelles/compounds using the appropriate assays and specific markers
7. To understand the principles of PCR and perform the PCR assay

Knowledge

Knowledge and understanding of basic concepts, principles, theories and assays related to the isolation, handling and function of biomolecules

Skills

Skills in the handling of cells, isolation of biomolecules using biochemical and molecular biology related assays

Problem solving skills through careful analysis of the data provided.

Capacities

Ability to use the acquired theoretical knowledge and apply it to laboratory setting.

Ability to handle, isolate and assay the function of biomolecules.

Ability to use biochemical assays and instrumentation.

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) what / which of these skills the course is aimed ?

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 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 Biochemistry) and in laboratory.

(3) TEACHING and LEARNING METHODS - EVALUATION

LECTURE DELIVERY METHOD *Face to Face, distance learning κ.λπ.*	Face to Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Using ICT in Teaching , Laboratory Training and in Communication with the students*	Electronic communication with students. Post-exercise additional notes etc. on the websites of teachers
ORGANIZING THE TEACHING *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 creation etc.* *Enter the hours of study for each student learning activity and hours of Non-guided study in accordance with the principles of ECTS*	
STUDENT EVALUATION *Description of the evaluation process* *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* *Indicate clearly defined evaluation criteria and whether and which are accessible to students.*	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.

ACTIVITY	*SEMESTER WORK LOAD*
Lectures	20
Laboratory practice	200
Tutorial	45
Writing work	20
Individual study and preparation	15
TOTAL	**300**

(1) GENERAL

SCHOOL	Natural SCIENCES		
ACADEMIC UNIT	Department Of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**IIIB01**	**SEMESTER**	**B**
COURSE TITLE	**BIOCHEMISTRY OF XENOBIOTIC COMPOUNDS_BIOTECHNOLOGICAL APPLICATIONS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	3
Project preparation	1	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	**4**	**6**

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*Special background* *Specialised general knowledge*
PREREQUISITE COURSES:	Biochemistry I, Biochemistry II
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

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

- Define xenobiotic compounds

- Explain the chemical /physicochemical properties and toxicity of xenobiotics
- Describe how they penetrate and distribute in the body
- Describe the logic of phase I, II and III reactions in microbes and eukaryotes.
- Illustrate characteristic reactions of Phase I, II and III reactions/procedures
- Implement the knowledge gained to accumulate data from original articles
- Design the biotransformation pattern of given compounds
- Resolve complex problems and questions
- Evaluate the impact of given xenobiotics on the environment, based on their biotransformations

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
- *Working in an interdisciplinary environment*
- Promoting free, creative and inductive thinking

(3) SYLLABUS

Basic concepts, definitions, chemical/physicochemical properties. Toxicity
Endogenous Biochemical Defense systems
Absorption and distribution. Selectivity.
Metabolism of xenobiotics-and biotransformations

- Phase I reactions
- Phase II reactions (Conjugation reactions)
- Phase III: Elimination of xenobiotics and metabolites
- Enzymic systems of biotransformations (oxidases, reductases, P_{450} monooxygenases, , glutathionyltrasferases, glucorunydyltransferases ect)

Transporters (with emphasis in ABC-transporters)
Microbial metabolism of xenobiotic compounds: aerobic and anaerobic metabolism

- Microbial oxidoreductases
- Microbial oxygenases
- Microbial monooxygenases
- Flavin monooxygenases

- P_{450} Monooxygenases
- Microbial dioxygenases
- Ring hydroxylating dioxygenases
- Ring-cleavage dioxygenases
- Microbial peroxidases
- Microbial laccases
- Microbial hydrolytic enzymes
- Biodegradation of alkanes
- Biodegradation of aromatic hydrocarbons
- Biodegradation of polycyclic aromatic hydrocarbons

Chemical and biochemical degradation of pharmaceuticals and pesticides
Bioremediation and Environmental Assessment

(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 PowerPoint in lectures. • Projection and analysis of scientific videos • Communication with the students 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*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-*	Written examination (70%), with questions requiring analytical answers, multiple choice and short-answer questions. Optional written projects with public presentation (30%).

