UNIVERSITY OF CRETE

COURSE OUTLINE

DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY

2020

CONTENTS

FIRST SEMESTER

ETY-011 English I

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-011**	**SEMESTER**	**1st**
COURSE TITLE	English 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**
		3	4
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND & SKILLS DEVELOPMENT		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YEs		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY011/ and https://chemistryenglish.wordpress.com/materials-i/		

(2) LEARNING OUTCOMES

Learning outcomes

The learning goals that students are expected to attain are the following:

1. learn scientific terminology of Materials science
2. Improve academic skills pertaining to formality, caution, legitimate paraphrasing, writing citations and synthesising sources, critical writing, essay writing (with documented evidence), peer-feedback and academic presentations

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 5 (comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge).

General Competences

The course is formed in such a way, that during lectures and especially during the preparation of the written assignment (homework), that students will train themselves in:

Noticing formality and academic style, scientific conventions in Materials Science Journals, transfer information form texts and visually enhance it in order to produce PowerPoint slides. Writing a report following a graph or chart, exercising peer-feedback and giving effective presentations. Writing citations and references. Synthesizing sources. Summarizing and paraphrasing.

(3) SYLLABUS

Introduction to Formality and Academic style. Students notice formality, citations and reference conventions and following a model text, produce their own. Reference and citation guides are provided for guidance. Students are asked to send an email to their instructor taking into account issues of politeness and formality.

Week 2 Students will read a text about Types of Materials and learn how to transfer information from text to slides. Listening practice: Students will practice different note-taking styles. Students will practice giving presentations using opening phrases and signposting language.

Week 3 Students will be using google docs to complete tasks collaboratively about different types of Metals and their properties. Students will be reading an article on the FUTURE of metals in order to identify topic sentences, support sentences and concluding sentences in paragraphs. Then, they will produce their own paragraph following prompts.

Week 4 Students will read an article and listen to a video about the scientific method and answer a quiz. They will look at statistical data, graphs and charts and learn how to write a report using appropriate linking words and terminology to express upward or downward trends, ratios, averages and numbers. Students will using information to produce a variety of visuals: mind-maps, diagrams, word tables or schemes.

Week 5 Students will watch a video about bio printing and then will compare different types of writing on the same topic "Bio-printing (2019)". They will be asked to notice the structure, the language and some conventions of a scientific article about Graphene, a relevant blog post on Graphene and a school textbook entry.

Week 6 Students will have a workshop on "How to give effective presentations" and a model presentation on "bio-printing" given by senior students whose presentations were deemed to be one of the best ones the year before. Students will be provided with *criteria for peer-evaluation* to complete during the student presentation and then discuss the student presentation strengths and weaknesses with the teacher and the presenters. Kindly note that attendance is compulsory for all.

Week 7 Students will classify and identify properties of *solids, liquids and gases* (using the English for Chemistry EAP textbook, Unit 1) Reading and Listening tasks. Students will be asked to notice and use legitimate paraphrasing strategies in order to produce a paragraph with citations and references.

Week 8 Students will be listening and reading a variety of listening and reading sources about Ceramics and advanced Ceramics in order to include all information elements, reminder phrases and references required for Summary writing. Language focus Passive voice

Week 9 Students will be introduced to essay writing (argumentative essay, counterarguments) making a distinction between descriptive, evaluative, cautious and biased language. Reading and Listening Practice on the topic of Composites. Students will be practicing answering mock exam reading comprehension questions and tasks.

Week 10 Following a listening and a reading on Polymers (from the book English for Chemistry EAP Unit 11) students will be asked to make a mind map connecting properties of of Polymers such as thermosetting, thermoplastic, linear, branched, cross-linked, fibers, plastics and elastomers, solubility and rigidity. Language focus: Gerund and infinitive Students will be re-writing sentences avoiding wordiness

Weeks 11 and 12 Student Presentations (Slides need to be in pptx or pdf format and student need to bring their file in a usb stick)

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY</td><td>Face-to-Face & Distance Learning (Asynchronous via Edmodo)</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of Power Point, and White board,
Supportive learning through teleconference tools, Googledocs, google forms , Edmodo, Socrative, Kahoot googleslides, edpuzzle
P</td></tr>
<tr><td>TEACHING METHODS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Workshops</td><td>30 hours</td></tr>
<tr><td>Student presentations-Peer-feedback</td><td>6 hours</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>36 hours</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>Students are evaluated by:
Coursework (Portfolio) and presentations 50%
Written exam 50%</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Katsampoxaki-Hodgetts K. (2017) English for Chemistry EAP, Disigma Publications
https://www.disigma.gr/english-for-chemistry-eap.html

- Related academic journals:
Suggested for presentations:

Please make sure you choose ONE article from the most downloaded articles section of the following journals:

a) https://www.journals.elsevier.com/journal-of-science-advanced-materials-and-devices/most-downloaded-articles
b) https://www.journals.elsevier.com/progress-in-materials-science/most-downloaded-articles
c) https://www.journals.elsevier.com/materials-today/most-cited-articles
d) https://www.journals.elsevier.com/materials-today-communications/most-downloaded-articles
e) https://www.journals.elsevier.com/biomaterials/most-downloaded-articles
f) https://www.journals.elsevier.com/energy-storage-materials/most-downloaded-articles
1. g) https://www.journals.elsevier.com/materials-characterization/most-downloaded-articles

ETY-101 General Physics I

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-101	**SEMESTER**	1st
COURSE TITLE	GENERAL PHYSICS I		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
		6	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND, SKILLS DEVELOPMENT		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://theory.materials.uoc.gr/courses/gfI/		

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

By the end of the course, students are expected to:

1. Consolidate high school classical mechanics albeit at a higher mathematics level.
2. Acquire critical thinking and the ability to develop physical models and solve problems.
3. Get accustomed to the mathematical formulation of the laws of physics: for this purpose, calculus and very simple differential equations are used.
4. Acquire the relevant background and skills for understanding materials physics in the more advanced theoretical and laboratory courses that follow.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…* *……*

- Production of free, creative and inductive thinking
- Working independently
- Adapting to new situations

(3) SYLLABUS

1. Physics in Materials Science, structure of matter and physical models, classical and modern Physics, Classical Mechanics
2. Introduction, fundamental and derived quantities, units, dimensional analysis, order-of-magnitude calculations, significant figures
3. Kinematics, motion in one dimension, position, displacement, average and instantaneous velocity, constant velocity motion, average and instantaneous acceleration, motion with constant acceleration, free fall, kinematic equations derived from calculus
4. Motion in three dimensions, position, velocity, acceleration vectors, motion in two dimensions with constant acceleration, projectile motion, curved orbit motion, tangential and radial acceleration, uniform circular motion, relative velocity and acceleration
5. The concept of force, Newton's 1st law and inertial frames, Newton's 2nd law, gravitational force and weight, Newton's 3rd law
6. Applications of Newton's laws, forces of friction, circular motion, motion in accelerated frames, motion in the presence of resistive forces
7. Energy of a system, work done by constant force, work of varying force, kinetic energy and the work - kinetic energy theorem, potential energy of a system, conservative and non-conservative forces, relationship between conservative forces and potential energy, energy diagrams and equilibrium of a system.
8. Isolated and non-isolated systems, conservation of energy, changes in mechanical energy for non-conservative forces, power
9. Linear momentum, isolated and non-isolated systems, momentum conservation, impulse of a force, impulse-momentum theorem, elastic and inelastic collision, perfectly inelastic (plastic) collision, collision in two dimensions, center of mass of a system of particles and of an extended object, physical significance and usefulness of the center of mass, deformable systems, rocket propulsion
10. Rotation of a rigid object about a fixed axis, angular position, velocity, acceleration, quantities of rotational and translational motion, rotational kinetic energy, calculation of moments of inertia, torque, relationship between torque and angular acceleration, energy in rotational motion, rolling motion of a rigid object
11. Angular momentum of a rotating particle and of a system of particles, non-isolated system, angular momentum of a rigid object, isolated system and angular momentum conservation
12. Static equilibrium and elasticity, elastic properties of solids
13. Oscillatory motion, harmonic oscillator, damped and forced oscillations

(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 for communication with students who are encouraged to search for online material for better understanding material taught in class.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*	

Activity	***Semester workload***
Lectures	52
Exercises	26
Study hours	78
Office hours	13

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS		
	Course total	***169***
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Student performance evaluation consists of an optional midterm exam and a mandatory final exam in Greek that includes multiple choice questions and problems. Students have the right to view their exam scripts after the grading results and to ask questions.	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- R.A. Serway, J.W. Jewett, Jr., Physics for Scientists and Engineers, Mechanics, Oscillations and Mechanical Waves, Thermodynamics, Relativity, 8th edition, Greek translation Kleidarithmos Editions, Athens (2012).
- H.D. Young, R.A. Freedman, University Physics with Modern Physics, Greek translation, Volume A', Mechanics-Waves, 11th edition, Greek translation, 2nd Greek edition, Papazisi Editions, Athens (2009).
- P.G. Hewitt, Conceptual Physics, 9th American edition, Greek translation, Crete University Press, Heraklion (2011).
- H.C. Ohanian, Physics, Norton, London, (1985), Greek translation, Symmetria Editions, Athens (1991)].
- C. Kittel, W.D. Knight, M.A. Ruderman, Mechanics: Berkeley Physics Course, Volume I, Symmetria Editions, Athens (1978).
- R.P. Feynman, R.B. Leighton, M. Sands, The Feynman Lectures on Physics, Volume I, Addison-Wesley (1963).

ETY-111 General Mathematics I

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-111**	**SEMESTER**	**1st**
COURSE TITLE	GENERAL MATHEMATICS I		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
		6	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND & SKILLS DEVELOPMENT		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://elearn.uoc.gr/login/index.php		

(2) LEARNING OUTCOMES

Learning outcomes

The learning goals that students should have achieved at the end of the lesson are the following:

- Compute limits of sequences, series and functions.
- Compute derivative of functions using proper theorems and methods.
- Use derivatives to find max/min values of functions and solve Initial value problems (IVP).
- Find Taylor series of simple functions and use them to approximate values of functions
- Compute define and indefine integrals.
- Use integrals to solve problems from physical sciences and engineering.

General Competences

The course is formed in such a way, that during lectures and especially during the preparation of the written assignment (homework), that students will train themselves in:

- Working independently on solving problems
- Critical thinking
- Interdisciplinary knowledge

(3) SYLLABUS

Content of the course:

1. Sequences, limits of sequences, properties.
2. Functions, elementary functions, limits of functions, properties.

3. Continuity. The maximum value theorem. The intermediate value theorem.
4. The derivative of a function, properties. Chain rule, inverse function rule. The theorems of Fermat and Rolle, the mean value theorem. Higher derivatives. Graphing using first and second derivatives. L'Hôpital's rule.
5. Applications of derivatives. Initial value problems (IVP). Taylor series.
6. Definite integrals, properties, examples.
7. Indefinite integrals, the fundamental theorem of calculus. Integration techniques. Applications in computing areas, volumes, etc. Improper integrals.
8. Applications of integrals.
9. Series, convergence, absolute convergence. Convergence tests. Power series, radius of convergence. Taylor series.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-Face & Distance Learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, of Board and Supportive learning through the active web site of the course in the learning platform of the University of Crete (elearn.uoc.gr).
TEACHING METHODS	

Activity	***Semester workload***
Lectures	52
Practice	26
Course total	78

STUDENT PERFORMANCE EVALUATION	Students are evaluated by: 1. Final exam 2. Exercises that are given every week.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *J. Hass, C. Heil, M. Weir, Thomas Calculus, Crete University Press, 2018.*

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ETY-114 Computers I: Introduction to Programming

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-114	**SEMESTER**	1st
COURSE TITLE	Computers I: Introduction to Programming		

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	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*	Compulsory (gerneral background)
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.materials.uoc.gr/el/undergrad/courses/ETY114/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

Upon successful completion of the course, students will

1. be familiar with the basic concepts of structured programming and will be able to develop and implement simple algorithms in Fortran.
2. be prepared to attend the computational courses of the curriculum: Computers II (ETY-213), Advanced programming (ETY-215), Computational Materials Science I (ETY-447) and II (ETY-512), etc.
3. be able to understand or even plan codes in programming languages similar to Fortran.
4. have developed a systematic method to tackle a complex problem by analyzing it into many, simple, and easy tasks.

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…*

Solving complex problems
Development of scientific thinking
Use of libraries and multiple bibliographic sources
Search for resources and online lessons
Create notes and standalone study method
Manage time and deadlines

(3) SYLLABUS

- Variables-Constants. Fundamental Fortran 95 types (INTEGER, REAL, COMPLEX, LOGICAL, CHARACTER). Numerical Operators. Assignement. Code development guidelines..
- Intrinsic numerical functions and subroutines.
- Control statements (IF, SELECT CASE). Comparison operators. Logical operators. Loop constructs (DO) and associate statements (CYCLE, EXIT).
- Arrays, static and dynamic (ALLOCATE, DEALLOCATE). Elemental operators and intrinsic functions.
- Functions - Subroutines.
- Derived types – MODULE.
- Algorithms for sorting and searching.

(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*	Computers and projector are used in teaching, exercises and for communicating with students (through the course website and by 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	26
Programming exercises	39
Study	115
Course total	180

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Lecturer's notes
- Fortran 77/90/95 and Fortran 2003, A. Karakos Kleidarithmos publishing, 2008.
- Introductions to Fortran 90/95/2003, N. Karampetakis, Zitis publishing, 2011.

- Related academic journals:

ETY-121 General Chemistry

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-121**	**SEMESTER**	**1st**
COURSE TITLE	General Chemistry		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
		6	6
COURSE TYPE	GENERAL BACKGROUND		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY121/		

(2) LEARNING OUTCOMES

Learning outcomes

General Chemistry is a course that deals with the fundamental concepts of chemistry. The course's goal is to introduce the Materials Science and Technology (MST) first-year students to the properties of chemical substances focusing on the chemical aspects of Materials' Science. Upon completion of the course, the students will be able to understand concepts such as:

1. To familiarize with…

- Basic Chemistry Principles

2. To acquire the basic knowledge of …

- Atomic and Molecular Structure of Matter
- States of Matter and Solutions
- Chemical Reactions and Chemical equilibria

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

-Development of critical thinking
-Promotion of free, creative and inductive thinking

(3) SYLLABUS

1. Basic Chemistry knowledge: Measuring units, Balancing of chemical reactions
2. Atomic and molecular structure of Matter: The structure of the atom, atomic orbitals, Periodic Table and the periodic properties of elements, Chemical bond and bond theories, Molecular geometry, Molecular orbitals
3. States of Matter and Solutions: Gas Phase, Ideal-gas equation, Kinetic Theory of Gases, Liquid phase, Intermolecular forces, Phase diagrams, Solid phase, Structure of Solids, Bonding in solids, Alloys, Metals-Semiconductors-Insulators, Polymers, Nanomaterials, Solution Properties, Colligative properties
4. Chemical Reactions and Chemical equilibria: Mechanism of chemical reactions, order of reaction, Chemical

equilibrium, LeChatelier principle, Acid-base equilibrium, acid-base classification, common-ion effect

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point
TEACHING METHODS	***Activity*** / ***Semester workload*** Lectures: 52 Worked-out examples: 26 Homework: 100 Course total: **178**
STUDENT PERFORMANCE EVALUATION	The student performance will be evaluated by two mid-term exams and a final exam at the end of the semester. The final grade will be the summation of the two mid-term exams' grade (30% each) and the final exam grade (40%) under the clause that the grade will be higher than 5 (out of 10) in the final exam.

(5) ATTACHED BIBLIOGRAPHY

1. T. L. Brown, H. E. Lemay, B. E Bursten, C. J. Murphy, P. M. Woodward, M. W. Stoltzfus «Chemistry, Central Science», 13η edition, Ziti publications 2016
2. D. D. Ebbing, S. D. Gammon «General Chemistry» 10η edition, Travlos publications 2014
3. P. Atkins, L. Jones, L. Laverman «Chemistry Principles» 1st edition, Utopia publications 2018

ETY-141 Materials I: Introduction to Materials Science

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES & ENGINEERING		
ACADEMIC UNIT	Materials Science and Technology		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**ETY-141**	**SEMESTER**	**1st**
COURSE TITLE	Materials I: Introduction to Materials Science		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	-
COURSE WEBSITE (URL)	http://www.materials.uoc.gr/el/undergrad/courses/ETY141

(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 **get acquainted** with the basic characteristics of the interdisciplinary approach of Materials Science that combines Physics, Chemistry and Mathematics.
- To **connect** the macroscopic properties of materials with the various levels of structure (atoms, bonds, crystal lattice)
- To **know** the basic quantities that describe the mechanical, thermal and electrical properties of materials.
- To **become acquainted** with the experimental methods of analysis of the structure and composition of matter and to **know** the principles on which they are based.
- To **become familiar** with the strategies of design and selection of materials as well as the open problems of the field.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

General Competences

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

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
	Showing social, professional and ethical responsibility and sensitivity to gender

Working independently	*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…*
	……

- Knowledge of the basic methods of materials characterization and understanding in quantitative and qualitative terms the results of such measurements.
- Can predict qualitatively and quantitatively, where possible, the macroscopic properties of materials based on their structure.
- Be able to describe qualitatively and quantitatively the basic requirements a material should satisfy for use in a realistic application.
- Can choose the most suitable material based on the specifications for applications involving mechanical, thermal or electrical properties or their combination

(3) SYLLABUS

1. **Introduction**
2. **Categories of Materials-Applications-Examples**
   Metals, Ceramics, Polymers, Composite Materials
3. **Atomic Structure**
   Structure and constituents of atoms, Fundamentals of Quantum Mechanics, Quantum mechanical description of atoms
4. **Bonds**
   Forces between atoms, Potential, Ionic bonds, *Ionization potential, Electron Affinity,* Covalent bonds, Metallic bonds ,Secondary Bonds, *Wan der Waals bonds, Hydrogen bonds*
5. **Structure**
   Crystalline, amorphous materials, *Unit cell, Atomic Packing Factor (APF),* Metallic crystals, (FCC), (BCC), (HCP), Ionic solids, Covalent solids, Crystal Lattice, *Crystal systems, Crystallographic directions, Crystallographic planes,* Structural analysis techniques, *X*-ray Diffraction (XRD)
6. **Mechanical Properties**
   Deformation, Mechanical Stress, Elastic behavior, Plastic behavior, *Tensile strength, Ductility, Resilience, Toughness,* Hardness.
7. **Thermal Properties**
   Heat Capacity, *Phonons,* Thermal Expansion, Thermal conductivity, Thermal stress-resistance to thermal shock
8. **Electrical Properties**
   Ohm's law, electrical conductivity, Electrical properties at the atomic scale, *Energy bands, Fermi energy, Carrier mobility and conductivity,* Electrical properties of metals, Semiconductors, Ionic ceramics, Electrical properties of polymers, Conductive polymers

(4) TEACHING and LEARNING METHODS - EVALUATION

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

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students
	• Use of slides (powerpoint)
	• Videos with demonstration/understanding experiments.
	• Open and free educational material available through the class webpage (Creative Commons CC-BY-ND-3.0, licenses) of the following:
	  o Lecture slides
	  o Supplementary materials (slides) for further understanding
	  o Solved and unsolved exercises
	• Furthermore in the class webpage the students can find:
	  o Selected previous exams
	  o Useful links and examples
	  o Bibliography

	• Communication through email and constant office hours available through the class webpage. The lectures are offered through the open courses of the University of Crete, (https://opencourses.uoc.gr/courses/course/view.php?id=216) where the students have access besides the abovementioned video lectures and exercises

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
Exercises	13
Directed learning activity (office hours)	10
Non-directed learning activity	88
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.