Activity	***Semester workload***
Lectures	40
Study and self preparation	55
Projects preparation and presentation	55
Course total	**150**

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:

- Introduction to Biochemical Toxicology , E Hodgson, RC Smat (1994), 2nd edition, Wiley Interscience, NY
- Biodegradation and Bioremediation Singh, Ajay, Ward, Owen P. (Eds.) 2004, Springer ISBN 978-3-662-06066-7
- Βιολογικές μεμβράνες. Από τη δομή στις λειτουργίες. Θεωρία και πειραματικές προσεγγίσεις ΜΕ Λέκκα, Γ Λεονταρίτης, Κ Γαλανοπούλου, Ει Κητσιούλη ISBN: 978-960-603-387-2, [ηλεκτρ. βιβλ.] Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. www.kallipos.gr. In http://hdl.handle.net/11419/4307
- Microbial Bioremediation of Non-metals. Koukkou AI, (ed) 2011Norfolk, UK: Caister Academic Press, ISBN 978-1-904455-83-7

Related academic journals:

- The Journal of Xenobiotics
- Environmental Science and Technology
- Applied Environmental Microbiology
- Biodegradation
- Ecotoxicology and Environmental safety

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Chemistry		
LEVEL OF STUDIES	Post-graduate		
COURSE CODE	**IIIB02**	**SEMESTER**	**A (1st)**
COURSE TITLE	**CHEMISTRY OF DIAGNOSTIC AND PHARMACEUTICAL COMPOUNDS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised general knowledge (post-graduate course)
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and 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*

Postgraduate students are taught the current trends in the design, synthesis and evaluation of pharmaceutical molecules, diagnostic and therapeutic molecules. They deepen and understand information on how to select candidate pharmaceutical targets in a disease and how the specific target can be exploited for the design of molecules that will target it, with an emphasis on cancer. The basic principles of designing molecules with theoretical calculations (in silico docking calculations) are mentioned. Lipinski's drug-likeness rules are described as well as parameters that may affect the pharmacokinetics of molecules. In addition, elements of the tumor microenvironment are described and how these can be exploited in the design of more effective therapeutic and diagnostic molecules. Also, the synthetic process of the designed molecules is taught as well as the biological evaluation methodology is presented.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision-making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Respect for difference and multiculturalism
- Criticism and self-criticism

(3) SYLLABUS

<u>Section 1: Targeting the tumor cell microenvironment for the development of diagnostic, therapeutic and therapeutic molecules</u>

The purpose of this thematic unit is to acquaint students with the principles that govern the characteristics of the microenvironment of cancer cells in relation to helthy cells and how candidate pharmaceutical targets can be selected. The

characteristics that a drug target should have are described. The basic principles of drug likeness of Lipinski are taught as well as the basic principles of pharmacokinetics and factors that influence it are explained. In silico tools for designing molecules to target a candidate therapeutic target are then presented. Then, students are taught about methodologies for exploiting the tumor microenvironment (pH, enzyme/receptor overexpression, biomarkers, ROS, GSH, EPR, etc.) to design molecules that will target the specific microenvironments and selectively transport and release the cytotoxic agent to these cells. The basic architecture of effective molecules that carry the cytotoxic agent, the microenvironment targeting unit and the linker that responds to the tumor cell microenvironment is described. The basic principles of their design and synthesis (peptide-drug conjugates, antibody-drug conjugates, etc.) are described for a number of molecules. At the same time, principles are described for the design of turn-on diagnostic molecules based on the enhancement of its fluorescence (near-infrared region) once the microenvironment of cancer cells is detected. The basic principle of designing, synthesizing and evaluating molecules that combine features of diagnostic and therapeutic molecules is also presented.

Section 2: Antithyroid drugs

(a) In this section the chemistry and mechanism of action of antithyroid drugs is described, the biosynthesis of thyroid hormones is analyzed, the enzymes that take part in the mechanism are described and finally the Chemical action of antithyroid drugs is emphasized. (b) Also in this section, reference is made to the development of resistance of microbes to modern antibiotics and reference is made to the mechanism of action of metal antibiotics such as silver sulfadiazine, nano silver, etc. (c) Finally, reference is made to the chemistry of pnictide compounds and their role to the activation mechanism of the cancer cell apoptosis pathway through mitochondrial inhibition.

Section 3: Platinum chemotherapeutic compounds

The action-mechanism of platinum chemotherapeutic compounds and the structural alterations of the nucleic acids that they cusses are described. Introduction in the chemistry of platinum(II)/(IV). The synthesis of cisplatin, carboplatin and oxaliplatin in the pharmaceutical industry is described. The synthesis of novel platinum compounds that are in advanced clinical trials, such as pyriplatin, pheanthriplatin, etc. is described with emphasis on their synthetic methodology. The chemistry of gold compounds is introduced and the synthesis and action-mechanism of Auranofin is described..

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Teaching courses to small groups of students given by several instructors (academic personnel from different disciplines and research specialties).
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Powerpoint slides and videos are used in the lectures. The powerpoint slides and videos presented, as well as complementary teaching material (links to important research articles or related textbooks, etc.), are freely accessible to the students through teams. -email addresses of the

<table>
<tr><td></td><td>teaching staff are made available to the students and are also freely used as a means of communication.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>60</td></tr>
<tr><td>Study</td><td>90</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Language of evaluation: Greek and English
Methods:
Written exam (which contributes to their final grade)
Each written exam may include:
Open-ended questions
Questions requiring combination of knowledge from different chapters
Questions requiring critical thinking/interpretation</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*
Peer-reviewed articles from the literature and textbook chapters that are suggested by the academic teachers on the thematic chapter they teach. This bibliography is available to the students via teams

(1) GENERAL

SCHOOL	Natural SCIENCES		
ACADEMIC UNIT	Chemistry		
LEVEL OF STUDIES	Post-Graduate		
COURSE CODE	**IIIB03**	**SEMESTER**	**B**
COURSE TITLE	**TOTAL SYNTHESIS OF NATURAL PRODUCTS AND PHARMACEUTICAL COMPOUNDS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background, general knowledge specialization
PREREQUISITE COURSES:	According to the undergraduate program, there are no prerequisites. However, to understand the course, requires good knowledge of basic organic chemistry, organic synthetic methods and mechanisms of the reactions.
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*

Knowledge

- Understanding the principles of the logic of total syntheses, the rules and methodology.

- Understanding the logic of total syntheses and the approach of complex organic compounds, such as natural and synthetic compounds with biological and medicinal-pharmaceutical activity.

Skills

-Widening the scientific horizon and deepening in organic synthesis.

-Design of complex multi-stage organic syntheses.

Abilities

-Ability to apply his knowledge and judgment to deal with synthetic problems of organic chemistry.

-Ability to approach and understand the structure of complex organic compounds with pharmaceutical or biological activity, to design and propose the most appropriate synthetic route of them.

-Ability to research the international literature and extract information in order 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*
	Respect for the natural environment
	Showing social, professional and ethical

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

- Theoretical training and acquisition of skills for the approach of interdisciplinary issues-problems.

-Ability to search for scientific information from the international literature, comprehension and presentation.

- Team work in a laboratory and in an international interdisciplinary environment.

(3) SYLLABUS

1. Introduction to total synthesis and basic reactions

Review of basic mechanisms of organic reactions-carbon chain length increase reactions. Protecting group chemistry, introduction and removal of protecting groups. Metal organic compounds and metal organic reactions. Convergent and divergent synthetic strategy. Chemo-, region-, and stereoselective reactions (enantio- and diastereoselective reactions). Disconnection approach-retrosynthetic analysis of complex compounds (natural and synthetic).

2. General review problems

Total synthesis of natural products: Estrone, Isocomene, Periplanone, Capnellene, Zingolide, etc.