Final written exams (100%)

The evaluation criteria are accessible in the class webpage.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- W. D. Callister, *"Materials Science and Engineering"*, Willey (2001)
- Michael F. Ashby, Hugh Shercliff, David Cebon, *"Materials: Engineering, Science, Processing and Design"*, Butterworth-Heinemann, (2007)

- Related academic journals:

SECOND SEMESTER

ETY-012 English II

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-012**	**SEMESTER**	**2nd**
COURSE TITLE	English 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**
		3	4
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND & SKILLS DEVELOPMENT		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	ENGLISH		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://new.edmodo.com/groups/e-mat-2-2019-31089866		

(2) LEARNING OUTCOMES

Learning outcomes

The learning goals that students should have achieved at the end of the lesson are the following:

The course is intended to teach students English terminology on subjects of materials science and general science and scientific approach and cooperation.

It is expected that after the successful completion of the course and completion of the specified assessment, individual work, individual presentation and group work required by the students, they will be able to:

- Seek, recall and work with relative ease with texts that contain terminology related to their specialty and subject matter.
- Create various types of well-structured materials science texts and research communication documents with differentiated goals and practices.
- Easily read and understand scientific papers and communications related to their subject matter.
- Evaluate sample writing in English, and provide documentation services related to their subject matter.
- Describe in English the research results or research and experimental processes to participants and public bodies with a view to seeking international funding.
- Draw conclusions from data they find in sources in English regarding their subject matter.

Have fluency in writing, spoken interaction, listening, written comprehension, and productive speech at a level equal to or greater than the B2+ of the Common European Framework of Reference of the Council of Europe in terms of their subject matter.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 5 (comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge).

General Competences

The course is formed in such a way, that during lectures and especially during the preparation of the written assignment (homework), that students will train themselves in:

- *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*
- *Production of free, creative and inductive thinking*

(3) SYLLABUS

The class goal is to act as a continuation of the hands-on introduction to English academic texts and terminology related to Materials Sicence. Major topics covered: Matter and materials structure, molecular physics, polymers, modern materials science applications and scientific method, and research documentation. Further aid is offered for the familiarization with authentic, subject specific texts and vocabulary. Development of reading skills and techniques. Additional writing skills to be developed: Introduction to EuroCVs, introduction to hands-on use of research databases and electronic resources in English.
The course is taught solely in English and has the following structure:

- Nine lectures covering the main topics outlined in the class goals, supplemented by relevant texts, multimedia and exercises.
- During this course, a combination of teaching practices is used which aim to optimize the participation and learning of the participating students. Thus, in parallel with a multimedia-enhanced presentation of the themes of each lecture in English, a form of continuous assessment is carried out through a series of graded portfolio-based mini-assignments, and a final written examination.
- Learning is aided by the extensive use of the interactive e-class Edmodo platform, where all relevant notes, announcements, feedback, and so on, as well as online, multimedia and other learning resources are posted.
- The reading texts are taken from existing course books and popular scientific journals.
- The general content of the course is geared towards teaching specific terminology related to the field of the materials science department. Furthermore, it aims to familiarize students with some of the practical skills they will be required to develop as future scientists in real work environments (oral presentations, writing letters, memos, participating in group meetings, etc.).

An overall aim is the improvement of the general communication ability of students in English. During the course, students have the ability to extensively practice oral and written skills as well as comprehension skills. At the same time, emphasis is placed on group-work, peer evaluation and the use of authentic language material. In general, the structure of the course is that of blended learning.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY</td><td>Face-to-Face & Distance Learning</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of Power Point, of Board and
Supportive learning through teleconference tools,</td></tr>
<tr><td>TEACHING METHODS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Written assignment (Homework) and oral presentation in the class of their written assignment</td><td>40</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>92</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>The evaluation is done solely in English.
Students are assessed on the basis of four sub-categories:
a) Selection of a paper from a scientific journal of Materials, which each student chooses to analyse and present both in writing and orally, and submission of the rationale behind the selection of a specific article. Selection of a second paper on the same topic to compare key points. Provision of written feedback to all students who submitted this assignment. This assignment follows a relevant model given to the students (3% of total grade).
b) Four-minute presentation of the paper, which each student has chosen to present and compare with a second paper. Provision of written feedback to all students who submitted this assignment. This assignment follows a relevant model given to the students (17% of total grade).</td></tr>
</table>

	c) Written of final project on the above-mentioned papers. Provision of written feedback to all students who submitted this assignment. This assignment follows a relevant model given to the students (30% of total grade). d) Final examination of the material covered during the semester (50% of total grade).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Stafilidis, D. (2009) Dictionary of Technology and Science, English-Greek Dictionary, Greek-English Dictionary, Stafilidis Technical Scientific Publications, Athens
- Sisamakis, M. (2019) Materials Science II course lecture notes (ver. 2)

- Related academic journals:

Indicative list of suggested academic journals for initial study and discussion:

1. Materials
2. Materials and Structures
3. Scientific American
4. New Scientist

ETY-102 General Physics II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-102	**SEMESTER**	2nd
COURSE TITLE	GENERAL PHYSICS II		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
		6	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY102/		

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The course covers the physics of electricity, magnetism and optics, using mathematics on an advanced level compared to the corresponding requirements in secondary education. The course learning outcomes are:

- Understanding basic physics laws and concepts in the fields of electricity, magnetism and optics.
- Employing the acquired knowledge to analyze and solve respective physics problems with the use of calculus and simple differential equations.
- Acquisition of the basic background required to follow courses on electromagnetism (ETY-301) and optics (ETY-302) on an advanced undergraduate level.

¨´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…*
	……

- Development of interdisciplinary and critical thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technology.

- Development of creative and inductive thinking

(3) SYLLABUS

- Electric field, Coulomb's law, Gauss law.
- Electric potential
- Capacitors, dielectrics, current and resistance.
- DC circuits, magnetic fields
- Sources of magnetic field, Biot-Savart law, Ampere's law.
- Faraday's law, electromagnetic induction, solenoids
- AC circuits
- Nature of light
- Geometrical optics, reflection, refraction
- Interference

(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*	Power Point , electronic correspondence (e-mail) for 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	52
Tutorials	26
Homework	72
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.*	The evaluation process, as reported on the course website, is carried out in the Greek language by a series of optional tests during the course and a final written examination using a combination of - Short-answer questions - Problem solving - Theory questions requiring a topic development Students retain the right to view their exam scripts after grades are published and ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography: (in Greek)

- R.A. Serway και Jewett, "Physics for Scientists and Engineers", Vol II , Cengage Learning, Greek translation: Kleidarithmos Publishing (2013).
- D.C. Giancoli, "Physics for Scientists and Engineers", Vol II, Pearson, Greek translation: Tziola Publishing (2017).
- D. Halliday, R. Resnick, J. Walker, "Physics", Vol. II, Wiley, Greek translation: Gutenberg Publishing (2008).

- H.D. Young, "University Physics with modern Physics", Vol. II, Pearson, Greek translation: Papazisis Publishing (2009)
  (the aforementioned books cover the course in its entirety)
- P.G. Hewitt, "Conceptual Physics", Vol. II, Pearson, Greek translation: University of Crete Publishing (1994)
- R.P. Feynman, R.B. Leighton, Sands, M., "The Feynman Lectures on Physics", Vol. I and II, Addison-Wesley (1963) (reference book for specialized topics)

ETY-112 General Mathematics II

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-112**	**SEMESTER**	**2st**
COURSE TITLE	GENERAL MATHEMATICS II		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
		6	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND & SKILLS DEVELOPMENT		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY112/		

(2) LEARNING OUTCOMES

Learning outcomes

The learning goals that students should have achieved at the end of the lesson are the following:

- Familiarization with vector algebra and differential and integral calculus especially in two and three but also in higher dimensions, with an eye to applications in problems of classical physics.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 5 (comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge).

General Competences

The course is formed in such a way, that during lectures and especially during the preparation of the written assignment (homework), that students will train themselves in:
Formulating and analyzing problems in geometry and physics by the methods of mathematical analysis

(3) SYLLABUS

Summary of topics to be covered in the course:

1. Vector algebra, operations and geometry in two, three or higher dimensions. Linear transformations and matrices. Determinants.

2. Real and vector functions of vectorial variables (of several real variables). Graphical representation. Limits. Continuity. Differentiation and fundamental properties thereof. Definition and calculus of the "grad", "div" and "curl" operators. Taylor's theorem. Implicit function theorem.
3. Extrema. Extension of methods for finding maxima and minima to functions of a vectorial variable. Quadratic forms. Constrained extrema, Lagrange multipliers.

4. Parametric curves. Line integrals.
5. Multiple integrals. Change of variables in multiple integration.
6. Parametric surfaces. Surface integrals.
7. Integral theorems of vector calculus (Green's, Stokes' and Gauss' s theorems).
8. Improper integrals in one or more dimensions.
9. Applications to mechanics and electromagnetism.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Computer and projector, recorded lectures
TEACHING METHODS	***Activity*** / ***Semester workload***
	Lectures — 52 hours (4/week)
	Problem sessions — 26 hours (2/week)
	Homework — 117 (9/week)
	Course total — **195 hours**
STUDENT PERFORMANCE EVALUATION	Students are evaluated by: • Frequent short written in-class tests • Final Examination.

(6) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Marsden and Tromba, Vector Calculus, Translation – Copy Edit: A.Giannopoulos, D. Karagiannakis, Crete University Press (1992) – edition 2017 (Vector Calculus, 3rd edition)
- THOMAS Calculus, [George B. Thomas, Jr.,] Joel Hass, Christopher Heil, Maurice D. Weir, Crete University Press (2018)
- M.R. Spiegel, Advanced Calculus, Schaum's Outline Series.
- Tom Apostol, Differential and Integral Calculus II, Atlantis (1990)

ETY-116 Applied Mathematics

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-116**	**SEMESTER**	**2nd**	
COURSE TITLE	APPLIED MATHEMATICS			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**	
		5	6	
COURSE TYPE	GENERAL BACKGROUND			
PREREQUISITE COURSES:	-			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	http://esperia.iesl.forth.gr/~kafesaki/Applied-Mathematics/			

(2) LEARNING OUTCOMES

Learning outcomes

The course is an introduction to four disciplines of Mathematics which are considered essential for the study and understanding of Material Science: Complex Analysis, Linear Algebra, Fourier Analysis, Probability Theory.

The learning goals that students should have achieved at the end of the course are:

- Knowledge and understanding of all concepts developed in the course (knowledge+understanding+analysis)
- Ability to utilize and use the concepts and mathematical "tools" introduced in the course to solve Materials Science problems (composition+application)
- Ability to independently explore more complex Mathematics topics (related to the four mathematics disciplines introduced in the course) that may be required to study specific Materials Science topics.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

- **Γενικές Ικανότητες**

The course aims to develop the following general competencies:
-Developing critical thinking
-Search, analyse and synthesize data and information, using the necessary technologies
-Self-employment
-Providing creative and inductive thinking

(3) SYLLABUS

A. Complex analysis

Complex numbers, complex functions, complex function derivation, complex function integration, complex series (Taylor and Laurant), Gamma function

B. Linear Algebra (Vectors, Matrices)

Vector spaces and vectors, operators and matrices, linear systems of equations eigenvalue problems for matrices

C. Fourier analysis
Fourier series, Fourier transforms, Dirac Delta function

D. Probability Theory
The concept of probability, permutations and combinations, random variables and probability distributions, expected value, variance

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of an online platform for classroom testing (www.classmarker.com) Use the course web site for tests, announcements, information on useful websites, etc. Use of technology to create multiple choice exams (much program, http://eigen-space.org/mk/much/)
TEACHING METHODS	

Activity	***Semester workload***
Lectures	65
Homework	65
Course total	**130**

STUDENT PERFORMANCE EVALUATION	The student evaluation is done through (a) a final written exam (b) mid-term optional exams (more than one) All exams are in Greek and consist of solving multiple choice exercises. The number of mid-term exams (usually 2) and their contribution to the final grade is announced at the beginning of the semester. Students can see their grades and discuss the tests outcome at the end of each assessment.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *Course notes:*
  http://esperia.iesl.forth.gr/~kafesaki/Applied-Mathematics/notes.html (relatively brief)
  https://www.materials.uoc.gr/el/undergrad/courses/ETY116new/notes.pdf (more analytic)
- S. Sokolnikoff & R. M. Redheffer, *Mathematics for Physicists and Engineers*, Edition by National Technical University of Athens, 2001 Athens (in Greek)
- I. Vergados, *Mathematical Methods of Physics*, Vol. I, Crete University Press, Heraklion (in Greek)
- K. F. Riley, M. P. Hobson, S. J. Bence, *Mathematical Methods for Physics and Engineering*, Cambridge University Press
- G. Arfken, *Mathematical Methods for Physicists*, Academic Press, New York (1995)
- G. Strang, *Linear Algebra and Applications*, Crete University Press, Heraklion (in Greek)
- P. Hoel, S. Port, C. Stone, Introduction to Probability Theory, Crete University Press, Heraklion (in Greek)

ETY-122 Organic Chemistry

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIAL SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-122**	**SEMESTER**	**2nd**
COURSE TITLE	ORGANIC 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	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	HELLENIC		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY122/ http://122organicchemistry.wordpress.com		

(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 organic chemistry course is an introductory course designed to provide basic organic chemistry knowledge necessary to understand and comply to other undergraduate general background courses such as chemistry of materials, polymer chemistry, biochemistry and biomaterials.

Upon successful completion of this course the students will be able to:
- Understand and draw the structure of widely used organic compounds and entities,
- Recognize and name the different classes of organic compounds and identify their properties,
- Know and understand all basic organic chemistry principles such as the nature of chemical bonds, isomerism, stereochemistry, chemical reactions and (curly arrow) mechanisms.
-Correlate the structure of an organic compound with physical properties (such as relative boiling point, melting point, solubility),
-Understand basic organic reaction mechanisms and use them to comprehend, design and synthesize new materials,
-To meet the needs of laboratory courses (general background and specialized courses) involving synthesis of organic compounds,
-To work in multidisciplinary environments requiring basic organic chemistry understanding (within the framework of a diploma thesis or Erasmus).

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…*
	……

- Research, analyze and synthesis in the area of organic chemistry,
- Working in interdisciplinary environments,
- Autonomous work,
- Team work.

(3) SYLLABUS

Structure, bonding, molecular properties and nature of organic compounds. Molecular representations. Acids and Bases. Alkanes and Cycloalkanes. Stereoisomerism. Stereochemistry. Chemical reactivity. Mechanisms of organic reactions. Substitution reactions. Alkenes: Structure, nucleophilic substitution and elimination reactions. Alkynes. Alkyl Halides. Determination of organic compound structures: Introduction to mass spectrometry (MS), infrared spectroscopy (IR), nuclear magnetic resonance spectroscopy (NMR), ultraviolet spctrocopy (UV). Radical reactions. Introduction to aromatic compounds, hydrocarbons, aminoacids, peptides, proteins and lipids.

(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*	**Socrative online quizzes dedicated webpage.**
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures	52
Tutorials	26
Office hours	8
Independent study	
Course total	***86***

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*	Midterm exam (40%) and final exam (60% or 100%) containing: -Multiple choice questions, -Short-answer questions, -Organic chemistry problems.

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Organic Chemistry for Life Sciences, David Klein, Utopia Publications, Athens, 2015.
Organic Chemistry, John McMurry, Crete University Press, Heraklion, 2012

- Related academic journals:

ETY-124 Chemistry Laboratory Course

(1) GENERAL

SCHOOL	Sciences and Engineering		
ACADEMIC UNIT	Materials Science and Technology		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**ETY-124**	**SEMESTER**	**2nd**
COURSE TITLE	Chemistry laboratory course		

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	8
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	General Chemistry (ETY-121)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY124/

(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 at the end of the course are expected to:

1. Familiarize themselves with the conditions of conducting a laboratory course as well as with the rules of operation and the safety rules that govern a Laboratory course.
2. To know basic analytical techniques that are expected if they use in their professional life such as titration, infiltration, sinking, quality analysis, preparation of solutions of specific concentration and content, dilutions of solutions.
3. Be able to know the use of basic chemical utensils such as the pipette, the burette, the volumetric and conical flask, the volumetric cylinder as well as the use of certain devices such as the analytical scale, the drying oven, the UV lamp etc.
4. Be prepared to attend more demanding laboratory courses such as the teaching of the next laboratory courses of the Department.

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…*

.....
Team work

(3) SYLLABUS

Basic Laboratory Techniques
Chemical equilibrium - , Weak electrolyte ionizations (salt hydrolysis, buffer solutions, indicators)
Peha metric titration (equivalent point, determination of the constant of a weak acid)
Titration analysis (acid-base, complexes, Iodometry),
Photospectroscopy,
Characteristic reactions and systematic semi-quantitative analysis of cations and anions.
Chromatography (Thins Layer Chromatography (TLC))
Gravimetric analysis methods

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The students after the execution of the scheduled experiment, they have to write a report concerning the experiment they executed and deliver the report in a week time at the latest. In the repost they are expected to describe the theoretical background lying behind the experiment, the stages of the experiment, the measurements they acquired, the processing of the measurements and the results, comments and assessment of the results. At the end of the reports they have to answer in some given questions in an effort to help them understand better the experimental procedure and evaluate the results. The report is written using a personal computer and is sent to the responsible by e-mail. The final grade of the lab takes into consideration the mare taken from a final exam and the average grade of the reports.

Activity	*Semester workload*
Lectures	10 hours
Experiments	32 hours
Report writing	50 hours
Course total	***92***

(5) ATTACHED BIBLIOGRAPHY

- M. Vamvakaki, Handbook of General Chemistry Laboratory, University of Crete, Heraklion, (2003).
- J. H. Nelson, K. C. Kemp, Lab Experiments, Prentice Hall (2000).
- L. Peck, K. J. Irgolic, Measurement and Synthesis in the Chemistry Laboratory, Prentice Hall (1998).
- G. M. Bodner, H. L. Pardue, Chemistry : An Experimental Science, John Wiley & Sons (1994).
- J. H. Nelson, K. C. Kemp, B. L. Bursten, Chemistry : The Central Science : Laboratory Experiments, Prentice Hall College Division (1996).
- S. L. Murov, B. Stedjee, Experiments in Basic Chemistry, 4th Edition, John Wiley & Sons (1996).
- R. A. D. Wentworth, Experiments in General Chemistry, Houghton Mifflin College (1999).
- S. L. Murov, Experiments in General Chemistry : Laboratory Manual to Accompany Umland/Bellama's General Chemistry, Brooks/Cole Pub Co. (1998).

THIRD SEMESTER

ETY-201 Modern Physics: Introduction to Quantum Mechanics

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-201**	**SEMESTER**	**3rd**	
COURSE TITLE	MODERN PHYSICS: INTRODUCTION TO QUANTUM MECHANICS			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**	
		5	6	
COURSE TYPE	GENERAL BACKGROUND			
PREREQUISITE COURSES:	-			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	http://esperia.iesl.forth.gr/~kafesaki/Modern-Physics/			

(2) LEARNING OUTCOMES

Learning outcomes

The course is an introduction to Quantum Mechanics and its applications to simple, basic systems, essential for the study and understanding of the structure of matter.

The learning objectives that students should have achieved at the end of the course are:

- To know, understand and be able to use all the concepts developed in the course concerning the behaviour of matter on a microscopic scale.
- Be able to use the concepts learned and the knowledge gained to study and understand / interpret the behaviour of more complex systems than those presented in the course (eg complex atoms, molecules and their spectra, magnetic materials, light-material interaction, etc.) which are fundamental in many areas of Materials Science.
- To be able to study on their own (with the bases they acquired in the course) more complex and advanced subjects of Quantum Mechanics which may be required for the study of special topics of Materials Science.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

- **General competencies**

The course aims to develop the following general competencies:
-Expanded perception (ability to perceive issues outside the common experience)
-Search, analyze and synthesize data and information, using the necessary technologies
-Both autonomous work and teamwork capability
-Creative and inductive thinking

(3) SYLLABUS

A) The crisis of Classical Physics and the Old Quantum Theory:

- The wave-particle duality for light: black body radiation, photoelectric effect, Compton effect, the particle-like natur of light
- The wave-particle duality for matter: atomic spectra, Bohr's theory, matter-waves (de Broglie waves). The position-momentum uncertainty principle, its interpretation and its consequences (atomic stability, order of magnitude of atomic and nuclear energies, etc.)

B) Introduction to Modern Quantum Mechanics:

- Quantum mechanics in one dimension: Schrödinger equation in one dimension, wave function and its statistical interpretation. Simple one-dimensional quantum mechanical systems and quantization of energy: the infinite square well, the finite square well (qualitative study), the harmonic oscillator, the step-function potential, the rectangular barrier potential and the tunneling effect.
- Quantum mechanics in three dimensions: Schrödinger equation in three dimensions. The hydrogen atom (spherically symmetric solutions, ground state, states with angular dependence (mainly qualitatively)). Atom in a magnetic field. Spin and Pauli's Exclusion Principle. Atoms with more than one electrons. The periodic system of elements. Selection Rules for atomic transitions.

C) Quantum Mechanics in more complex systems (briefly and mainly qualitatively):

- Molecules: The basic theory of chemical bonding; simple molecules (H_2, H_2O). The phenomenon of hybridization. Rotation and oscillation of diatomic molecules; molecular spectra.
- Solids: The theory of energy bands. Fermi energy. Conductors, semiconductors, insulators and their conductivity. Semiconductor doping and applications (brief description).

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of an online platform for classroom testing (www.classmarker.com) Use the course web site for tests, announcements, information on useful websites, etc. Use of technology to create multiple choice exams (much program, http://eigen-space.org/mk/much/) Use and suggest related online courses from the Mathesis online course platform (http://mathesis.cup.gr/) for further study.
TEACHING METHODS	
STUDENT PERFORMANCE EVALUATION	The student evaluation is done through (a) a final written exam (b) mid-term optional exam All exams are in Greek and consist of solving simple quantum mechanics problems. In some cases also multiple choice exams are given. Students can see their grades and discuss the exams outcome at the end of their assessment.

Activity	***Semester workload***
Lectures	65
Homework	65
Course total	**130**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Course notes from the course web-page: http://esperia.iesl.forth.gr/~kafesaki/Modern-Physics/lectures/
- Material from the online course of the platform Mathesis «Introduction to Quantum Physics I: The basic principles» (in Greek) at https://mathesis.cup.gr/courses/Mathesis/Phys1/2015_T1/course/; instructor Stefanos Trachanas
- Material from the online course of the platform Mathesis «Introduction to Quantum Physics II: The main applications» (in Greek) at https://mathesis.cup.gr/courses/course-v1:Physics+Phys1.2+18F/course/; instructor Stefanos Trachanas.
- Stefanos Trachanas, Quantum Mechanics I, Crete University Press 2005, Heraklion (in Greek)
- Stefanos Trachanas, Elementary Quantum Mechanics, e-book, Crete University Press (in Greek)
- R. Serway, Physics for Scientists and Engineers, Vol IV, translated to Greek and edited by L. Resvanis
- R. Eisberg, R. Resnick, Quantum Physics of Atoms, molecules, solids and particles, Wiley, London (1974)
- R. Feynman, Leighton and R. Sands, The Feynman Lectures in Physics, Vol III, Addison-Wesley, Reading (1965)

ETY-203 Physics Lab I

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIAL SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-203	**SEMESTER**	**3rd**
COURSE TITLE	PHYSICS LAB 1		
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	8
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Background- Skills Development		
PREREQUISITE COURSES:	GENERAL PHYSICS 1 (ETY-101)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY203/		

(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, the students:

- Through the experiments the students acquire a better understanding of basic laws of physics (knowledge)
- Are able to use, on a basic level, specialized measurement instruments such as laser, photogates and Computer Assisted Measurements. (skill)
- Are able, starting from experimental data, to provide a report analysing and presenting the results. (competence)
- Can assess the quality and the reliability of experimental data. (competence)

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…
…….

Collection, analysis, synthesis and assessment of data and information with the use of the necessary technological means. (measurement instruments, computer processing)
Working independently
Working in a team.
Composition of reports presenting scientific data.

(3) SYLLABUS

Educational quantitative experiments on simple physics phenomena.
Includes linear and rotational motion, oscillations, circular motion, simple and compound pendulum, heating and phase-change. The students perform verificatory experiments for basic laws of physics: Newtons laws of motion, Hook's law on elasticity, basic laws of calorimetry.
In the experiments are used basic and more specialized instruments and techniques for the measurements of physical quantities. Thermometer, Stopwatch, Vernier Caliper, Micrometer Caliper, laser, photogate, computer assisted measurements.,
The experimental process is followed by basic data processing and analysis: average value, standard deviation, linear least square regression, error in measured and calculated quantities.
Finally, the experimental procedure and the results are summarised in a report which is written by a group of students (usually triad).

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face, introduction followed by guidance
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**Communication with teaching stuff is performed via email. The use of computers in data processing and presentation is strongly recommended, encouraged and facilitated**
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***
Introductory lectures	6 hours
Induction to the lab	1.5 hour
Personal report	1.5 hour
Experiments	21 hours
Report Writing	40 hours (estimation)
Course total	***70 hours***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The assessment of students is performed in Greek language, in 3 steps, using 4 different procedures. Step 1. Brief oral or written examination on the experiment to follow Criteria : Description of the physical phenomenon, knowledge of the laws of physics involved, basic understanding of the experimental procedure (what is measured and how) Step 2: Evaluation of the report submitted by the students on the experimental procedure. The grade is the same for all members of the same group. Criteria : Measurement process and analysis, Plots, Presentation of results, judgment of the plausibility of results, overall appearance of report. Step 3: Written exam at the end of the semester where students are asked to process and present given experimental data. Criteria : Ability to apply the methods used during the semester, correct graphic representation of results, and calculation of physical quantities, on provided measurements.

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Andreas Zezas, Notes for Physics Lab I, Mechanics and Thermodynamics, Department of Physics, University of Crete 2013 (only in Greek)
- Chr. Chaldoupis, Physics Lab Exercises, Mechanics-Heat Transfer, University of Crete, Heraklion (1996). (only in Greek)
- R.A. Serway, Physics for Scientists and Engineers, Volume I: Mechnanics, Athens (1991).
- D. Halliday and R. Resnick, Physics, Part A, 3η edition, Editor Pnevmatikos, Athens (1986).
- F.W. Sears, M.W. Zemasky and H.D Young, University Physics, Addison Wesley (1981).

- *Related academic journals*

ETY-211 Differential Equations I

(1) GENERAL

SCHOOL	**SCIENCES AND ENGINEERING**		
ACADEMIC UNIT	**MATERIALS SCIENCE AND TECHNOLOGY**		
LEVEL OF STUDIES	**UNDERGRADUATE**		
COURSE CODE	**ETY-211**	**SEMESTER**	**3rd**
COURSE TITLE	**DIFFERENTIAL EQUATIONS 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**
	5	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE	**GENERAL BACKGROUND**
PREREQUISITE COURSES:	MATHEMATICS I (ETY-111) AND MATHEMATICS II (ETY-112)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY211/

(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*

At the end of the course, students are expected:

1. To familiarize themselves with the solution of simple first and second order differential equations
2. To know very well the methodology of solving higher-order linear differential equations
3. To be able to use this knowledge to solve physical problems mainly from the fields of mechanics and electricity

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

General Competences

- Enhance the mathematical background of differential and integral calculus
- Develop critical thinking in solving physics and chemistry problems
- Promoting creative and inductive thinking

(3) SYLLABUS

1. First-order differential equations:

Introductory concepts. The problem of initial conditions. The concept of the general solution of a differential equation. Equations with separable variables, first order homogeneous equations. Exact

equations and integral factors. Bernoulli equation. Simple applications.

2. Second-order Differential Equations:

Linear Equations with constant coefficients. Non-homogeneous equations with simple functions. Euler Equations, homogeneous and non-homogeneous. 2nd order equations reduced to 1st order because of symmetry.

3. Newton's differential Equation:

Applications to basic Mechanics problems. Motion under different friction laws in a homogeneous gravitational field. Harmonic Oscillation with and without friction. Forced Harmonic Oscillation with and without friction. Problems from electricity based on mechanical analogues.

4. General Study of Linear Differential Equations: Concepts and Techniques

The principle of superposition. Linear independence and dependence. Vronskian and its uses. Calculation of the second solution when one solution is known. Decrease of the order. Complete solution of the non-homogeneous equation when the solutions of the homogeneous are known.

5. Linear Differential Equations of higher order with constant coefficients

Homogeneous, non-homogeneous

6. Systems of Linear Differential Equations with constant coefficients

The method of elimination and exponential replacement. Solving methods and use of matrices. Normal oscillations and applications to coupled oscillation and electrical circuit problems.

7. Linear Differential Equations with variable coefficients

From Taylor series to Frobenius. Examples. Convergence and critical points.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Traditional classroom teaching and problem solving with student's participation.
TEACHING METHODS *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	Students are evaluated in Greek as follows: a. Optional mid-term exam (30%) b. Final examination (70%) that includes: - Solving differential equations that cover the entire course - Application Problem. Students are required to find the equation that describes the physical problem and then solve it based on the initial conditions. The problem promotes their critical and creative thinking. Students have the right to see their exam and ask questions.

Activity	***Semester workload***
Lectures	39
Exercises in the class	26
Homework	65
Course total	***130***

(5) ATTACHED BIBLIOGRAPHY

1. S. Trachanas, Ordinary Differential Equations, Crete University Press, Heraklion (2002)

2. Thomas Kyventidis, Differential Equations, Vol I, ZHTH 1996 Thessaloniki, Greece

3. S. Trachanas, Partial Differential Equations, Crete University Press, Heraklion (2001)

4. W.E. Boyce, R.C. Di Prima, Elementary Differential Equations and Boundary Value Problems, Wiley 8th edition, 2004

5. G.F. Simmons, Differential Equations with Applications and Historical Notes, McGraw-Hill (1991)

ETY-215 Advanced Programming I: Introduction to the C++ Programming Language

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-215	**SEMESTER**	3rd
COURSE TITLE	Advanced Programming I: Introduction to the C++ Programming Language		

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	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*	Elective (special background)
PREREQUISITE COURSES:	Computers I (ETY-114)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.materials.uoc.gr/el/undergrad/courses/ETY215/

(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, the students will
1. have deepen their knowledge of the basic concepts of structured programming
2. be familiar with certain advanced programming concepts, as implemented in C++ (such as the Standard Library components and object-oriented programming).
3. be able to develop complex, safe and fast code as well as understand or even plan code in programming languages with features simlilar to those of C++.

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…*

	…….

Solving complex problems
Development of scientific thinking
Use of libraries and multiple bibliographic sources
Search for resources and online lessons
Create notes and standalone study method
Manage time and deadlines

(3) SYLLABUS

A) General:
Introduction - Fundamental types and operators of C++.
C++ syntax, reserved keywords, naming rules. Fundamental types: boolean, character, integer, real, complex. The "void" type. Enumerations. Declarations and scope of variables and constants. Structures. Arithmetic operators, priorities. Namespaces, references, pointers.

Control structures, Loops.
If statement, (?:) operator, the switch statement, the assert function. Loop structures: while, do while, for. continue, break statements.

Functions
Function definition, declaration and usage. the main function. Overloading, function template. Math functions.

Exceptions.

B) Standard Library
Containers: vector, deque, list, set/multiset, map/multimap. Iterators. Algorithms, function objects, lambda functions, adapters.

C) Object-Oriented Programming: Introduction to classes: encapsulation, inheritance, polymorphism.

D) Other topics
Large program structure. Interface to Fortran and C.

(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*	Computers and projector are used in teaching, exercises and for communicating with students (through the course website and by 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	26
Programming exercises	26
Study	98
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*	Final written exams.

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Notes: (https://www.materials.uoc.gr/el/undergrad/courses/ETY215/notes.pdf)
- Bjarne Stroustrup. Programming - Principles and Practice Using C++ (Second Edition), Addison Wesley, Reading, MA, USA, 2014.
- Stanley B. Lippman, Josée Lajoie and Barbara E. Moo. C++ Primer. Addison Wesley, Reading, MA, USA, fifth edition, August 2012.
- Nicolai M. Josuttis. The C++ Standard Library: A Tutorial and Reference. Addison Wesley, Reading, MA, USA, March 2012.
- Bjarne Stroustrup. The C++ Programming Language. Addison Wesley, Reading, MA, USA, fourth edition, 2013.

- Related academic journals:

ETY-223 Inorganic Chemistry

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-223**	**SEMESTER**	**3rd**
COURSE TITLE	INORGANIC CHEMISTRY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	5	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND
PREREQUISITE COURSES:	GENERAL CHEMISTRY (ETY-121)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY223/ https://www.materials.uoc.gr/~garmatas/teaching.html

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The course includes an introduction to the basic principles that govern the chemical reactivity and physicochemical properties of elements with emphasis on those of transition metals. The structure of transition metal complexes in terms of chemical activity and energy stability is described.

The learning goals of the course are:
1. Consolidate the basic principles that govern the chemical reactivity of elements, especially of transition metals.
2. Acquire the knowledge necessary to understand the structure of inorganic complexes and the factors affecting their chemical stability.
3. The course aims at understanding the physicochemical principles that characterize the growth and properties of inorganic supramolecular solids.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…*
	……

- Development of interdisciplinary and critical thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technologies
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. Electron Configuration and Chemical Periodicity
The physical and chemical properties and the tendency of elements to form particular compounds in relation to their position in the periodic table.

2. Acid-Base and Donor-Acceptor Principles
Pearson acid-base concept (HSAB). Definitions of Arrhenius, Bronsted-Lowry, and Lewis acids and bases. Acid-base strength classification and factors affecting it.

3. Electrochemistry
Electrode potentials, redox reactions and electrochemical cells (voltaic and electrolytic cells). Relative strength of oxidizing and reducing agents. Free energy (Gibbs) and electrical work (Standard cell potential and the equilibrium constant). The effect of concentration on cell potential (Nernst equation) Corrosion: An example of environmental electrochemistry. Protecting against corrosion.

4. Transition Elements: Electronic Configuration and Bonds
Electronic configuration and oxidation states of the transition metals and their ions. Valence bond theory and orbital hybridization. Crystal field theory. Molecular orbital theory. Crystal field splitting of energy of d-orbitals (high-spin and low-spin symmetry compounds). Strong and weak-field ligands. Spectrochemical series. Magnetic properties of transition metal complexes (paramagnetic and diamagnetic complexes). Absorption spectroscopy (electronic spectra of d^n ions, charge transfer spectra: allowed/forbidden electronic transitions). Jahn-Teller distortion. Color of transition metals.

5. Coordination Chemistry: Structure
Compounds with coordination number 2 (linear), 3 (trigonal planar and trigonal pyramidal), 4 (tetrahedral and square planar arrangement), 5 (tetragonal pyramidal and trigonal dipyramidal), 6 (octahedral and triangular prismatic), 7 (pentagonal dipyramid, substituted octahedral and substituted triangular prismatic) and 8 (triangular dodecahedron and square antiprismatic). Isomerism in coordination compounds.

6. Coordination Chemistry: Rates and Mechanisms of Chemical Reactions
Reactions of nucleophilic substitution in transition metal compounds. Trans effect. Factors that influence reaction rate. Racemic mixtures and isomerization. Electron-transfer reaction mechanisms (outer and inner sphere mechanisms).

7. Solid State Chemistry
Synthesis of inorganic ionic and covalent compounds. Crystalline inorganic solids (Ionic and supramolecular 3D structures, laminate structures). Amorphous inorganic solids (Ceramics and glasses).

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Power Point, Supportive learning through the use of multimedia (videos) and valid online scientific sources, *e.g. https://ptable.com*, in order to understand the properties of chemical elements and the theories of covalent bonding.
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	48
Exercises	17
Homework	80

	Course total	**145**	
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 by an intermediate (optional) and final written examination in Greek that includes a combination of: - Problem solving - Developing of topics - Oral examination (for students with learning disabilities) Students have the right to view their exam scripts after the grading results are published and to ask questions. The evaluation process of the students is described during the first lecture and presented on the web site of the course: https://www.materials.uoc.gr/el/undergrad/courses/ETY223/		

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1) "Inorganic Chemistry", 2nd Ed., Catherine E. Housecroft, Alan G. Sharpe (Greek edition: N. Hatziliadis, T. Kampanos, A. Keramidas, S. Perlepes), Unibooks IKE, 2017.
   The book comprehensively covers the syllabus of the course.
2) P.P. Karagiannidis, "Inorganic Chemistry", 3rd Ed., ZHTH Publishers, Thessaloniki, 2008.
   The book largely covers the syllabus of the course.

- *Additional bibliography:*

1) I. Tossidis, "Chemistry Coordination Compounds ", ZHTH Publishers, Thessaloniki, 2001.
2) N.D. Klouras, "Basic Inorganic Chemistry ", 2η Ed., P. Travlos Publishers, Athens, 1997.
3) Albert F. Cotton, Geoffrey Wilkinson and Paul L. Gaus, "Basic Inorganic Chemistry", 3rd ed., John Wiley & Sons, New York, 1995.
4) James E. Huheey, Ellen A. Keiter and Richard L. Keiter, "Inorganic Chemistry: Principles of Structure and Reactivity" 4th ed., HarperCollins College Publishers, New York, 1993.
5) Martin S. Silberberg, "Chemistry: The molecular nature of matter and change", 4th ed., McGraw-Hill, New York, 2006.
6) R. Chang, "Chemistry", 6th ed., McGraw-Hill, Boston, 1998

- *Related academic journals:*

Inorganic Chemistry
Coordination Chemistry Reviews
European Journal of Inorganic Chemistry
Journal of Inorganic Chemistry

ETY-225 Chemistry of Materials Laboratory Course

(1) GENERAL

SCHOOL	Sciences and Engineering		
ACADEMIC UNIT	Materials Science and Technology		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**ETY-225**	**SEMESTER**	**3**
COURSE TITLE	Chemistry of materials laboratory course		

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	8
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	General Chemistry
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY225/

(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 at the end of the course are expected to:

1. Familiarize themselves with experimental practice and safety rules during the experimental process in more demanding experiments such as composing materials.
2. To know the experimental procedures that follow for the synthesis of useful materials such as zeolites, complexes, polymers and superconductors.
3. To be able to evaluate the synthetic course of a material and to find ways to determine the result of the composition by applying appropriate characterization methods depending on the material they have to do.
4. Familiarize themselves with material characterization instruments such as the Ultraviolet-visible photometer (UV-vis), Infrared spectroscope (IR), X-ray diffraction (XRD), microscope, etc.

General Competences

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

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

Team work

(3) SYLLABUS

Solid-state synthesis and superconductivity testing of inorganic material. Determination of average oxide state of the atoms with iodine titration.
Hydrothermic synthesis of Zeolite Na X and characterization of the material using infrared spectroscopy.
Synthesis and characterization of CdS nanoparticles by the aid of organic stabilizers. Characterization with UV-vis spectroscopy and X ray diffraction.
Synthesis of complex compounds $[Co(NH_3)_4CO_3]NO_3$ και $[Co(NH_3)_5Cl]Cl_2$. Determination of energy difference between d-orbitals t2g and eg of the various octahedral complex compounds with electronic adsorbance spectroscopy.
Kinetics of the substitutional reaction of the compound $[Co(NH_3)_5Cl]Cl_2$.
Lower critical solubility temperature of macromolecules. Effect of homopolymerization on the lower critical solubility temperature of a given macromolecule.
Modification of the side chain of a polymer. Characterization with Infrared spectroscopy.
Condensation and photopolymerization on a surface of silicon oxide. Characterization of the surface properties.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Theoretical lectures are given in the class using power point presentation. Laboratory education takes place in the laboratory face to face with the students.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**The reports are written from the students using personal computers and are delivered for being marked by e-mail**
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures	10 hours
Experiments	32 hours
Report writing	50 hours
Course total	***92***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The students after the execution of the scheduled experiment, they have to write a report concerning the experiment they executed and deliver the report in a week time at the latest. In the repost they are expected to describe the theoretical background lying behind the experiment, the stages of the experiment, the measurements they acquired, the processing of the measurements and the results, comments and assessment of the results. At the end of the reports they have to answer in some given questions in an effort to help them understand better the experimental procedure and evaluate the results. The report is written using a personal computer and is sent to the responsible by e-mail. The final grade of the lab takes into consideration the mare taken from a final exam and the average grade of the reports.