Total synthesis of pharmaceutical and biogenic organic compounds: Brufen, Zyrtec, Plavix, Esmolol, Iscover, Imatinib, Nilotinib, Sorafenib, Adrenaline, etc.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Electronic communication with students.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures-Presentations</td><td>50</td></tr>
<tr><td>Individual study-Learning</td><td>50</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total
(20 hours of workload per credit unit)</td><td>120</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>The evaluation of students will be done with a written exam that includes:
-Development of issues
-Short answer questions
-Answers to crisis questions-problem solving.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

-Total Synthesis of Natural Products, Volume 1-11.

-Teachers notes

(1) GENERAL

SCHOOL	School of Sciences		
ACADEMIC UNIT	Chemistry		
LEVEL OF STUDIES	Post-graduate		
COURSE CODE	**IIIB05**	**SEMESTER**	**2nd**
COURSE TITLE	**LABORATORY OF BIOCHEMISTRY II**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	5	5
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*	Scientific area/ Developing Skills
PREREQUISITE COURSES:	There are no prerequisites. However, the knowledge of basic principles of inorganic chemistry with emphasis on coordination compounds (complexes) is desirable.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek and English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	It does not exist

(2) LEARNING OUTCOMES

Learning outcomes *The learning outcomes of the course the specific knowledge, skills and abilities appropriate level 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.* • *Summary writing Guide of Learning Outcomes*
The aim of the course is to teach and consolidate principles of biochemistry through appropriate laboratory exercises and to train students in synthesis and characterization techniques of inorganic compounds • After successful completion of the course students should be able to: 1. To clone genes in expression vectors, express these genes in cell models, isolate the expressed protein

2. To perform reverse transcription reaction in order to synthesize a gene or part of it
3. To understand enrichment strategies (affinity and chemical) and apply them to enrich for post translationally modified proteins.
4. To perform 1-D and 2-D protein electrophoresis.
5. To assess protein expression by western blot analysis and flow cytometry.
6. To handle and prepare biological samples for mass spectrometry based analysis
7. To process and analyzed data generated in MS-based proteomic studies

Knowledge

Knowledge and understanding of the basic concepts of cloning, protein isolation, protein expression and large scale data analysis

Skills

Skills in advanced assays in molecular biology and proteomics

Problem solving skills through careful analysis of the data provided.

Capacities

Ability to use the acquired theoretical knowledge and apply it to laboratory setting.

Ability to handle, isolate and assay the function of biomolecules.

Ability to use analytical, biochemical and molecular biology assays and the corresponding instrumentation.

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) what / which of these skills the course is aimed ?

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 are:
Search, analysis and synthesis of data and information and making decisions.
Turning theory into practice.
Promotion of free, creative and critical 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 Biochemistry) and in laboratory.

(3) TEACHING and LEARNING METHODS – EVALUATION

LECTURE DELIVERY METHOD *Face to Face, distance learning κ.λπ.*	Face to Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Using ICT in Teaching , Laboratory Training and in Communication with the students*	Electronic communication with students. Post-exercise additional notes etc. on the websites of teachers

ORGANIZING THE TEACHING *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 creation etc.* *Enter the hours of study for each student learning activity and hours of Non-guided study in accordance with the principles of ECTS*	

ACTIVITY	*SEMESTER WORK LOAD*
Lectures	20
Laboratory practice	200
Tutorial	45
Writing work	20
Individual study and preparation	15
TOTAL	**300**

STUDENT EVALUATION *Description of the evaluation process* *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* *Indicate clearly defined evaluation criteria and whether and which are accessible to students.*	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.