(5) ATTACHED BIBLIOGRAPHY

- Murray Zanger, James, R. Mackee, "Small Scale Syntheses, A Laboratory Textobook of Organic Chemistry", Wm. C. Brown Publishers, 1995
- Stanley, R. Sandler, Wolf Karlo, Jo-Anne Bonesteel, Eli M. Pearce, "Polymer Syntesis and Characterization, A Laboratory Manual" Academic Press, California, USA, 1998
- Francesco Trotta, Davice Cantamessa, Marco Zanetti, "Journal Of Inclusion Phenomena and Macrocyclic Chemistry", 37, 83-92, 2000
- Gregory S. Girolami, Thomas B. Rauchfuss, Robert J. Angelici, "Synthesis and Technique in Inorganic Chemistry: A Laboratory Manual", 3rd ed., University Science Books, Sausalito, USA, 1999.
- Zvi Szafran, Ronald M. Pike, Mono M. Singh, "Microscale Inorganic Chemistry: A Comprehensive Laboratory Experience", John Wiley & Sons, New York, 1991.

ETY-260 Thermodynamic

(1) GENERAL

SCHOOL	School of Sciences and Engineering		
ACADEMIC UNIT	Department of Materials Science and Technology		
LEVEL OF STUDIES	Undergraduate Studies		
COURSE CODE	**ETY-260**	**SEMESTER**	**3rd**
COURSE TITLE	THERMODYNAMIC		
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*	General background		
PREREQUISITE COURSES:	General mathematics II (ETY-112)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY260/		

(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*

Understanding of the laws of thermodynamics and their applications with emphasis on phase diagrams of materials. Develop critical thinking on the topic and analytic ability to solve problems. Rational approach to problems aiming at strict wording of problem data and assumptions as well as quantitative analysis. Develop ability to assess knowledge and understand the physical meaning of concepts and the results of experimental or theoretical analysis.

General Competences

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

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

Critical thinking in science in general with emphasis on quantitative analysis. Develop ability to give answers to specific questions. Work independently with emphasis on deep understanding rather than sterile memory. Feeling of self-assessment and self-criticism.

(3) SYLLABUS

The course involves a lengthy discussion of classical thermodynamics with emphasis on entropy changes and phase equilibria and a short basic introduction to statistical thermodynamics with main focus the most probable distribution and the microscopic description of entropy.

- Elementary introduction to the goals of Thermodynamics: energy, heat, systems, variables and equilibrium
- Zeroth Law of Thermodynamics
- Ideal and Real Gases
- First Law, Internal Energy, Enthalpy, heat capacity
- Second Law, Entropy and Reversibility
- Third Law
- Thermodynamic Functions, Chemical Potential
- Phase Transitions, Equilibrium
- Mixtures, Phase Diagrams, Phase Rule
- Elementary Probablity Theory and Statistical Physics
- Canonical Ensemble
- Microscopic States and Entropy, Fundamental Equations
- Equations of State, Phase Transitions

(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 whiteboard, discussion and questions/answers
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 hours
Problems/questions	13 hours
Course total	52 hours

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.*	Mid-term exam (elective, 40% of final grade) Homework problems (elective) Final exam (mandatory, 60% or 100% if mid-term is not taken)

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

P.W. Atkins "Physical Chemistry", 9th Edition, Greek Translation, Crete University Press
Instructor's notes on elementary statistical thermodynamics

- Related academic journals:

J. Chem. Phys., J. Phys. Chem., Chem. Eng. Education, Phys. Today, Chem. & Eng. News, Materials Today

FOURTH SEMESTER

ETY-202 Modern Physics II: Matter and Light

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES & ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIAL SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**ETY-202**	**SEMESTER**	**4th**
COURSE TITLE	Modern Physics II: Matter and Light		
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*	General background		
PREREQUISITE COURSES:	Modern Physics: Introduction to Quantum Mechanics (ETY-201), Applied Mathematics (ETY-116)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY202/		

(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 at the end of the course:

- They will possess advanced knowledge and skills (critical understanding of theories and principles) in the field of modern quantum mechanics with emphasis on the structure of matter and its interaction with electromagnetic radiation.
- They will be able to use the knowledge they acquired in a way that shows a professional approach to their work.
- They will be able to gather and interpret elements of the subject to form scientifically documented opinion, both on scientific and social/ethical issues. (e.g. risks of new technologies to human health).
- They will be able to communicate information and solutions to the subject of the course (structure of matter and interaction with electromagnetic radiation) to both a specialized and non-specialized audience.
- They will have developed those knowledge-acquiring skills, which they need to pursue further studies with a high degree of autonomy.

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…*
	…….

Autonomous and group work. Analytic and synthetic ability for solving complex problems. Critical thinking.

(3) SYLLABUS

- Mathematical foundations of quantum mechanics, Hermitian operators, Eigenvalues, continuous and discrete spectrum. Conservation laws.
- Dirac formalism, Harmonic oscillator, Angular momentum, Spin, synthesis of spins.
- Atoms, solids, band structure
- Time-Dependent Problems, Approximation Techniques in Time-Dependent Problems. Laser radiation and interaction with matter.

(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 delivery 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	42
Practice	10
Homework	10
Course total	***62***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language: Greek Evaluation methods: Problem solving, Short-answer questions Active participation in the class 10%, Homework 20%, Exam 70% Or Final Exam 100%

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *S. Trachanas. Quantum Mechanics, vol. II (New Edition), Crete University Press (2008).*
- *A. Messiah, Quantum Mechanics, Dover (1999).*
- *R. Shankar, Principles of Quantum Mecahnics, Plenum Press (1994).*
- *E. Merzbacher, Quantum Mechanics, John Wiley & Sons, 3rd Edition (1998).*
- *J. Sakurai, Modern Quantum Mechanics, Addison Wesley (1994).*

- Related academic journals:

ETY-204 Physics Laboratory II: Electromagnetism - Optics

(1) GENERAL

SCHOOL	School of Sciences and Engineering		
ACADEMIC UNIT	Department of Materials Science and Technology		
LEVEL OF STUDIES	Undergraduate Studies		
COURSE CODE	**ETY-204**	**SEMESTER**	4th
COURSE TITLE	Physics Laboratory II: Electromagnetism - Optics		

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	8
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background, Skills Development
PREREQUISITE COURSES:	General Physics II (ETY-102)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY204

(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*

A] The knowledge which the students will acquire upon successful completion of the course comprises:
a) the basic laws governing physical phenomena and physical processes in particular fields of Electricity, Magnetism and Optics as described in the Syllabus Section
b) the concepts of experimental measurement, absolute and relative experimental errors and their sources, and how to present results with meaningful significant digits
c) the construction of correct two dimensional graphical representations of the evolution of two physical quantities with each other

B] The skills which the students will acquire upon successful completion of the course are:
a) understanding of a physical problem related to Electromagnetism or Optics, especially one that needs an experimental approach in order to be solved and finding the correct methodology necessary for answering to the specific problem
b) choosing the right instruments or modules for the implementation of an experimental setup, making correct interconnections between them with/or without the aid of a control computer, finding the useful range of instrument/module functionality for each specific experimental need
c) conducting experimental measurements, in-situ assessing of their reliability based on known physical laws and expectations
d) analyzing experimental data. This includes calculations of the values of experimental quantities and of their expected errors as a measure of trust on these values. Analysis includes the ability i) to perform correct graphical representations that reveal, upon sight, the relationship between two physical quantities and ii) to find the mathematical description of this relationship using the least-squares fit formalism
e) writing laboratory reports that include i) title and purpose of conducting each experiment, ii) summary of the methodology, instrumentation, setup, and theoretical physical background to be used in order to achieve the goals of

the experiment, iii) comprehensive presentation of experimental procedure and experimental data iv) analysis of the experimental data, formally presenting the corresponding calculations and results on the needed experimental values. f) assessment of the experimental results by i) verifying (or not) expected physical laws, quantities or constants within the range of trust imposed by experimental error ii) commenting on the experiment-dependent true sources of error and iii) proposing ways to remedy or bypass these errors in future attempts to run the same experiments, as a way to improve the accuracy of the experimental values

The students also learn how to use a computer in writing experimental reports and in order to construct graphs and analyze experimental data through the use of corresponding spreadsheet preparation and editing software

C] The competences which the students will acquire upon successful completion of the course are:
a) the ability to design the proper experimental procedure for addressing physical problems based on known physical laws
b) the ability to cooperate with other people, as part of a team, in designing and implementing the above mentioned procedure, in collecting and analyzing experimental data, in assessing experimental results and in writing experimental reports
c) the ability to recognize *in-vivo* and correct or bypass errors or even modify certain steps throughout the process of implementation of an experimental task in order to reach to the answer the safest and most unambiguous way.

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…*
	……

Analysis and synthesis of data and information, with the use of the necessary technology. Decision-making. Working independently. Team work. Project planning and management. Production of free, creative and inductive thinking

(3) SYLLABUS

Introduction I: Theory of experimental measurement and error
Introduction II: Construction of 2D diagrams and the Least-Square Fit Method

Laboratory Exercises from Electricity and Magnetism

H1. Construction and operation of DC electrical circuits, Ohm's law, Kirchhoff's rules, simple electrical measurements
H2. Construction and operation of AC electrical circuits, RLC combination, using the Oscilloscope, study of resonance
H3. Electrolytic dissociation and Faraday's laws in Copper Sulfate and dilute Sulfuric acid aqueous solutions.
H4. Ampere's law and magnetic field in solenoids
H5. Gauss law, electric field and force between the parallel plates of an plane capacitor.

Optics Laboratory Exercises

O1. Linear Optics and rules governing the functionality of thin lenses and their combinations.
O2. Dispersion phenomena in light. Refraction and Fresnel laws in an optical prism.
O3. Wave optics phenomena: Fraunhoffer diffraction and Interference

(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,*	Introductory lectures are given as computer-based slide-show presentations. Two of them are an introduction in the use of spreadsheet software for data processing and the construction of diagrams. Certain laboratory setups require human-instrument interaction through a computer graphical user interface. Students are encouraged to communicate with the teachers by e-mail for all matters having to do with the course. All announcements, the lab manual, the course

communication with students	regulations and complementary reading material are posted in the course webpage. The students are encouraged to write lab reports with a computer.
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***
4 Introductory lectures	4 x 3 hours
8 Laboratory exercises	8 x 3 hours
Writing the Introductory Report	8 hours
Writing 8 prototype laboratory reports	8 x 8 hours
Final lecture for answering students questions	3 hours
Final visit to the lab	3 hours
Study before the final written exam	3 x 8 hours
Final Exam	3 hours
Course total	**141 hours**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The course teaching and student evaluation regulations are permanently posted in the course webpage. The course grade comprises four separate evaluation procedures: a) each student at the beginning of each lab exercise takes a short-answer-questions test, either oral (face-to-face) or written. The purpose of the test is to evaluate the degree at which the student is prepared for conducting the experiment as far as the necessary physical background is concerned. The student receives his or her grade at the end of the corresponding class. b) evaluation of the Introductory Report which is different for every student and includes questions and exercises from the Experimental Measurement and Error Theory and the 2D Graph Construction and Mathematical Processing methodology c) evaluation of each written lab report which is separate for each lab exercise and is prepared by all the members of the team that conducted the experiment. The factors taken into account for evaluating the report are i)completeness, ii) proper processing of experimental data and accurate determination of the values of desired physical quantities and their errors and iii) critical assessment of the integrity and level of trust of the final results d) the grade of the final written examination which is based on correctly utilizing and analyzing experimental data given by the examiner for answering to identical or similar problems as those encountered during the course.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

a) Emmanuel Spanakis 'Laboratory Exercises: Electricity-Magnetism',Department of Materials Science and Technology, University of Crete, Heraklion 2017 ***(in Greek only)***

b) P. Rakintzis and T. Tzouros "Notes on Laboratory III -Optics", Department of Physics, University of Crete, Heraklion 2013 ***(in Greek only)***

c) R.A. Serway και J.W.Jewett, Jr. "Physics for Scientists and Engineers: Electricity and Magnetism. Light and Optics. Modern Physics" ***(translated in Greek and published by Kleidarithmos, 2013)***

d) H.D. Young και R.A. Freedman " University Physics with Modern Physics: Electromagnetism and Optics" ***(translated in Greek and published by Papazisis, 2010)***

e) Especially for the Electrolytic Dissociation experiment related chapters from the following books are suggested:

i) Darell D. Ebbing, Steven D. Gammon "General Chemistry" 6th Edition ***(translated in Greek and published by Εκδόσεις Τραυλός, 2002)***

ii) Petros P. Karagianides "Inorganic Chemistry", Zitis Publications, 2016 ***(in Greek only)***

- Related academic journals

ETY-212 Differential Equations II

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING			
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-212**	**SEMESTER**	**4**	
COURSE TITLE	DIFFERENTIAL EQUATIONS 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	6	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).				
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	SPECIALIZED GENERAL KNOWLEDGE			
PREREQUISITE COURSES:	DIFFERENTIAL EQUATIONS I (ETY-211)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY212/			

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The main course objective is to provide a modern education on partial differential equations. The course learning outcomes are as follows :

- Demonstrated knowledge and understanding of the mathematical principles of second order differential equations.
- Advanced ability to apply this knowledge in order to solve realistic problems in physics.

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…
……

- Ability to express physical problems on a mathematical basis

- Acquisition of mathematical skills useful in other branches of materials science.
- Development of creative and inductive thinking

(3) SYLLABUS

- Partial differential equations (PDE) by function elimination. General form of 2nd order differential equations. Wave, Laplace and heat equations.
- Method of separation of variables. PDE is three dimensions. Superposition principle. Initial and boundary conditions.
- Sturm-Liouville equation. Eigenvalue problem. Expressing a function as a series of eigenfuctions. Degeneracy.
- Fourier series. Parseval's theorem.
- PDE in finite domains. 2-dimensional Laplace equation in Cartesian and spherical polar coordinates. Legendre polynomials . 2-dimensional wave equation in polar coordinates. Bessel functions.
- Complex Fourier series. Fourier transformation. Delta functions. PDE in infinite domains.
- Inhomogeneous PDE's. Green's functions method.

(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*	**Projector, electronic correspondence (e-mail),course website**
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
Tutorials	13
Homework	78
Course total	***130***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to* ***students.***	The evaluation process, as reported on the course website, is carried out in the Greek language by an optional test during the course and a final written examination using a combination of - Short-answer questions - Problem solving Students retain the right to view their exam scripts after grades are published and ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography: (in Greek)

1. S. Trahanas, "Partial Differential Equations " (in Greek), University of Crete Publishing (2001).
2. W.A. Strauss, "Partial Differential Equations", Wiley, Greek translation: National Technical University

Publishing (2007).
3. I. Vergados, "Mathematical Methods of Physics I" (in Greek), University of Crete Publishing (2005)
4. I. Vergados, II, "Mathematical Methods of Physics II" (in Greek), Symmetria Publishing, Athens (2004)
5. W.E. Boyce and R.C. DiPrima, D.B. Meade, "Elementary differential equations", Wiley, Greek translation: National Technical University Publishing (1999).

ETY-213 Computers II: Introduction to Numerical Analysis

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-213	**SEMESTER**	4th
COURSE TITLE	***Computers II: Introduction to Numerical 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**
	5	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*	EY1 (special background)
PREREQUISITE COURSES:	Computers I (ETY-114), Applied Mathematics (ETY-116)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://www.materials.uoc.gr/el/undergrad/courses/ETY213/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

Upon successful completion of the course, students will
1. know the basic numerical methods for solving computational mathematical problems and will be able to develop complex computer programs in order to implement them.
2. be prepared for other computational courses in the curriculum: Computational Materials Science I (ETY-447) and II (ETY-512), Special topics in Computational Materials Science (ETY448), etc.
3. be able to understand and apply other numerical methods to solve complex mathematical and physical 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 *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…* *……*

Solving complex problems
Development of scientific thinking
Use of libraries and multiple bibliographic sources

Search for resources and online lessons
Create notes and standalone study method
Implementation of research work
Manage time and deadlines

(3) SYLLABUS

Numeral systems. IEEE Standards for integer and floating point numbers. Computer representation of numbers.
Numerical solution of a nonlimear equation. Definitions, useful theorems. Methods: bisection, regula falsi, secant, Muller, fixed point, Householder (Newton-Raphson, Halley).
Systems of linear equations. Direct methods (Gauss elimination, Gauss-Jordan, LU). Iterative methods (Gauss-Seidel, Jacobi, SOR). Other methods. Applications: calculation of the determinant of a matrix, inverse matrix, matrix eigenvalues and eigenvectors. Numerical solution of systems of nonlinear equations.
Function/set of points approximation: Interpolation of polynomial, rational, piecewise polynomial, spline. Runge phenomenon. Numerical differentiation.
Least squares approximation: line, polynomial, logarithmic and exponential. Correlation coefficient.
Numerical quadrature. Trapezoid and Simpson rules. Newton-Cotes formulas. Gauss quadrature methods (Legendre, Hermite, Laguerre, Chebyshev). Clenshaw–Curtis method. Other methods.
Numerical solution of initial value problems of first order ordinary differential equations (ODE). Methods: Euler (explicit/implicit), Taylor, Runge-Kutta 2nd and 4th orders. Systems of ODEs. Higher order ODEs.
Other topics (FFT, optimization, etc)

(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*	Computers and projector are used in teaching, exercises and for communicating with students (through the course website and by 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	26
Programming exercises	39
Study	115
Course total	180

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Grammatikakis M., Kopidakis G., Stamatiadis S.- Introduction to Numerical Analysis, Lecture and Lab Notes (in Greek) (http://www.materials.uoc.gr/el/undergrad/courses/ETY213/notes.pdf)

- Forsythe G.E., Malcom M.A., Moler C.B.- Computer Methods for Mathematical Computations.
- Akrivis G.D., Dougalis V.A.- Introduction to Numerical Analysis (in Greek)

- Related academic journals:

ETY-222 Spectroscopy

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-222**	**SEMESTER**	**4th**
COURSE TITLE	Spectroscopy		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
		3	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*	Specialized general knowledge		
PREREQUISITE COURSES:	No-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY222/		

(2) LEARNING OUTCOMES

Learning outcomes

The learning goals that students should have achieved at the end of the lesson are the following:

The understanding by students the basic principles and concepts of using modern spectroscopic techniques in the field of materials science.
At the end of the lectures the students to obtain the basic experience of how important are the spectroscopic techniques to their science.

General Competences

The course is formed in such a way, that during lectures and especially during the preparation of the written assignment (homework), that students will train themselves in:

Searching, analysis and synthesis of data and information, with the use of the necessary technology
Creative and inductive thinking
Team work

(3) SYLLABUS

Συνοπτική θεματολογία/Περιεχομένου μαθήματος:

Introduction
Vibrational spectroscopy of molecules
Group Theory
Raman and SERS spectroscopic methods
FT-IR spectroscopy
Nuclear Magnetic Resonance (NMR) spectroscopy
Laser spectroscopy (Laser Induced Fluorescence/LIF and Laser Induced Breakdown Spectroscopy/LIBS)
X-ray Fluorescence (XRF) spectroscopy
Students Presentations

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, of Board and video (from internet)
TEACHING METHODS	

Activity	*Semester workload*
Lectures	39
Homework and creation - presentation of the specific slides	80
Finding of time and space in laboratories (chemistry department and IESL/FORTH) for demo experiments in correlation to the theory	20
Course total	**139**

STUDENT PERFORMANCE EVALUATION	Students are evaluated by: Their presence and participation in the lectures By questions and exercises during the lectures Preparation and presentation of a topic related to spectroscopy (in groups) Students are evaluated by a final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. P. Atkins, J. De Paula, "Φυσικοχημεία" Πανεπιστημιακές Εκδόσεις Κρήτης, 2018
2. Skoog, Holler, Crouch, "Αρχές Ενόργανης Ανάλυσης", 6η Έκδοση, 2007
3. D. C. Harris, "Ποσοτική χημική ανάλυση", Τόμος Β, Πανεπιστημιακές Εκδόσεις Κρήτης, 2010
4. D.C. Harris, M.D. Bertolucci, "Symmetry and Spectroscopy" (Dover, NY 1978)

- Related academic journals:

Analytical and Bioanalytical Chemistry
Spectrochimica Acta Part A
Microchemical Journal
Physical Chemistry Chemical Physics

ETY-232 Biochemistry and Molecular Biology

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-232**	**SEMESTER**	**4th**	
COURSE TITLE	BIOCHEMISTRY AND MOLECULAR BIOLOGY			
INDEPENDENT TEACHING ACTIVITIES			**WEEKLY TEACHING HOURS**	**CREDITS**
			3	6
COURSE TYPE	GENERAL BACKGROUND			
PREREQUISITE COURSES:	ORGANIC CHEMISTRY (ETY-122)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY232/			

(2) LEARNING OUTCOMES

Learning outcomes

The course outline includes an introduction to the basic concepts of molecular design of life, structure and function of fundamental biochemical molecules, biochemical evolution and the flow of genetic information. The learning goals that students should have achieved at the end of the lesson are the following:

1. To become familiar with the molecular design of life
2. To consolidate the notions of structure and function of the fundamental biochemical molecules used by nature as building blocks (nucleic acids, proteins, carbohydrates, lipids)
3. To be conceptually prepared to follow the course of natural biomaterials and their applications (course ETY-391).

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

General Competences

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

(3) SYLLABUS

• Molecular design of life
• Biochemical evolution
• Structure and function of proteins
• DNA, RNA and the flow of genetic information
• Exploring evolution
• Enzymes: basic principles and kinetics
• Catalytic strategies
• Carbohydrates and lipids
• Moreover, during the last two academic years, an invited lecture is given by Professor Ioannis Iliopoulos of the Medical School on SwissProt and BLAST search software, along with an introductory lecture on Bioinformatics.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, Supportive learning through the use of valid online scientific tools, *eg.* proteopedia.org in order to understand biological structures
TEACHING METHODS	***Activity*** / ***Semester workload*** Lectures: 39 Homework: 100 Course total: **139**
STUDENT PERFORMANCE EVALUATION	Students are evaluated by a final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics - Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

"BIOCHEMISTRY AND MOLECULAR BIOLOGY" L. STRYER, GREEK TRANSLATION, 8th EDITION, CRETE UNIVERSITY PRESS, 2015

- Related academic journals:

Biochemistry
Journal of Biological Chemistry

ETY-242 Materials III: Microelectronic - Optoelectronic - Magnetic Materials

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-242**	**SEMESTER**	**4th**
COURSE TITLE	Materials III: Microelectronic - Optoelectronic - Magnetic 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**
	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	GENERAL BACKGROUND
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY242/

(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*

- Understand basic optical and electrical properties of semiconductors associated with crystalline structure, energy bands and impurities.
- Understand basic physical principles of operation of semiconductor devices.
- Knowledge of basic semiconductor growth and fabrication processes such as optical lithography, thermal and e-beam metal and dielectric deposition, wet and dry chemical etching.
    - Apply knowledge to select purpose specific semiconductor materials and design devices such as LEDs, detectors and laser diodes.
    - General overview of modern developments in the rapidly expanding field of optoelectronic semiconductor devices.

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…*

.....
- Can handle complex technical or professional activities or work plans. - Development of interdisciplinary and critical thinking - Production of free, creative and inductive thinking

(3) SYLLABUS

The aim of the course is introduction to fundamental properties of semiconductor materials and their application in modern microelectronic and optoelectronic devices.

- Introduction to solid state materials - crystal structures –reciprocal lattice -Brillouin zone
- Bandgaps in semiconductors – properties of conduction and valence bands - band structure – bandgap engineering
- Fermi distribution – density of states – intrinsic and extrinsic carrier concentrations – n and p type doping - extrinsic semiconductor Fermi energy level
- Material growth and basics of semiconductor device fabrication - photolithography
- Electronic and electric properties of semiconductors, carrier transport by diffusion and drift
- Homo and heterojunctions - PN diodes
- Optical properties of semiconductors, absorption, spontaneous and stimulated emission
- Excitons : Origin, electronic levels and properties , radiative and nonradiative recombination
- Semiconductors Quantum structures, density of states
- Optoelectronics devices (LED, Laser diodes, photodetectors)

(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 Power Point, Support for learning by using multimedia (videos) and solid scientific web resources to display additional information when required.
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***
Lecture presentation	36
Problem solving	12
Research Laboratory visits	2
Intermediate test (problems and theory) 50%	3
Study at home. Problem solving and theory reading	72
Course total	***122 hours***

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*	Students are evaluated with optional 50% intermediate progress and 50% written final exam in Greek which includes: •Problem solving • Developing of topics • Oral examination (for students with learning difficulties) Students have the right to see their writing after the grading results are published and to ask questions. The method of student assessment and course material (transparencies) is described in the first lecture and is mentioned on the course web site:

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.	https://www.materials.uoc.gr/en/undergrad/courses/ETY242/

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*
J. Singh, " Οπτοηλεκτρονική "
S.O. Kasap, "Αρχές Ηλεκτρονικών Υλικών & Διατάξεων"

- *Additional bibliography:*
D. Neamen, "Semiconductor Physics and Devices"
BG Streetman, "Solid State Electronic Devices"

- *Related academic journals:*
-Physical Review Letter
-Applied Physics Letter
-Physical Review B
-Nature Physics
-Nature Materials

ETY-243 Materials II: Polymers & Colloids

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-243**	**SEMESTER**	**4th**	
COURSE TITLE	MATERIALS II: POLYMERS & COLLOIDS			
INDEPENDENT TEACHING ACTIVITIES			**WEEKLY TEACHING HOURS**	**CREDITS**
			4	6
COURSE TYPE	GENERAL BACKGROUND			
PREREQUISITE COURSES:	-			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY243/			

(2) LEARNING OUTCOMES

Learning outcomes

The course is a first introduction to Soft Matter with emphasis on Polymers and Colloids. The outline includes the study of their building blocks such as the polymeric chains and colloidal particles with emphasis on their molecular characteristics, their interactions, their thermodynamic behavior and their structure and self-organization in solution.
The learning goals that students should have achieved at the end of the lesson are the following:

1. Familiarize with Soft materials and learn to distinguish between different types of systems
2. To consolidate the Physical mechanisms responsible for the structure of polymer chains their interactions and thermodynamic phase behavior.
3. To understand the role of Interparticle interactions between colloidal particles in their self-assembly in crystal phases and out of equilibrium glasses and gels
3. To provide the knowledge background for students to follow more advanced elective courses in Colloidal Dispersions and Polymer Physics (ETY-471 and ETY-450).

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

Introduction
Examples of Soft Matter systems: Polymers, Colloids, Biomaterials, Surfactants and Micelles, Liquid Crystals, Emulsions and Foams.
Polymers
1. Introduction

2. Types and names of polymeric systems
3. Basic examples in Polymer Synthesis
4. Macromolecular characterization, Chain architecture, Molecular weight, End-to-end distance and Radius of gyration
5. Solutions, concentration regimes, interactions
6. Phase behavior
7. Amorphous and Crystalline polymers. Elastomers
8. Polymer mixtures and copolymers

Colloids

1. Introduction
2. Types of colloidal systems
3. Colloidal Interaction, colloidal stabilization
4. Colloid-polymer mixtures
5. Dense suspensions and crystals
6. Colloidal glasses and gels

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	In Classroom
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point and video material from the internet
TEACHING METHODS	
STUDENT PERFORMANCE EVALUATION	Students are evaluated by a final written exam in Greek that includes a combination of: - Questions on theory - Exercises including calculations Oral exam is foreseen for students with specific learning difficulties - Students have the right to view their exam scripts after the grading results are published and to ask questions.

Activity	*Semester workload*
Lectures	52
Homework	100
Course total	**152**

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- Course notes (G. Petekidis)
- W.D. Callister, Jr. Materials Science and Engineering, An introduction,
- 5th edition, John Willey and Sons, New York, 1999.
- I. W. Hamley, Introduction to soft Matter, John Willey and Sons, New York, 2000.
- R.A.L. Jones, Soft Condensed Matter, Oxford University Press. Oxford, 2002.
- Κ. Παναγιώτου, Επιστήμη και Τεχνολογία Πολυμερών, Εκδ. Πήγασος 2000, Θεσσαλονίκη, 1996.
- Κ. Παναγιώτου, Κολλοειδή, Θεσσαλονίκη, 1998.
- D. F. Evans, H. Wennerström, The Colloidal Domain, Where Physics, Chemistry, Biology and Technology meet, 2nd Edition, John Willey and Sons, New York, 1999.

- *Related academic journals:*

Soft Matter, Macromolecules, Langmuir, Journal of Colloid and Interface Science, Physical Review Letters, Physical Review E

ETY-248 Structural and Chemical Analysis of Materials

(1) GENERAL

SCHOOL	School of Sciences and Engineering		
ACADEMIC UNIT	Department of Materials Science and Technology		
LEVEL OF STUDIES	Undergraduate Studies		
COURSE CODE	**ETY-248**	**SEMESTER**	**4th**
COURSE TITLE	Structural and Chemical Analysis of 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	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*	*Specialised general knowledge. Special background*
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY248/

(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*

A] The knowledge which the students will acquire upon successful completion of the course comprises:
Radiation-matter interaction. Theory of elastic scattering. Elastic scattering from isolated atoms. Theory of X-Ray, neutron, electron diffraction. Secondary emission. Absorption of radiation from materials. Emission-detection-measurement of radiation. UV/vis, FT-IR, Fluorescence spectroscopy. X-Ray absorption spectroscopy. NMR. Scanning and Transmission Electron Microscopy. Electron spectroscopy for analysis of materials surfaces and interfaces.

B] The skills which the students will acquire upon successful completion of the course are:
a) mastering real-life experimental techniques and instrumentation which are widely used for the structural and chemical characterization of materials such as X-Ray diffractometry, UV-Vis spectroscopy, FT-IR spectroscopy, Raman spectroscopy
Fluorescence Spectroscopy, Nuclear Magnetic Resonance (NMR), Scanning and Transmission Electron microscopy
b) choosing the right instruments or equipment for the chemical and structural analysis of materials added by finding the, application dependent, useful range of functionality for each specific experimental technique.
c) the students also learn how to use a computer for preparing an oral presentation that includes text, arrays and charts, two and three dimensional graphical representations, images and video.

C] The competence which the students will acquire upon successful completion of the course is
a) the ability to decide on and properly utilize the proper experimental technique for a specific structural and/or chemical characterization of materials
b) the ability to correctly assess and utilize results presented by other scientists regarding the aforementioned specific characterizations of different classes of materials.

General Competences

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

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

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

(3) SYLLABUS

Introduction

Types of radiation, Energy-wavelength relation, Radiation applications to Materials Science, Atomic theory, Atomic energy levels.

Radiation-Matter interaction

Electromagnetic waves, Electromagnetic spectrum, Ionizing (X-Ray) and non-ionizing radiation, Study of the interaction of beams with electrons/neutrons/ions. Basic principles of elastic scattering (amplitude/intensity of radiation). Elastic scattering from isolated atoms.

X-Ray diffraction

Theory, Emission of X-rays and affecting factors (potential, current etc), Absorption of X-rays, Detection of X-rays and measurement of their intensity, Crystallography, Crystal lattice, Primitive cell, Crystalline planes, Instrumentation, Application of X-rays to materials characterisation, X-Ray Fluorescence (XRF), X-Ray Photoelectron Spectroscopy (XPS), Principle of Operation, Information available to materials science (chemical composition, bond arrangements, etc.).

Ultraviolet-Visible (UV-Vis) spectroscopy

Beer-Lambert Law, Electronic transitions, Visible range of the spectrum, Color - wavelength relation, Typical examples of chemical compound spectra, Absorption/Transmission/Reflection spectra in liquid and solid samples.

Fourier Transform - Infrared spectroscopy (FT-IR)

Dipolar moment, Vibrational/Rotational energy levels, Types of molecular vibrational motion, Selection rules, Instrumentation, Michelson Interferometer, Typical FT-IR spectra of organic compounds, Attenuated Total Reflectance (ATR), Applications.

Raman spectroscopy

Basic principles, Stokes/Anti-Stokes lines, Polarization, Vibration - Rotation types, Selection rules, Comparison with FT-IR: similarities and differences, laser, Instrumentation, Typical Raman spectra of organic and inorganic compounds / materials, Applications.

Fluorescence Spectroscopy

Basic principles, Electronic transitions (ground and excited states), Selection rules, Instrumentation (fluorimeter), Typical fluorescence spectra of compounds, Laser Induced Fluorescence (LIF), Applications.

Nuclear Magnetic Resonance (NMR)

Magnetic field, spin, fission, Principle of chemical shift, Spectrum Types (Hydrogen 1H and Carbon 13C), Single and Multidimensional spectra (COSY, HMQC, etc.), Instrumentation, Applications in organic compounds.

Electron microscopy

Aspects of an optical microscope (focusing lens, objective lens, magnification), Scanning Electron Microscopy (SEM), Instrumentation, Examples, Transmission Electron Microscopy (TEM), Instrumentation, Examples, Comparison between SEM/TEM microscopes, Combination of an Electron Microscope with Energy Dispersive Spectroscopy (EDS).

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, Visits to research laboratories - Instrument demonstration
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Lectures and student presentations are given as computer-based slide-show presentations. Students are encouraged to communicate with the teachers by e-mail for all matters having to do with the course. All announcements, the lectures, the course regulations and complementary reading material are posted in the course webpage. The students are encouraged to prepare their presentations with a computer.
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*** 10 lectures — 10 x 3 hours Preparatory study for the presentation and implementation of the presentation with the computer — 2 x 8 hours Presentations' day — 3 hours Final lecture and answering students questions — 3 hours Study before the final written exam — 3 x 8 hours Final Exam — 3 hours Course total — **79 hours**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The course teaching and student evaluation regulations are permanently posted in the course webpage. The course grade comprises two separate evaluation procedures: a) the oral presentation that the student gives in order to assess his/her ability i) to gather and summarize knowledge on a certain topic of chemical and/or structural characterization of some class of materials by acquiring information both from scientific books and from recent research publications and ii) to present his/her work in a simple, comprehensive, cohesive manner which is simultaneously complete in every way for his/her fellow students. b) the final written examination which intends to give proof of the knowledge that the student should have acquired both on the basic operation principles of the taught structural and chemical analysis methods and on the potential of utilization of these methods in different materials science applications

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *J. P. Eberhart, "Structural and Chemical Analysis of Materials", John Willey & Sons Inc., 1991.*
- *P.E.J. Flewitt, R.K. Wild, "Physical Methods for Materials Characterization", IOP Publ., London (1994)*
- *H.-M. Tong and L.T. Nguyen, Eds., "New Characterization Techniques for Thin Polymer Films", Wiley, New York (1990)*
- *D. A. Skoog, F. J. Holler and T. A. Nieman, "Principles of Instrumental Analysis", 5th Edition, Saunders College Publishing, Philadelphia (1998)*

FIFTH SEMESTER

ETY-301 Electromagnetism

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-301**	**SEMESTER**	**5th**	
COURSE TITLE	ELECTROMAGNETISM			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**	
		5	6	
COURSE TYPE	SPECIAL BACKGROUND			
PREREQUISITE COURSES:	GENERAL PHYSICS II (ETY-102), GENERAL MATHEMATICS (ETY-112)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY301/			

(2) LEARNING OUTCOMES

Learning outcomes
The syllabus of the course includes the study of Electrostatics and Magnetostatics, making use of mathematical tools such as vector calculus and partial differential equations. The learning goals that students should have achieved at the end of the lesson are the following: 1. Advancement of their understanding of Electromagnetism at the undergraduate level. 2. Application of mathematical techniques in solving physical problems. 3. Development of physical understanding and use of symmetry for approaching and checking physical problems. 4. Preparation of the students for attending similar postgraduate level classes. *The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.*
- Development of analytical and critical thinking - Production of free, creative and inductive thinking - Working independently

(3) SYLLABUS

1. Vector analysis
2. Electrostatics: Coulomb's law and electric field, divergence and curl of electric field, Gauss's law, electric potential, Poisson's and Laplace's equations, work and energy in electrostatics, conductors.

3. Special techniques in calculating electric potential, uniqueness theorems, the method of images, separation of variables, electric dipole.
4. Electric fields in matter: polarization, field of a polarized object, electric displacement, linear dielectrics.
5. Magnetostatics: Lorentz force, Biot-Savart law, divergence and curl of magnetic field, magnetic vector potential.
6. Magnetic fields in matter: magnetization, field of a magnetized object, auxiliary field, linear and nonlinear magnetic media.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point during lectures.
TEACHING METHODS	***Activity*** / ***Semester workload*** Lectures: 65 Homework: 80 Course total: **145**
STUDENT PERFORMANCE EVALUATION	Students have the choice to be evaluated by one of the following methods: the first involves a combination of graded homework, midterm exam on part of the material and final exam on the rest of the material. The second is a final written exam on all material. The exams are in Greek and typically involve the solution of 3 to 5 problems of Electromagnetism. Students have the right to view their exam scripts after the grading results are published and ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- D. J. Griffiths, Εισαγωγή στην Ηλεκτροδυναμική, Πανεπιστημιακές Εκδόσεις Κρήτης, Ηράκλειο (2013)
- R.K. Wangsness, Electromagnetic fields, Wiley, New York (1986)
- D. Corson and P. Lorrain, "Introduction to Electromagnetic Fields and Waves", Freeman and Company, San Francisco (1962)

ETY-305 Solid-State Physics: Introduction

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-305**	**SEMESTER**	**5th**	
COURSE TITLE	Solid-State Physics: Introduction			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**	
		5	6	
COURSE TYPE	GENERAL BACKGROUND			
PREREQUISITE COURSES:	Modern Physics- Introduction to Quantum Mechanics (ETY-201)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	http://theory.materials.uoc.gr/courses/fsk/			

(2) LEARNING OUTCOMES

Learning outcomes

By the end of the course, students are expected to

1. Become familiar with quantities that tell if if a material is (a) hard or soft (b) heats up easily or not (c) conducts electricity (d) is transparent or (e) is affected by magnetic fields.
2. Know simple crystal structures and calculate their basic structural properties, as well as quantities that describe the main properties of a material and the characteristic order of magnitude for their numerical values.
3. Have learned to calculate the approximate density, the distance between adjacent atoms, modulus, heat capacity, dielectric constant, refractive index, magnetoresistance in simple solids. They should have understood the mechanisms of quantum motion of electrons and the thermal motion of atoms in solids.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

This course is an introduction to the relationships connecting atomic structure and macroscopic properties of solids. It includes an introduction to the calculus of periodic functions of three variables, including Bravais Lattices.
Two simple models are used throughout the class: the homogeneous solid (Jellium) and the linear combination of atomic orbitals (LCAO). Through these models, all key properties of solids are introduced to the students, including mechanical, thermal, electrical, optical and magnetic properties. Relatioships between quantities that describe different properties are highlighted.