(1) GENERAL

SCHOOL	Natural Sciences		
DEPARTMENT	Chemistry		
STUDY LEVEL	Postgfraduate		
COURSE CODE	**IIIA06**	**SEMESTER**	**1**
COURSE NAME	**SYNTHESIS AND CHARACTERIZATION LABORATORY II**		

TEACHING ACTIVITIES if credits are awarded in separate parts of the course eg Lectures, laboratory practicals, etc. If credits are awarded the same for the entire course, they should indicate the hours per week and the total of credits	**WEEKLY LECTURE HOURS**	**CREDITS**
	5	5

TYPE OF COURSE general background, special background, specialization, general knowledge, developing skills	Scientific area / Developing skills
PREREQUISITE COURSES:	There are no prerequisites. However, the knowledge of basic principles of inorganic chemistry with emphasis on coordination compounds (complexes) is desirable.
LANGUAGE TEACHING and EXAMINATION:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	It does not exist

(2) LEARNING OUTCOMES

Learning outcomes

The learning outcomes of the course the specific knowledge, skills and abilities appropriate level 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.

- *Summary writing Guide of Learning Outcomes*

The aim of the course is to teach and consolidate principles of inorganic chemistry through appropriate laboratory exercises and to train students in synthesis and characterization techniques of inorganic compounds

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

1. To recognize the contribution of inorganic chemistry to the development of chemistry and other related branches of science.
2. To be able to synthesize COMPLEXES compounds using appropriate synthetic methods.
3. Be able to isolate complexes compounds in pure form using appropriate purification methods.
4. To know some characteristic properties (geometry, mode of integration, etc.) of various metal ions.
4. Understand geometric isomerism (eg cis, trans) in inclusion compounds.
5. To know principles (stability of oxidation states, kinetics, etc.) regarding the chemistry of inclusion of transition metals and elements of main group groups, etc.
6. To recognize the different ways of incorporating substitutes (monodental, chelating, bridging, etc.).
7. Interpret infrared and visible-UV spectroscopic data of inorganic compounds and be led to conclusions about the way of inclusion of substituents, geometry, isomerism, symmetry, crystal field crossing energy, etc.
9. To be able to estimate and evaluate biological biochemical mechanical catalytic properties of compounds and their technological importance.

Knowledge

Knowledge and understanding of basic concepts, principles and theories related to the synthesis and physicochemical characterization of coordination compounds.

Skills

Skills in the synthesis and purification of coordination compounds, use of spectrometers and the magnetic balance, interpreting IR and visible-ultraviolet spectroscopic data, processing magnetic susceptibility data at room temperature.

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 Inorganic Chemistry.

Ability to prepare coordination compounds in pure form.

Ability to use spectrometers and magnetic balance.

Ability to interpret spectroscopic data.

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) what / which of these skills the course is aimed ?

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 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

Instructor Professor M Louloudi (2X5 hours)
(1) Synthesis of hybrid materials, through surface chemical modification, with antioxidant properties & their characterization.

Instructor Professor A. Garoufis (2X5 hours)
(2) Synthesis of polynuclear compounds of the elements of the platinum group. Study of their interactions with oligonucleotides using multinuclear and multidimensional NMR.

Instructor Professor G Malandrinos (2X5 hours)
(3) Synthesis and characterization of luminescent transition metal complexes

Teacher Professor E Manos (2x5 hours)
(1) -Solvothermal synthesis of microporous metal organic materials-study of ion sorption properties

Instructor Professor A Tsipis (2X5 hours)
(2) Study of the compounds of ammonia with trimetallic complexes.

Instructor Professor I. Plakatouras (2X5 hours)
(3) - Synthesis, and characterization of inclusion polymers - Properties of reversible moisture binding.

Teaching Professor S. Hadjikakou (2x5 hours)
(4) · Small bioactive molecules containing main group elements Synthesis and characterization

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>LECTURE DELIVERY METHOD
Face to Face, distance learning κ.λπ.</td><td>Face to Face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES
Using ICT in Teaching , Laboratory Training and in Communication with the students</td><td>Electronic communication with students.
Post-exercise additional notes etc. on the websites of teachers</td></tr>
<tr><td>ORGANIZING THE TEACHING
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 creation etc.