Course content:
- Basic physical properties of solids. Dimensional analysis and estimations of orders of magnitude.
- Crystal lattices and periodicity. Bravais- and composite lattices. Lattice- and basis vectors. Reciprocal latice

and Brillouin zone. Bloch's theorem.
- The model of homogeneous solid (jellium) and first-principles calculations for the cohesive energy, density and bulk modulus.
- Motion of electrons motion in the homogeneous solid - Fermi model.
- Motion of ions in the homogeneous solid - Debye model.
- Thermal properties of solids .
- Motion of electrons and ions in realistic materials.
- Electrical, magnetic and optical properties.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, Supportive learning through the use of valid online scientific tools, *eg*. phonon website in order to understand phonons.
TEACHING METHODS	
STUDENT PERFORMANCE EVALUATION	Students are evaluated by a final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics - Students have the right to view their exam scripts after the grading results are published and to ask questions.

Activity	***Semester workload***
Lectures	39
Homework	64
Guided problem solving	26
Course total	**129**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- E. N. Οικονόμου, Φυσική Στερεάς Κατάστασης, Πανεπιστημιακές Εκδόσεις Κρήτης (1997-2003)
- C. Kittel, Introduction to solid state physics , Wiley, New York (1976)
- R. A. Levy, Φυσική Στερεάς Κατάστασης, Εκδόσεις Πνευματικού, Αθήνα (1978)
- N. W. Ashcroft - N. D. Mermin, Solid state physics, Holt, Rinehart and Winston, New York (2012)
- Σ. Τραχανάς, Κβαντομηχανική Ι, Πανεπιστημιακές Εκδόσεις Κρήτης (2005)
- E. Kaxiras, Atomic and electronic structure of solids, Cambridge University Press (2003)

- Related academic journals:

Physical Review B
Journal of Chemical Physics
Physica Status Solidi
Solid State Communications
Journal of Physics: Condensed Matter

ETY-335 Molecular Cellular Biochemistry

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-335**	**SEMESTER**	**5th**
COURSE TITLE	Molecular Cellular Biochemistry		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	6

COURSE TYPE	GENERAL BACKGROUND
PREREQUISITE COURSES:	ORGANIC CHEMISTRY (ETY-122)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY335/

(2) LEARNING OUTCOMES

Learning outcomes

The course outline includes the study of cells and cell structures, the transport mechanisms of molecules and ions in cells, the signalling pathways and the interaction of cells with the environment. The learning goals that students should have achieved at the end of the lesson are the following:

1. To become familiar with cells, cellular structures and biochemical reactions within cells
2. To consolidate the notions of the biochemical ques of signalling pathways to various cell responses
3. To use this knowledge towards the understanding of cellular functions
4. To be conceptually prepared to follow the course of biological materials and composite biomaterials and their applications (course ETY-491).

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

1. Introduction to the cell
2. Lipids and biological membranes
3. Cell membrane transport
4. Signalling pathways
5. DNA replication, repair and recombination
6. Metabolism
7. Immunological responses and introduction to the immune system
8. mRNA translation
9. Sensation/esthetic systems

10. Cell-cell interactions and extracellular matrix

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, Supportive learning through the use of valid online scientific tools
TEACHING METHODS	
STUDENT PERFORMANCE EVALUATION	Students are evaluated by a final written examination in Greek that includes critical development of topics. Students have the right to view their exam scripts after the grading results are published and to ask questions.

Activity	***Semester workload***
Lectures	39
Homework	90
Course total	**129**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, Βιοχημεία (απόδοση στα ελληνικά), 8th Edition, University Press Crete 2018

The book covers at 100% the molecular cellular biochemistry aspects of the course.

Additional bibliography:

- Principles in Cell Biology, (2nd edition) Alberts, Bray, Hopkin, Johnson, Lewis, Raff, Roberts & Walter
- Molecular Biology of the Cell (5th edition), Alberts, Johnson, Lewis, Raff, Roberts & Walter. Garland Publishing Inc 2008.
- Molecular Cell Biology, (6th edition), Lodish, Berk, Kaiser, Krieger, Scott, Bretscher, Ploegh & Matsudaira, W.H. Freeman & Co Ltd, 2007.
- Cell Biology (4th edition), Margaritis, Galanopoulos, Keramari et al, Publisher Litsa 2004.

- Related academic journals:

ETY-343 Soft Matter Laboratory

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-343**	**SEMESTER**	**5th**
COURSE TITLE	SOFT MATTER LABORATORY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	6	8
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background, Skills development
PREREQUISITE COURSES:	MATERIALS II: POLYMERS & COLLOIDS (ETY-243)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY343/

(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*

At the end of the course the students are expected to:

1. Be familiar with the main techniques used in the synthesis and characterization of soft matter
2. To acquire knowledge of the basic theoretical principles of the methods for polymer and colloid synthesis
3. To acquire theoretical and practical training on the basic characterization techniques used for the determination of the thermal and mechanical properties of soft matter
4. To be ready to carry out their diploma thesis or graduate studies in the field of soft matter

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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 in an international environment	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Working in an interdisciplinary environment	*Criticism and self-criticism*
Production of new research ideas	*Production of free, creative and inductive thinking*
	……
	Others…
	……

- Development of interdisciplinary and critical thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technologies

- Practical training on methods and techniques
- Working independently
- Team work
- Production of free, creative and inductive thinking

(3) SYLLABUS

- Theory

Introduction:

Type of Polymers, Colloids, Nomenclature, Polymerization Techniques, Molecular Weight, Size-Shape of Polymers, Applications

Polymerization Methods & Polymer Reactions:

Polycondensation, Free-Radical, Ionic, Copolymerization

Molecular characterization of Polymers:

Determination of Absolute Molecular Weight (Static Light Scattering)
Size Exclusion Chromatography (SEC)
Viscosity measurements
Polymer Composition-Nuclear Magnetic Resonance (NMR) Spectroscopy

Thermal Properties:

Crystallization, Glass Transition, Elastomers, Methods for the determination of the thermal transitions

Mechanical Properties:

Viscosity, Viscosity Nomenclature for Dissolutions, Flow curve, Viscosity as a function of volume fraction, Viscosity Measurements, Tensile, Hardness.

- Lab experiments

1. Soft Matter Synthesis
1.1 Synthesis of Polystyrene homopolymer by Bulk Free-Radical Polymerization
1.2 Synthesis of Random Polystyrene-co-Poly(butyl methacrylate) by Solution Free-Radical Copolymerization
1.3 Synthesis of Polystyrene Colloids by Emulsion Polymerization
1.4 Synthesis of a Poly(acrylic acid) Random Polymer Network Παρασκευή
2. Soft Matter Characterization
2.1 Determination of Thermal Transitions of Polymers by Differential Scanning Calorimetry (DSC)
2.2 Determination of the Molecular Weight Distribution of Polymers by Size Exclusion Chromatography (SEC)
2.3 Investigation of the Themal and Mechanical durability of Polymers and Hybrid Materials by Thermogravimetric Analysis (TGA) and Mechanical Analysis (Hardness)
2.4 Determination of the Particle Size and Investigation of the Rheological Properties of Colloidal Systems by Optical Microcopy and rheology

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Power Point, communication via the departmental website and e-mail. Use of valid online scientific sources to find references and present related topics to the 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	32
Practical experiments	45
Homework study	30
Preparation of lab reports	90
Course total	**197**

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure*	The students are evaluated via short questionnaires during the practical experimentation, by their lab reports and by a final written examination in Greek which includes a combination of problem solving and questions on developing related topics.

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 with learning disabilities are examined orally. The students have the right to check their exam script after the grades are announced and ask the tutor questions on the exam. The evaluation process is presented in detail to the students orally and in written form, together with the course syllabus, during the first lecture and is uploaded on the course web site: https://www.materials.uoc.gr/el/undergrad/courses/ETY343/

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Laboratory experiments in Synthesis and Characterization of Soft Matter, M. Vamvakaki, S. Parouti, K. Chrisopoulou, Heraklion, September 2004.
2. Allcock, H.R.; Lampe, F.W. Contemporary Polymer Chemistry, 2nd ed., Prentice Hall, Englewood Cliffs, 1990.
3. Hiemenz, P.C. Polymer Chemistry: The Basic Concepts, Marcel Dekker, NY, 1984.
4. Young, R.J.; Lovell, P.A. Introduction to Polymers, 2nd ed., Chapman & Hall, 1996.

- *Additional bibliography:*

- Brandrup, J. and Immergut, E.H., eds., Polymer Handbook, 3rd ed., John Wiley & Sons, New York, 1989.
- Odian, G. Principles of Polymerization, 3rd ed., John Wiley & Sons, New York, 1991.
- Rempp, P.; Merill, E.W. Polymer Synthesis, 2nd ed., Huthig & Wepf, Basel, 1991.
- Cowie, L.M.G. Polymers: Chemistry and Physics of Modern Materials, 2nd ed., Chapman & Hall, Padstow, Cornwall, UK, 1998.
- Stevens, M.P. Polymer Chemistry: An Introduction, 2nd ed., Oxford Univ. Press, 1990.
- Flory, P.J. Principles of Polymer Chemistry, Ithaca, HY, Cornell University Press, 1953.
- Σιμιτζή, Ι. Χρ. Επιστήμη Πολυμερών, Έκδοση Εθνικού Μετσοβείου Πολυτεχνείου, Αθήνα, 1994.
- Παναγιώτου Κ. Επιστήμη και Τεχνολογία Πολυμερών, Εκδόσεις Πήγασος2000, Θεσσαλονίκη, 1996.
- Seymour, Raymond B. and Carraher, Charles E., Giant Molecules, JohnWiley and Sons, Inc., New York, 1990.

- *Websites:*

- Macrogalleria
- National Plastics Center

- *Related academic journals:*

- Macromolecules, American Chemical Society
- Langmuir, American Chemical Society
- Chemistry of Materials, American Chemical Society
- Biomacromolecules, American Chemical Society
- Advanced Materials, Wiley
- Advances in Polymer Science, Springer-Verlag
- Polymer, Elsevier
- Journal of Colloid and Interface Science, Elsevier
- Journal of Material Chemistry, Royal Society of Chemistry

ETY-349 Mechanical and Thermal Properties of Materials

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-349**	**SEMESTER**	**5th**	
COURSE TITLE	Mechanical and Thermal Properties of Materials			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**	
		3	5	
COURSE TYPE	GENERAL BACKGROUND			
PREREQUISITE COURSES:	NONE			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY349/			

(2) LEARNING OUTCOMES

Learning outcomes

The course provides an introduction to the basic Mechanical and Thermal properties of solids as well as methods for characterizing materials We will deal with metals, ceramics, polymers as well as composites. The properties of the materials will be related to their microscopic description (bonds, structure), which will explain similarities and differences in their mechanical and thermal properties. Emphasis will be given on the use of these materials both in everyday objects and in more demanding environments. We will present methods of optimizing properties according to the intended use.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 5 (comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge).

General Competences

- Develop interdisciplinary and critical thinking
- Search, analyze and synthesize data and information, using the necessary technologies
- Promoting free, creative and inductive thinking

(3) SYLLABUS

1. Introduction. Material Classification. Microstructure and links between atoms
2. Crystal structures and their effect on properties
3. Mechanical Properties of Metals I. Stress and Strain. Elastic deformation. Plastic deformation
4. Mechanical properties of metals II. Material property fluctuations. Design - safety factors. Characteristics of dislocations and their effect on plastic deformation.
5. Mechanical properties of metals III. Metal reinforcement mechanism. Material failure. Improvement of mechanical properties of heat-treated metals and alloys.
6. Mechanical Properties of Ceramics. Brittle fracture of ceramics, fracture toughness in flat deformation. Elastic tension-strength behavior. Mechanisms of plastic deformation in crystalline and non-crystalline ceramics. Introducing the concept of viscosity. Effect of porosity on modulus of elasticity and bending strength. Hardness. Creep in ceramics.
7. Applications and processes of ceramics. Glasses. Glass ceramics. Clay products. Refractory materials. Abrasive ceramics. Mortar. Carbon: Diamond, graphite, carbon fiber. Advanced ceramics: microelectromechanical systems, carbon nanotubes, graphene, 2D materials.

8. Mechanical Properties of Polymers I. Examples of natural and artificial polymers. Strain-deformation behavior in brittle, plastic and fully elastic polymers (elastomers). Temperature dependence of the stress-deformation relationship. Effect of deformation rate on mechanical behavior. Macroscopic deformation of polymers. Viscoelastic deformation. Viscosity elasticity measure. Viscoelastic creep.
9. Mechanical Properties of Polymers II. Polymer breaking. Impact strength. Fatigue. Resistance to cracking and hardness. Polymers deformation and reinforcement mechanisms. Type of Polymers.
10. Thermal properties of materials. Heat capacity, specific heat, temperature dependence of heat capacity. Thermal expansion. Thermal conductivity. Thermal stresses.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	**Face-to-Face**
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	**Supporting learning by using valid online science tools.** **Reference to online web platforms.**
TEACHING METHODS	

Activity	*Semester workload*
Lectures	39
Study of lecture material at home	90
Course total	**129**

STUDENT PERFORMANCE EVALUATION	Students are evaluated with final written examination in Greek that includes: - developing themes - students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Lecture notes
2. 'Material science and engineering', William D. Callister, 2008
3. Norman E. Dowling, 'Mechanical Behavior of Materials', 3rd Edition, Pearson Education, 2007
4. I. M. Ward and J. Sweeney, 'An Introduction to the Mechanical Properties of Solid Polymers', Wiley 2nd Edition, 2004

ETY-391 Materials IV: Natural Biomaterials

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-391**	**SEMESTER**	**5th**	
COURSE TITLE	MATERIALS IV: NATURAL BIOMATERIALS			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**	
		3	6	
COURSE TYPE	GENERAL BACKGROUND			
PREREQUISITE COURSES:	ORGANIC CHEMISTRY (ETY-122)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY391/			

(2) LEARNING OUTCOMES

Learning outcomes
The course outline includes the study of materials of biological origin, their molecular structure and architecture, the mechanisms of self-organization and their properties as materials. The learning goals that students should have achieved at the end of the lesson are the following: 1. To become familiar with materials of biological origin 2. To consolidate the notions of the structural mechanisms used by Nature to create materials with defined properties 3. To use this knowledge towards the design of biomimetic materials 3. To be conceptually prepared to follow the course of biological materials and composite biomaterials and their applications (course ETY-491). *The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.*
- Development of interdisciplinary and critical thinking - Search for, analysis and synthesis of data and information, with the use of the necessary technology - Production of free, creative and inductive thinking

(3) SYLLABUS

1. Biological introduction
2. Examples of biological materials
3. Collagen-Gelatin-Elastin-Keratin
4. Silk, spider webs, mussel collagen, amyloid fibrils
5. Cellulose, starch, cotton
6. Biological composite materials: nacre, chitin, bones, teeth
7. Diatomes and magnetotactic bacteria
8. Keratin, muscle structure and examples of molecular motors: cytoskeleton, kinesin, bacterial flagellae, flagellin
9. Design of biomimetic materials

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, Supportive learning through the use of valid online scientific tools, *eg*. proteopedia.org in order to understand biological structures
TEACHING METHODS	
STUDENT PERFORMANCE EVALUATION	Students are evaluated by a final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics - Students have the right to view their exam scripts after the grading results are published and to ask questions.

Activity	***Semester workload***
Lectures	39
Homework	90
Course total	**129**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- C. Branden and J. Tooze, "Introduction to protein structure», Garland Publishing. Greek translation, : Basdra Academic Editions, 2019

The book largely covers the structural / biochemical aspects of the course (50% of the total material). Unfortunately, due to the interdisciplinarity of the course, there is still no textbook in Greek that combines the structural aspects with the mechanical and other properties of natural biomaterials. A combination of primary bibliography and English books is used (below).

- D. Whitford, "Proteins-Structure and Function", Wiley, 2005
- P. R. Shewry, A.S. Tatham, A. J. Bailey, "Elastomeric Proteins: Structures, Biomechanical Properties, and Biological roles" The Royal Society and Cambridge University Press, 2003
- S. Mann, "Biomineralization: Principles and Concepts in Bioinorganic Materials Chemistry" , Oxford Chemistry Masters, 2001
- E. Gazit and A. Mitraki, "Plenty of Room for Biology at the Bottom: an Introduction to Bionanotechnology", Imperial College Press, 2013
- J.F.V. Vincent, "Structural Biomaterials", University Presses of California, Columbia and Princeton University Press (1990)
- C. Neville, "Biology of fibrous composites", Cambridge University Press (1993)
- J. Benyus, "Biomimicry - innovation inspired by Nature", Quill, William Morrow (1997)
- J. Howard, "Mechanics of the motor proteins and the cytoskeleton", Palgrave Macmillan (2001)
- S.R. Fahnestock and A. Steinbuchel, Polyamides and complex proteinaceous materials, volumes 7 and 8, in "Biopolymers", Wiley-VCH (2003)
- Vogel, S. "Comparative Biomechanics", Princeton University Press (2003)

- Related academic journals:

Biomaterials
Acta Biomaterialia
ACS Biomaterials Science and Engineering
ACS Applied Biomaterials

ΠΡΑ-001 ΠΡΑ-002 Internship I and II

(1) GENERAL

SCHOOL	Sciences and Engineering		
ACADEMIC UNIT	Materials Science and Technology		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**ΠΡΑ-001** **ΠΡΑ-002**	**SEMESTER**	**5**
COURSE TITLE	Internship I and 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**
	40	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*	Skills development
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/praktiki/praktiki.html

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

Students at the end of their Internship are expected to:

1. Familiarize themselves with the working conditions in places that are very likely to be found later in their professional careers and see how what they have learned is applied in practice.
2. To have expanded their knowledge in terms of materials and technological applications.
3. Have developed a sense of cooperation and professional solidarity.

General Competences

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

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

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

Working independently
Team work

(3) SYLLABUS

During their internship the students work at various companies whose field is compatible with the fields of expertise the students get during their studies at the Department. They work as fully employed and for two months. During their internship the students work on a specific field among the many ones the company may deal with and under the supervision of a supervisor from the company. During their internship they fill on a weekly basis a diary that signs the supervisor from the company. At the end of the internship period the supervisor fills an evaluation form where comments concerning the student may be added at the end. At the of the internship the evaluation form together with the diary are sent to the academic supervisor of the Department. The student has also to write a report concerning the field of the Internship, at the end of the internship period. At the end, for the evaluation of the student from the Department the evaluation of the student together with an oral exam are taken into consideration.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	A series of meetings between the students that are interested in doing internship and the academic supervisor from the Department take place. During these meetings the students are informed for the procedures they have to follow in order to be eligible for internship.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**The report concerning the internship is written from the students using personal computers and are delivered for being marked by e-mail.**
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Internship execution	400 hours
Report writing	10 hours
Course total	***410***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The students after the internship period have to write and deliver a report which has to do with what they dealt with, by the end of a 20 day period. In this report are described the theoretical background behind the field of the internship, the measurements, the processing and the results for each case. The report is written using a personal computer and is sent to the academic supervisor by email. The final grade takes into consideration the evaluation of the company and oral exam, from the academic supervisor.

ATTACHED BIBLIOGRAPHY

SIXTH SEMESTER

ETY-302 Optics and Waves

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES & ENGINEERING		
ACADEMIC UNIT	Materials Science and Technology		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-302**	**SEMESTER**	**6th**
COURSE TITLE	Optics and Waves		
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	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*	special background		
PREREQUISITE COURSES:	General Physics II (ETY-102), General Mathematics II (ETY-112)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	-		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY302/		

(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 **get acquainted** with the basic principles of Wave and Optics.
- To **know** the basic principles of Electromagnetism as well as their application in Optics and in the Geometric Optics approximation
- To **become familiar** with the phenomenon of optical anisotropy.
- To **know** the basic principles that govern the wave propagation as well as the phenomena of interference and diffraction.
- To **know** the basic operation principles of optical systems.
- To **solve** problems related to light propagation through complex optical systems.

- To **know** the description of the polarization the transverse waves
- To **solve** problems related to light propagation through polarized optical systems

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…*
	…….

- To understand the basic principles of wave propagation.
- To be able to analytically describe transverse waves, that propagate at an arbitrary direction, in any medium, for any polarization.
- To be able to identify wave phenomena in nature.
- To be able to describe both qualitatively and quantitatively the behavior of an optical system.
- To be able to select and effectively use optical metrology techniques.
- To use international literature to be informed about matters of Optics and Photonics.

(3) SYLLABUS

1. **Introduction**,
   Waves in nature, Longitudinal and transverse waves, Wave propagation, Huygens-Fresnel principle,
2. **Electromagnetism**,
   Maxwell equations, Geometrical Optics, ,
3. **Imaging,**
   Fermat's principle Snell law, Lenses and Mirrors, Optical Aberrations, Basic principles of Optical engineering,
4. S**ources and detectors of optical radiation**,
   Black body radiation, diodes, Lasers, Photometry, Photomultipliers, Photodiodes, CCD sensors.
5. **Polarization**,
   Jones and Stokes representation, Optical anisotropy and Dichroism,
6. **Interference**,
   Interferometers and Optical metrology,
7. **Diffraction**,
   Fresnel and Fresnel-Kirchhoff diffraction integrals, Fraunhofer diffraction, diffraction from various apertures, resolution of optical systems

(4) TEACHING and LEARNING METHODS - EVALUATION

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

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

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

- Use of slides
- Videos with demonstration/understanding experiments.
- Demonstration experiments of basic optical phenomena
- Open and free educational material available through the class webpage (Creative Commons CC-BY-ND-3.0, licenses) of the following:
  - Lecture slides
  - Solved and unsolved exercises
- Furthermore in the class webpage the students can find:
  - Selected previous exams
  - Sets of self-study exercises
  - Bibliography
- Communication through email and constant office hours available through the class webpage.
- Optional student projects are monitored and presented through a cloud-based platform (Google Docs)

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
Projects	20
Directed learning activity (office hours)	10
Non-directed learning activity	56
Course total	***125***

STUDENT PERFORMANCE EVALUATION

Description of the evaluation procedure

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

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

Language: Greek
Evaluation Methods:
Final written exams (100%)
or participate in projects: 20% Presentation, 80% final written exams.

Participation in Projects is optional. The grade is auxiliary to the percentage mentioned above. The presentation deals with a topic in the wider area of optics and lasts 10 minutes.

The evaluation criteria are accessible on the class webpage.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

"Topics in Optics", E. Hecht, translated in Greek as "Οπτική" from I. Spyridelis, Schaum's Outline Series.
"Optics", E. Hecht, Addison-Wesley, (2001).
"Introduction to Modern Optics", G.R. Fowles, Dover, (1989).
"Principles of Optics", M. Born, E. Wolf.
"Introduction to Fourier Optics", J. W. Goodman, McGraw-Hill, (1996).

- Related academic journals:

ETY-306 Solid State Physics II: Electronic and Magnetic Properties

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-306	**SEMESTER**	6th
COURSE TITLE	SOLID STATE PHYSICS II: ELECTRONIC AND MAGNETIC 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**
		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*	SPECIAL BACKGROUND, SKILLS DEVELOPMENT, SPECIALIZED GENERAL KNOWLEDGE		
PREREQUISITE COURSES:	MODERN PHYSICS – INTRODUCTION TO QUANTUM MECHANICS (ETY-201)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://theory.materials.uoc.gr/courses/fskII/		

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The course addresses students who are interested in understanding the relationship between the atomic and electronic structure of solid materials with their macroscopic properties as well as with the properties that render them invaluable in modern technology. The course covers topics such as the relation between atomic configuration and electronic structure (electronic energy states, bands and gaps), how this determines conductors, semiconductors and insulators, the interaction of materials with the electromagnetic field. The learning goals that should have been achieved by the end of the course are:

1. Students understand the basics of quantum theory of solids required for electric properties description.
2. Students should be able to explore the interaction of materials with electromagnetic fields.
3. Students become familiar with the most important aspects of the electronic, optical, magnetic properties of materials so that they can understand the design and operation of electronic and magnetic devices in more advanced courses.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…*
	……

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

(3) SYLLABUS

(1) Structural properties review
(2) Quantum mechanics review
(3) Electron motion
(4) Electrical conductivity in crystalline metals and alloys
(5) Electrical conductivity in crystalline semiconductors, insulators
(6) Optical properties of materials
(7) Magnetic properties of materials
(8) Superconductivity

(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 for communication with students who are encouraged to search for online resources for better understanding material taught in class and for lecture presentations.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Student performance evaluation consists of an optional midterm exam and a mandatory final exam in Greek that includes developing questions and problem solving. Students have the right to view their exam scripts after the grading results and to ask questions.

Activity	***Semester workload***
Lectures	39
Study hours	78
Office hours	26
Course total	***143***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

• E.N. Economou, Solid State Physics, Volume I, Metals, Semiconductors, Insulators, Crete University Press, Heraklion (1997).

• C. Kittel, Introduction to Solid State Physics, 5th Edition, Greek translation, Pneumatikos Editions, Athens (1979).
• E.N. Economou, Solid State Physics, Volume II, Order, Disorder, Correlations, Crete University Press, Heraklion (2003).
• S. Trachanas, Quantum Mechanics I: Fundamental Principles, Simple Systems, Structure of Matter. A Basic Introduction for Physicists, Chemists and Engineers, Crete University Press, Heraklion (2005).
• W.D. Callister, Jr., Materials Science and Engineering, 5th Edition, Greek translation, Tziola Editions, Thessaloniki (2004).
• I. Harald, L. Hans, Solid-State Physics. An Introduction to Principles of Materials Science, Greek Translation, Ziti Editions, Thessaloniki (2012).
• P. Robert, Electrical and Magnetic Properties of Materials, Artech House, Norwood MA (1988).
• W.A. Harrison, Electronic Structure and the Properties of Solids: The Physics of the Chemical Bond, Dover, New York (1989).
• R.C. O' Handley, Modern Magnetic Materials: Principles and Applications, Wiley (2000).

ETY-340 Transport Phenomena in Materials Science

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-340**	**SEMESTER**	**6th**
COURSE TITLE	TRANSPORT PHENOMENA IN MATERIALS SCIENCE		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	3	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*	SPECIAL BACKGROUND
PREREQUISITE COURSES:	DIFFERENTIAL EQUATIONS (ETY-211)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY340/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The course includes an introduction to the basic principles governing processing of materials and their response to external stimuli. It focuses on the description of momentum, heat and mass transport with emphasis on Newtonian fluids.

The learning goals of the course are:
1. Familiarization of students with the laws of Newton, Fourier και Fick, and their applications in processes where materials are used.
2. Deep understanding of the methodolody of development of conservation balances and the solution of simple cases with appropriate selection of initial and boundary conditions and with appropriate assumptions.
3. Preparation of students for advances courses such as rheology and processing of polymeric materials.

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…*

- Development of analytical, interdisciplinary and critical thinking
- Search for appropriate quantitative argumentation (assumptions) for the simplification and solution of difficult problems
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. Introductory concpets:
   Fluids – fluid statics. What is transport phenomena. Conservation principles. Elements of vector and tensor analysis.
2. Momentum transport.
   Viscosity and mechanisms of momentum transport. Microscopic momentum balances gia steady laminar flow. Macroscopic momentum balances. Mechanical energy.
3. Heat transport.
   Heat conduction and mechanisms of thermal energy transport. Microscopic balances in laminar flow. Macroscopic balances.
4. Mass transport.

Diffusion and mechanisms of mass transport. Microscopic balances in laminar flow. Macroscopic balances.

(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*	Student assessment is described on the course web site: https://www.materials.uoc.gr/el/undergrad/courses/ETY340/
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Students are evaluated with homework problems, project (dependent on students interest), participation (mandatory) in class and response to questions, and final exam in Greek which involves solution of problems. Oral examination is offered to students with learning disabilities. Students have the right to see their exam after the grades are announced and ask questions. The course evaluation is discussed during the first class and posted on the web. https://www.materials.uoc.gr/el/undergrad/courses/ETY340/

Activity	***Semester workload***
Lectures	25
Exercises	14
Homework	60
Course total	**99**

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Instructor's notes (course webpage).

2. R. Bird, W. Stewart, E. Lightfoot, Transport phenomena, 2nd Ed., Wiley, NY, 2001. Latest edition is also

translated in Greek, publisher: A. TZIOLAS (2017).

3. J. Welty, R. Wilson, C. Wixks, Fundamentals of momentum, heat and mass transfer, 2nd ed., Wiley, NY, 1976.

1. R. S. Brodkey, H. C. Hershey (translation K.E. Labdakis), Transport phenomena, Greek, publisher: A. TZIOLAS, 2001.
2. R. W. Fox, A. T. McDonald, P. J. Pritchard, Introduction to fluid mechanics, 6th ed., Wiley, NY, 2006.

- *Related academic journals:*

Journal of Fluid Mechanics
Physical Review Fluids
Physics of Fluids
AIChE Journal

ETY-344 Solid State Materials Laboratory

(1) GENERAL

SCHOOL	School of Sciences and Engineering		
ACADEMIC UNIT	Department of Materials Science and Technology		
LEVEL OF STUDIES	Undergraduate Studies		
COURSE CODE	**ETY-344**	**SEMESTER**	**6th**
COURSE TITLE	Solid State Materials Laboratory		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
	6	8
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*Specialised general knowledge. Skills development*
PREREQUISITE COURSES:	Physics Laboratory II (ETY-204)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY344/

(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*

A] The knowledge which the students will acquire upon successful completion of the course comprises:

a) basic elements of semiconductor physics and technology (conductivity, carrier type, types of dopants, thermal diffusion doping) and of semiconductor diodes

b) basic aspects and use of high dielectric permittivity materials, fabrication of powders and pellets using liquid chemistry followed by high-temperature calcination, structural characterization by X-Ray diffractometry and dielectric assessment by impedance spectroscopy and its thermal dependence

c) basic aspects of magnetron sputtering and its use in the preparation of thin metallic films

d) mechanical properties of metals and their study using uniaxial stress-strain measurements (tensile strength) and hardness tests. Study of implications after thermal treatment.

e) introductory elements on nanomaterials and their unique properties using two approaches:

i) preparation of metallic nanoparticles and study of plasmon resonance

ii) preparation of photocatalytic nanopowders and application in organic pollutant dissociation (mineralization)

B] The skills which the students will acquire upon successful completion of the course are:

a) mastering experimental techniques which are widely used in solid-state materials science and technology such as X-Ray diffractometry, Impedance Spectroscopy using Lock-In Amplifiers, Van der Pauw Conductivity, Hall sensing of carrier type, Ellipsometry, Sputtering, Tensile strength and Hardness measurements, UV-Vis absorption spectroscopy etc.

b) choosing the right instruments or modules for the implementation of an experimental setup in materials science, making correct interconnections between them with/or without the aid of a control computer, finding the useful range of instrument/module functionality for each specific experimental need

c) conducting experimental measurements, in-situ assessing of their reliability based on known material properties

d) analyzing experimental data. This includes calculations of the values of experimental quantities and of their

expected errors as a measure of trust on these values. Analysis includes the ability i) to perform correct graphical representations that reveal, upon sight, the relationship between two quantities and ii) to find the mathematical description of this relationship using the least-squares fit formalism
e) writing laboratory reports that include i) title and purpose of conducting each experiment, ii) summary of the methodology, instrumentation and setup to be used in order to achieve the goals of the experiment and introduction on materials to be studied along with their specific characteristics and properties, iii) comprehensive presentation of experimental procedure and experimental data iv) analysis of the experimental data, formally presenting the corresponding calculations and results on the needed experimental values.
f) assessment of the experimental results by i) verifying (or not) the expected material, ii) studying of its known properties with assessment of material quality always within the range of trust imposed by experimental error and iii) proposing ways to remedy or bypass methodology drawbacks in future attempts to run the same fabrication and/or characterization experiments, as a way to improve the quality of materials and the accuracy of the experimental results

The students also learn how to use a computer in writing experimental reports and in order to construct graphs and analyze experimental data through the use of corresponding spreadsheet preparation and editing software

C] The competences which the students will acquire upon successful completion of the course are:
a) the ability to design the proper experimental procedure and use the proper experimental techniques for fabrication and characterization of solid-state materials
b) the ability to cooperate with other people, as part of a team, in designing and implementing the above mentioned procedure, in collecting and analyzing experimental data, in assessing experimental results and in writing experimental reports
c) the ability to recognize *in-vivo* and correct or bypass errors or even modify certain steps throughout the process of implementation of an experimental task in order to reach the answer the safest and most unambiguous way.

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…*
	…….

Analysis and synthesis of data and information, with the use of the necessary technology. Decision-making. Working independently. Team work. Project planning and management. Production of free, creative and inductive thinking

(3) SYLLABUS

1. Doping of silicon
Introduction. Thermal Diffusion doping. Fick's law. Diffusion coefficients and Einstein's relation. Predeposition and drive-in diffusion processes. RCA cleaning of silicon wafers. Spin-coating of spin-on boron diffusants. Fabrication of a p^+n junction. Introduction to Ellipsometry. Thickness measurement of a thin thermal oxide on silicon

2. Preparation of $BaTiO_3$ dielectric with the Pechini method
Introduction to high permittivity dielectric materials. Dielectric polarization mechanisms, dependence of dielectric permittivity on frequency and temperature. Ferroelectrics: Barium Titanate. Structural properties and Curie (temperature) phase transition. Aspects on preparation of barium titanate powders with the Pechini method: esterification-polymerisation-grinding-calcination-sintering

3. Sputtering and thin-film deposition
Introduction to dc magnetron sputtering: Townsend relation-Paschen curve. Plasma creation. Ion-collision stimulated sublimation of a metal target. Need of the 'magnetron'. Arrival of atoms, adsorption, clustering and nucleation, 2D (Frank-Van der Merwe) and 3D (Volmer-Weber) growth of thin films. Study of the dependence of thin-film growth rate on chamber pressure and operating ion current. Resistivity measurements (4pt probe technique) on thin metal films and dependence on the growth rate

4. Electrical characterization of doped semiconductors
Introduction to the electrical properties of semiconductors: case study on silicon. Ellipsometric measurement of thermal oxide thickness and chemical etching of the oxide. Paint and fire technique for making metal contacts on silicon. Van der Pauw measurement of conductivity. Hall measurement of carrier type an mobility. Acquiring a dark current-voltage curve of a silicon diode. Measurement of ideality factor.

5. Structural and dielectric characterization of an insulator
Basic elements of X-Ray diffraction on single crystals and polycrystalline materials: Bragg notation and Laue equations, crystallite size and distortion effects. Application on $BaTiO_3$.
Introduction in the Lock-In amplification technique. Use of a lock-in amplifier for measuring the dielectric permittivity of $BaTiO_3$ as an active material in capacitors: study of an RC circuit, dependence of circuit current on frequency and capacitor temperature. Estimation of Curie temperature and type of dielectric phase transition.

6. Mechanical properties of metals
Mechanical behavior of metals under tensile uniaxial loading: elastic, inelastic and plastic deformation. Young's modulus, resilience, toughness, yield stress and fraction point of aluminum alloys. Introduction and implementation of a Brinell hardness test on carbon steel and bronze specimens. Effect of high temperature treatment and of cooling rate on the hardness of these materials.

7. Synthesis and optical properties of gold nanoparticle colloids
Properties and applications of gold nanoparticles. Synthesis of colloidal gold nanoparticles by the citrate gel (Turkevich) method: chemical reactions and their effect on the size and shape of the nanoparticles. Introduction in light propagation through dispersive media. Absorption, scattering and Plasmon resonance in dilute nanoparticle aqueous solutions. Nanoparticle size and shape effects on the resonant absorption of colloidal gold as measured by UV-Vis spectrometry.

8. Titanium dioxide and application in photocatalysis
Properties and applications of Titanium dioxide. Synthesis of nanopowders using the sol-gel method followed by calcination in oxygen-rich ambient: study on how the chemical reactions and post-synthesis heat treatment affect the size and crystallinity of the grains. Study of the mechanism of UV-excited photocatalytic action of TiO_2 on the dissociation (mineralization) of organic pollutants: case study on "methylene blue". Paths for radical formation on the surface of the grains and radical contribution to the enhancement of pollutant dissociation: effects of grain size and UV wavelength. Rate of photocatalytic dissociation: the Langmuir-Hinshelwood model

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Introductory Lectures and Face-to-face in the laboratory
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Introductory lectures are given as computer-based slide-show presentations. All laboratory setups require human-instrument interaction through a computer graphical user interface. Students are encouraged to communicate with the teachers by e-mail for all matters having to do with the course. All announcements, the lab manual, the course regulations and complementary reading material are posted in the course webpage. The students are encouraged to write lab reports with a computer.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work,*	The course teaching and student evaluation regulations are permanently posted in the course webpage. The course grade comprises three separate evaluation procedures: a) grade of the written progress test. The purpose of the test is to show the level of knowledge of the basic material properties and of the theoretical background and practical implementation of basic experimental materials' characterization techniques. The students are introduced to the above during the lectures after which the test is taken. b) evaluation of each written lab report which is separate for each lab exercise and is prepared by all the members of the team that conducted the experiment. The factors taken into account

Activity	*Semester workload*
6 Introductory lectures	6 x 3 hours
8 Laboratory exercises	8 x 5 hours
Study before the progress test	3 x 8 hours
Written Progress Test	3 hours
Writing 8 prototype laboratory reports	8 x 12 hours
Final lecture for answering students questions	3 hours
Study before the final written exam	3 x 8 hours
Final Exam	3 hours
Course total	**211 hours**

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.*	for evaluating the report are i)completeness, ii) proper processing of experimental data and accurate determination of the values of desired material quantities and their errors and iii) critical assessment of the integrity and level of trust of the final results c) the grade of the final written examination which is based on correctly utilizing and analyzing experimental data given by the examiner for answering to identical or similar problems as those encountered during the course.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

a) Emmanuel Spanakis "Solid State Materials Laboratory. Lab manual", Department of Materials Science and Technology, University of Crete, Heraklion 2013 ***(in Greek only)***

b) Callister Wıllıam D. " Materials science & Engineering" 9th Edition, Wiley, New York, 2014

c) C. Kittel "Introduction to Solid State Physics", 5th Edition, Wiley, New York, 1976

d) D. L. Smith "Thin-Film Deposition" McGraw-Hill, Boston, 1995

e) S. M. Sze "Physics and Technology of Semiconductor Devices" Wiley, New York, 1981

f) M. Barsoum "Fundamentals of ceramics", Mc Graw-Hill, 1997

- Related academic journals

a) W. Haiss, N.T.K. Thanh, J. Aveyard, D.G. Fernig, "Determination of Size and Concentration of Gold Nanoparticles from UV-Vis Spectra" Anal. Chem. 79 (2007) 4215

b) A. Houas, H. Lachheb, M. Ksibi, E. Elaloui, C. Guillard, J.-M. Herrmann "Photocatalytic degradation pathway of methylene blue in water" Applied Catalysis B: Environmental 31 (2001) pp. 145–157

ETY-346 Nanomaterials for Energy and Environment

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-346**	**SEMESTER**	**5th**	
COURSE TITLE	Nanomaterials for Energy and Environment			
INDEPENDENT TEACHING ACTIVITIES			**WEEKLY TEACHING HOURS**	**CREDITS**
			3	5
COURSE TYPE	GENERAL BACKGROUND			
PREREQUISITE COURSES:	Materials I: Introduction to Materials Science (141)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	http://theory.materials.uoc.gr/courses/een/			

(2) LEARNING OUTCOMES

Learning outcomes

By the end of the course, students are expected to

1. Become familiar with basic concepts of Nanophysics, Nanochemistry and Surface Science, understanding key differences between macroscopic and nano-physics and becoming familiar with key mechanisms that take place in solar cells, modern batteries and other devices for energy conversion.
2. Know key differences between meso- and nanophysics, as well as the basic physical and chemical properties that are common to many nanomaterials.
3. Be introduced to important branches of Materials Science, in particular materials for data storage, sensors, batteries, photovoltaics, while they revisit basic concepts of crystallography, chemical kinetics and solid-state physics.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

This course focuses on fundamental theoretical and experimental concepts/techniques used for studies of solid surfaces and nanomaterials, in particular sytems used in devices for energy conversion and storage, as well as environmental applications.
Modern nanotechnology allows for the synthesis and characterization of systems in which the basic units have dimensions of few nanometers. Such systems are used in electornics (processors, memories) in chemical industry (catalysts), in medicine (drug delivery) and in optoelectronics (photovoltaics).
Topics Covered:
1. Principles of nanophysics: specific area, quantum confinement, quantum dots, Coulomb blockade.
2. Atomic structure of solid surfaces and crystallography in two dimensions.
3. Surface energy, surface tension and shape of nanoparticles
4. Adsorption, active sites. Sensors. Catalysis and degradation of pollutants.