Enter the hours of study for each student learning activity and hours of Non-guided study</td><td>
<table>
<tr><th>ACTIVITY</th><th>SEMESTER WORK LOAD</th></tr>
<tr><td>Lectures</td><td>20</td></tr>
<tr><td>Laboratory practice</td><td>200</td></tr>
<tr><td>Tutorial</td><td>45</td></tr>
<tr><td>Writing work</td><td>20</td></tr>
<tr><td>Individual study and preparation</td><td>15</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>TOTAL</td><td>300</td></tr>
</table>
</td></tr>
</table>

in accordance with the principles of ECTS	*(25 hours of work load per credit)*	
STUDENT EVALUATION *Description of the evaluation process* *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* *Indicate clearly defined evaluation criteria and whether and which are accessible to students.*	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.	

(5) SUGGESTED LITERATURE

-SUGGESTED LITERATURE :

EYDOXOS

Experimental Method in Inorganic Chemsitry
Book's code: 77121307
Edition: 1η /2018
Συγγραφείς: JOHN TANAKA, STEVEN L. SUIB ΣΩΤΗΡΗΣ ΧΑΤΖΗΚΑΚΟΥ, ΝΙΚΟΛΑΟΣ ΧΑΤΖΗΛΙΑΔΗΣ, ΣΠΥΡΙΔΩΝ Π. ΠΕΡΛΕΠΕΣ
ISBN: 9786185304744
Τύπος: Σύγγραμμα
Διαθέτης (Εκδότης): UNIBOOKS ΙΚΕ

OTHERS

1. K. Nakamoto, "Infrared and Raman Spectra of Inorganic and Coordination Compounds, 5th edition, Parts A and B", Willey-Interscience
Pubs, 1997.
2. Butler, Harrod, «Inorganic Chemistry: Principles and Application», 1994
3. A.B.P. Lever, "Inorganic electronic spectroscopy (second edition), Elsevier, 1984
4. Zvi Szafran, Ronald M. Pike, Mono M. Singh, "Microscale Inorganic Chemistry",
J. Wiley (1991).
5. http://orgchem.colorado.edu/hndbksupport/irtutor/tutorial.html
6.http://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/InfraRed/infrared.htm
7. http://riodb01.ibase.aist.go.jp/sdbs/cgi-bin/direct_frame_top.cgi
8.http://symmetry.otterbein.edu/tutorial/index.html
9. http://chemistry.bd.psu.edu/jircitano/TSdiagram.pdf

-Related Scientific Journals:
Inorganic Chemistry
European Journal of Inorganic Chemistry
Journal of Chemical education
Polyhedron
Inorganic Synthesis

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**I-II-IIΓ01**	**SEMESTER**	**3rd**
COURSE TITLE	**LABORATORY RESEARCH**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	6	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	6	12

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized 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*

This course enables students to

i) Apply the basic principles of chemical instrumentation and instrumental techniques of chemical analysis
ii) Use the principles of applied chemistry and apply, modify and optimize experimental procedures, design of new experimental procedures and validate their effectiveness
iii) Apply data processing methods and techniques and advanced computational calculations

Knowledge

i) Knowledge and understanding of specialized and advanced principles and theories related to chemistry and chemical analysis
ii) Knowledge of advanced data processing methods
iii) Knowledge of quality control and validation of chemical procedures
iv) Search of international literature

Skills

i) Extract information from literature and put them into practice
ii) Selections of the most appropriate experimental procedures
iii) Interaction with other postgraduate students and more experienced researchers
iv) Team work
v) Working in an international / multi-national 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	*……*
Production of new research ideas	*Others…*
	…….

Search, analysis and synthesis of data and information, by using the proper technologies.
Working independently
Team work
Promoting free, creative and inductive thinking
Understanding chemical science, synthesis and characterization of new compounds and materials and demonstrate a coherent understanding of these practises

(3) SYLLABUS

The content of the course is depends on the research field and the specific task assigned to each student by his/her supervisor.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Use of PowerPoint in lectures.
Communication via email.
Laboratory education</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>15</td></tr>
<tr><td>Lab practice</td><td>240</td></tr>
<tr><td>Assignment writing</td><td>10</td></tr>
<tr><td>Study and analysis of bibliography</td><td>35</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>300</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of</td><td>Written examination in Greek, with multiple choice questionnaires and short-answer questions.
Assay writing / project evaluation</td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

SUGGESTED BIBLIOGRAPHY: : Multiple sources depending on the field of research

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**I-II - IIIΓ02**	**SEMESTER**	**3**
COURSE TITLE	**MASTER THESIS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	9	18
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	9	18

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized 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*
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- *Guidelines for writing Learning Outcomes*

This course enables students to

iv) Apply the basic principles of chemical instrumentation and instrumental techniques of chemical analysis

v) Use the principles of applied chemistry and apply, modify and optimize experimental procedures, design of new experimental procedures and validate their effectiveness

vi) Apply data processing methods and techniques and advanced computational calculations

Knowledge

v) Knowledge and understanding of specialized and advanced principles and theories related to chemistry and chemical analysis

vi) Knowledge of advanced data processing methods

vii) Knowledge of quality control and validation of chemical procedures

viii) Search of international literature

Skills

vi) Extract information from literature and put them into practice

vii) Selections of the most appropriate experimental procedures

viii) Interaction with other postgraduate students and more experienced researchers

ix) Team work

x) Working in an international / multi-national 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	*……*
Production of new research ideas	*Others…*
	…….

Search, analysis and synthesis of data and information, by using the proper technologies.
Working independently
Team work
Promoting free, creative and inductive thinking
Understanding chemical science, synthesis and characterization of new compounds and materials and demonstrate a coherent understanding of these practises

(3) SYLLABUS

The content of the course is depends on the research field and the specific task assigned to each student by his/her supervisor.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face to face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
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Communication via email.
Laboratory education</td></tr>
<tr><td>TEACHING METHODS
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The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>20</td></tr>
<tr><td>Lab Practice</td><td>100</td></tr>
<tr><td>Master thesis writing</td><td>40</td></tr>
<tr><td>Study, preparation</td><td>290</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>450</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of</td><td>Evaluation is made on the basis of the following criteria:
a) Understanding of theoretical background
b) experimental performance
c) Quality of experimental results</td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

SUGGESTED BIBLIOGRAPHY: : Multiple sources depending on the field of research

(1) GENERAL

SCHOOL	Natural Sciences		
ACADEMIC UNIT	Department of Chemistry		
LEVEL OF STUDIES	Postgraduate		
COURSE CODE	**I-II-IIIΔ01**	**SEMESTER**	**4**
COURSE TITLE	**WRITING AND SUPPORT OF MASTER THESIS**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	15	30
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).	15	30

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized 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

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This course enables students to

vii) Apply the basic principles of chemical instrumentation and instrumental techniques of chemical analysis

viii) Use the principles of applied chemistry and apply, modify and optimize experimental procedures, design of new experimental procedures and validate their effectiveness

ix) Apply data processing methods and techniques and advanced computational calculations

Knowledge

ix) Knowledge and understanding of specialized and advanced principles and theories related to chemistry and chemical analysis

x) Knowledge of advanced data processing methods

xi) Knowledge of quality control and validation of chemical procedures

xii) Search of international literature

Skills

xi) Extract information from literature and put them into practice

xii) Selections of the most appropriate experimental procedures

xiii) Interaction with other postgraduate students and more experienced researchers

xiv) Team work

xv) Working in an international / multi-national environment

General Competences

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Decision-making	*Respect for the natural environment*
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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…*
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Search, analysis and synthesis of data and information, by using the proper technologies.
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<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>15</td></tr>
<tr><td>Lab research</td><td>260</td></tr>
<tr><td>Assignment writing</td><td>240</td></tr>
<tr><td>Preparation-of presentation & Examination of the master-thesis</td><td>60</td></tr>
<tr><td>Study</td><td>175</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>750</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of</td><td>Evaluation is made by a three member committee which is assigned by the Department of Chemistry.</td></tr>
</table>

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

(5) ATTACHED BIBLIOGRAPHY

SUGGESTED BIBLIOGRAPHY: : Multiple sources depending on the field of research