5. Nanomaterials for solar cells: From Gratzel cell to perovskites.
6. Nanomaterials for wind turbines and for other renewable energy systems.
5. Nanomaterials for batteries.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, Supportive learning through the use of valid online scientific tools, *eg*. phonon website in order to understand phonons.
TEACHING METHODS	***Activity*** / ***Semester workload*** Lectures: 39 Homework: 52 Guided problem solving: - Course total: **91**
STUDENT PERFORMANCE EVALUATION	Students are evaluated by homework, a mid-term exam in Greek that includes a combination of Multiple-choice questions and developing of topics and a final project that they have to present. - Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Edward L. Wolf, Nanophysics and Nanotechnology, Wiley-VCH, Weinheim 2006.
- P. W. Atkins, Physical Chemistry, Oxford University Press, Oxford 1998,.
- Ib Chorkendorff and J. W. Niemantsverdriet, Concepts of modern catalysis and kinetics, Wiley-VCH, Weinheim 2006.
- Nanotechnology, wikibooks.

- Related academic journals:

ACS Nano
Nano Letters
Advanced Materials

ETY-348 Materials and Environment

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-348**	**SEMESTER**	**6th**
COURSE TITLE	Materials and Environment		
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	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*	Specialized general knowledge		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY348/		

(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.

The course covers at the basic level the basic categories of nanomaterials, polymers, building materials, catalysts, adsorbents following two directions a) the use and application of these materials in environmental technologies and b) the impact of these materials on the environment during their production, use and disposal after the end of their life cycle as well as their recycling.
1. Understanding the basic parameters of environmental pollution.
2. Understanding the importance of the structure of materials in relation to their function and physical properties.
3. To gain deeper knowledge of the connection of the physicochemical properties of the materials with respect to their environmental behavior.
4. Introduction to the use of new innovative anti-pollution materials

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?

- Develop interdisciplinary and critical thinking
- Search, analyze and synthesize data and information using the necessary technologies
- Promote free, creative and inductive thinking
- Independent work

(3) SYLLABUS

Introduction - environmental pollution
Physicochemicals of materials

Water-solid transfer process
The use of materials for pollution processing
Different lighting
Exhaust settlement
Low cost accessories
Molecular impact
Polymer-basic principles-properties
Environmental behavior and environmental impact of multilateral materials
Biodegradable polymer
Cement - concrete
Asbestos

(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*	**POWERPOINT** **MP4**
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
Homework	25
Presentation	50
Course total	***114***

STUDENT PERFORMANCE EVALUATION	Students are evaluated by a final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics And a presentation of a topic related to ceramics Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Deligiannakis, I. Materials and Environment 2011 publisher: A. TZIOLAS
- Environmental Nanotechnology: Applications and Impacts of Nanomaterials (1st Ed) M. Wiesner, J.-Y. Bottero, McGraw-Hill Education, 2007.
- Degradable Polymers, Recycling, and Plastics Waste Management A-C. Albertson, S.J, Huang, 1995 Marcel-Dekker
- Materials Characterization Techniques, Sam Zhang, Lin Li, Ashok Kumar (2008) CRC Press.
- Physical Methods for Materials Characterisation, Peter E.J. Flewitt, R.K. Wild (2003) CRC Press

ETY-362 Materials V: Ceramic and Magnetic Materials

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-362**	**SEMESTER**	**6th**
COURSE TITLE	MATERIALS V: CERAMIC AND MAGNETIC 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	SPECIAL BACKGROUND
PREREQUISITE COURSES:	MODERN PHYSICS – INTRODUCTION TO QUANTUM MECHANICS (ETY-201)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY362/

(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*

At the end of the course, students are expected:

1. To familiarize themselves with the fundamental principles of magnetism
2. To know very well the methodology of solving problems related to magnetic and ceramic materials
3. To be able to use this knowledge to solve physical problems

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

General Competences

- Strengthen the theoretical background to understand fundamental principles of Magnetism
- Develop critical thinking in solving problems in Magnetism and Magnetic Materials
- Promoting creative and inductive thinking

(3) SYLLABUS

- Magnetic moment, Magnetization, Special Magnetization, Magnetic susceptibility
- Diamagnetism

- Paramagnetism: Classical and a Quantum theory
- Currie and Currie-Weiss laws
- Langevin and Brillouin functions
- Ferromagnetism, classical and quantum theory
- Law of corresponding States
- Weiss areas, Magnetic Anisotropy
- Soft and hard Magnetic Materials
- Anti-ferromagnetism
- Low dimensional interactions, Spin glass, super-paramagnetism
- Magnetization and thermodynamic properties
- Magneto-Resistance and Giant Magento-Resistance

- Introduction to Ceramics
- Sintering and microstructure development
- Bonds on Ceramic Materials
- Silicate grids
- Imperfections. Kroger-Vink terminology
- Iinfluence of chemical forces and structure on the physical properties
- Mechanical and Thermal Properties

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Traditional classroom teaching and problem solving with student's participation.
TEACHING METHODS *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 Homework: 65 Course total: ***104***
STUDENT PERFORMANCE EVALUATION	Students are evaluated in Greek as follows: c. Optional mid-term exam (30%) d. Final examination (70%) that includes: - Theory. Understanding of basic principles is examined - Solve problems that promote their critical and creative thinking Students have the right to see their exam and ask questions.

(5) ATTACHED BIBLIOGRAPHY

- B.D. Cullity and C.D. Graham, "Introduction to Magnetic Materials", 2nd edition, Willey and IEEE.
- Notes from the instructor on the course's website.
- David Jiles, "Introduction to Magnetism and magnetic Materials", 2nd edition, Chapman & Hall (1998)
- W.D. Callister JR, "Fundamentals of Materials Science and Engineering", , John Willey, and Sons Inc. 2001.
- M.W. Barsoum, "Fundamentals of Ceramics", Taylor and Francis group, 2003.
- X.P. Ftikos, "Science and Techniques of Ceramics", EMP University Press, 2005.

ETY-461 Introduction to Ceramics

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-461**	**SEMESTER**	**6th**
COURSE TITLE	INTRODUCTION TO CERAMICS		
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*	Specialized general knowledge		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY461/		

(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.

It develops the basic concepts of Ceramic Materials Science. In addition to an important theoretical background in the field of ceramics, it offers students the opportunity to see the applications and possibilities of using these materials in a wide range of applications, ranging from classical applications of everyday life to advanced state-of-the-art applications, such as sensors and spacecraft units.
The course also teaches characterization and analysis techniques, which are important for the student in the industry, both in the product line and in the field of development research. following:
1. familiarizing students with ceramic materials
2. consolidation of the structural mechanisms for the creation of ceramic materials with defined properties
3. using this knowledge to properly apply ceramic materials in the various fields.

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?

• Develop interdisciplinary and critical thinking
• Search, analyze and synthesize data and information using the necessary technologies
• Promote free, creative and inductive thinking
• Independent work

(3) SYLLABUS

- Definition - properties and applications of ceramic materials
- Individual structure and individual construction of ceramic materials

- Mechanical properties of ceramic materials
- Thermal properties of ceramic materials
- Electrical properties of ceramic materials
- Production of ceramic items
- Sintering
- Characteristics and analysis techniques
- Introduction to composite materials
- Presentation

(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*	**POWERPOINT** **MP4**
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
Homework	50
Presentation	50
Course total	***129***

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 by a final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics And a presentation of a topic related to ceramics Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

Barsoum M., Fundamentals of Ceramics, 2003 Institute of Physics Publishing Bristol and Philadelphia
Ftikos C. (2005). Ceramics Science and Technique, NTUA University Publications
Vatalis A. (2008) Material Science and Technology, Ziti Publications

www.eke.gr
www.acers.org

SEVENTH SEMESTER

ETY-205 Innovation, Entrepreneurship and Intellectual Property

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-205**	**SEMESTER**	**7th**
COURSE TITLE	INNOVATION, ENTREPRENEURSHIP AND INTELLECTUAL PROPERTY		
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*	GENERAL BACKGROUND & SKILLS DEVELOPMENT		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY205/		

(2) LEARNING OUTCOMES

Learning outcomes

At the end of the course students are expected:

- To familiarize themselves with how the science of economics interprets the effects of technological change and birth of innovations.
- To know the mechanism with which intellectual property and its management create or destroy innovation
- To learn the different types of intellectual property
- To learn the basic procedures of intellectual property filing and protection

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 5 (comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge).

General Competences

The course is formed in such a way, that during lectures and especially during the preparation of the written assignment (homework), that students will train themselves in:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Creative and inductive thinking

- Team work

(3) SYLLABUS

1. The phases of innovation and its evolution mechanisms,
2. The effects of diffusion and substitution of innovations and product life-cycle
3. Innovation and standardization
4. Measuring innovation in economics, academia and firms
5. Microeconomic and macroeconomic effects of innovation and intellectual property
6. Patents, trademarks, copyright, software, open source technologies, international treaties, filing procedures
7. Familiarization with the national filing procedures
8. Patent searches and the motivation of the research activity
9. Intellectual property as business tool
10. Lectures of specialists in intellectual property

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-Face & Distance Learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, of Board and Supportive learning through teleconference tools,
TEACHING METHODS	

Activity	***Semester workload***
Lectures	52
Written assignment (Homework) and oral presentation in the class of their written assignment	40
Course total	**92**

STUDENT PERFORMANCE EVALUATION	Students are evaluated by: 1. Their participation in the class 2. The quality of written assignment (homework) relevant to the course's syllabus. 3. The oral presentation in the class of their written assignment. 4. The final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Greenhalgh, C. and Rogers, M. (2010), Innovation Property and Economic Growth, Princeton Univ. Press, ISBN: 9780691137995
2. Swann, G.M. (2009), The Economics of Innovation: An Introduction, Edward Elgar Publishing, ISBN: 978 1 84844 006 7.
3. EspaceNet – European Patent Office Database for patent search

- Related academic journals:

1. International Journal of Research in Marketing
2. Curriculum Open-access Resources in Economics

3. Technological Forecasting & Social Change
4. International Journal of Industrial Organization
5. Research Policy
6. Strategic Management Journal
7. The Journal of Technology Transfer
8. Technovation

ETY-209 Innovation and Entrepreneurship

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-209**	**SEMESTER**	**7th**
COURSE TITLE	INNOVATION AND ENTREPRENEURSHIP		

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 & SKILLS DEVELOPMENT
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY209/

(2) LEARNING OUTCOMES

Learning outcomes

At the end of the course students are expected:

- To familiarize themselves with the characteristics of the entrepreneur, their traits & typology.
- To know how innovation leads to new product development and differentiation form the competition.
- To know how geographic, social, cultural and economic proximity, as well as participating in social networks and in innovation systems helps the birth of innovations and new products.
- To learn how to recognize entrepreneurial opportunities and design products according to the principles of sustainable development.
- To learn how to design a firm and how to raise funding.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 5 (comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge).

General Competences

The course is formed in such a way, that during lectures and especially during the preparation of the written assignment (homework), that students will train themselves in:

- Business opportunity discovery
- Creation of business motivation
- Team work
- Creative and inductive thinking
- Conceiving new business ideas
- Criticism and self-criticism
- Show social responsibility following the principles of sustainable development

- Presenting their business plan briefly and clearly to investors

(3) SYLLABUS

1. Innovation and the characteristics of startup entrepreneurs
2. Geographic, social, cultural and economic proximity – innovations systems – science & technology parks – startup incubators & accelerators.
3. Entrepreneurship, modern global challenges and sustainable development
4. Social Economy & entrepreneurship
5. New technologies & private investments
6. From the idea to business
7. The basics of a business plan
8. Elements of marketing
9. Sources of venture funding
10. Lectures of executives from public organisations/institutions, private firms and venture capitals

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-Face & Distance Learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, of Board and Supportive learning through teleconference tools,
TEACHING METHODS	

Activity	***Semester workload***
Lectures	52
Written assignment (Homework) and oral presentation in the class of their written assignment	40
Course total	***92***

STUDENT PERFORMANCE EVALUATION	Students are evaluated by: 5. Their participation in the class 6. The quality of written assignment (homework) relevant to the course's syllabus. 7. The oral presentation in the class of their written assignment. 8. The final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Andrew Metrick, Ayako Yasuda Venture Capital and the Finance of Innovation, ISBN-13: 978-0470454701
2. Handbook of Entrepreneurship Research: An Interdisciplinary Survey and Introduction, Springer New York Dordrecht Heidelberg London, ISBN 978-1-4419-1190-2
3. Το Εγχειρίδιο του μικρού και μεσαίου επιχειρηματία – Πρακτικός οδηγός για μια κερδοφόρα μικρή και μεσαία επιχείρηση, Νίκος Ε. Σκουλάς, Εκδόσεις NSA, ISBN: 960406276X.

- Related academic journals:

4. Harvard Business Review
5. Journal of Business Venturing
6. Journal of Business Research
7. Strategic Entrepreneurship Journal

8. Journal of Technology Management Innovation

ETY-453 Crystal Chemistry

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-453**	**SEMESTER**	**7th**
COURSE TITLE	Crystal Chemistry		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
		4	6
COURSE TYPE	ELECTIVE		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Mixed: Lectures in GREEK exams in ENGLISH		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY453/		

(2) LEARNING OUTCOMES

Learning outcomes

The course discusses the study of inorganic crystalline solids. The crystal structures of the elements, binary, ternary and modular compounds is presented. Correlation between electronic structure and crystal structure using the LCAO approach. Defects in crystals and how those affect the physical properties of the solids (semiconductors, scintillators, transparent conducting oxides, etc.). Methods of crystal growth and structural characterization with X-ray diffraction. Modern technological applications of inorganic materials. The main educational goals that the students will achieve upon completion of the course include:

1. To familiarize with…

- **The structure of solids**: Description and classifications of crystals through polyhedral representations of inorganic crystal structures.
- **Band structure**: Electronic structure derived from crystal structure. Structure-property relations.
- **Non-stoichiometry and defects in crystals:** Manipulation and control of the physical properties of solids.

1. To acquire the basic knowledge of…

- **Synthetic methods and basic structural characterization in inorganic solids:** Crystal Growth of single-crystals, polycrystalline and amorphous solids
- **Application of Inorganic compounds in technology**

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

-Relating the structure of matter with the physical properties of solids.
-Relating the structure of matter with technological applications of advanced materials.
-Practical exercise on crystal structure determination from X-ray diffraction data.
-Skill development in writing scientific manuscripts in English
- Skill development in public presentation of a scientific topic.

(3) SYLLABUS

1. Structure types of Solids
α) Metals and Nonmetals
β) Binary compounds: AB, AB_2, AB_3, A_2B_3, A_xB_y
γ) Ternary compounds: ABX_2, ABX_3, AB_3, AB_2X_4, A_2BX_4, AB_2X_2
δ) Intermetallics and Zintl Phases
ε) Modular compounds: Polytypes, Homologous series and misfit layered compounds

2. Band structure (based on R. Hoffmann review).
α) Contructing "Spaghetti" diagrams starting from molecular orbitals.
β) Electronic instability(Peierls distortion, Jahn-Teller effect)
γ) Density of states, band folding, direct and indirect bandgap
δ) Quantum confinement: Low-dimensional materials, Quantum wells, Quantum wires, Quantum dots

3. Non-Stoichiometry and Defects in Crystals
α) Nonstoichiometry and diffusion. Thermal quenching, sintering, and annealing.
β) Phase diagrams, eutectics, spinodal decomposition and solid solutions.
γ) Phase transitions. Phase transitions in inorganic solids, crystals and amorphous solids.

4. Synthesis methods
α) Solid-state synthesis, wet synthesis, solvothermal synthesis
β) Crystal Growth
Growth from melts, solutions and vapor transport.
γ) Structural characterization
Structure determination from single-crystals and crystalline powders. Characterization of amorphous solids (Pair Distribution Functions (PDF))

5. Applications of Inorganic Compounds in Modern Era Technology
- Inorganic Semiconductors in Optoelectronics
Photodiodes in Photovoltaics, Detectors and LED's
- Porous Materials
Gas Separation and Catalysis
- Hydrogen Technology
Production, Storage and Reactivity
- Energy Storage
Solid State Batteries

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	**Use of Power Point, Use of interactive online databases, eg database of ionic radii, physical properties of semiconductors, ICSD, CSD** **Use of visualization and analysis software of the crystal structure.**
TEACHING METHODS	

Activity	*Semester workload*
Lectures	39
Homework	90
Course total	**129**

STUDENT PERFORMANCE EVALUATION	Successful completion of the course involves the writing of a scientific manuscript in English (40%) (JACS Communication format) on a topic related with the technological application of inorganic materials, and its oral presentation in the class (40%). The remaining (20%) is evaluated based on the class participation and understanding throughout the course. The topic will be chosen by the student after consultation with the instructor.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1) **Ulrich Müller, «*Inorganic Structural Chemistry*», 2nd Edition, Wiley 2006.**
2) Alexander F. Wells, «*Structural Inorganic Chemistry*», 5th Edition, Oxford University Press 1984.
3) Roald Hoffmann, «*How Chemistry and Physics Meet in the Solid State*», *Angew. Chem. Int. Ed. Engl.* (1987) 846-878
4) Anthony R. West. «*Solid State Chemistry and Its Applications*», 2nd Edition, Wiley 2014.
5) Richard J. D. Tiley, «*Defects in Solids*», Wiley 2008
6) Giovanni Ferraris, Emil Mackovicky, Stefano, Merlino, «*Crystallography of Modular Materials*», IUCr 2004.
7) Erwin Parthé «*Crystal Chemistry of Tetrahedral Structures*» CRC Press 1964

- Related Scientific Journals:

Chemistry of Materials

Materials Horizons

Nature Materials

Advanced Materials

Journal of Solid State Chemistry

ETY-471 Introduction to Colloidal Dispersions

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-471**	**SEMESTER**	**7th**	
COURSE TITLE	INTRODUCTION TO COLLOIDAL DISPERSIONS			
INDEPENDENT TEACHING ACTIVITIES			**WEEKLY TEACHING HOURS**	**CREDITS**
			3	6
COURSE TYPE	ELLECTIVE COURSE			
PREREQUISITE COURSES:	MATERIALS II: POLYMERS & COLLOIDS (ETY 243)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY471/			

(2) LEARNING OUTCOMES

Learning outcomes

The course is an introduction to colloidal dispersions aiming in providing a basic knowledge on colloidal interactions, phase behavior and colloidal dynamics The learning goals that students should have achieved at the end of the lesson are the following:

1. Familiarize with Colloidal systems and the main physical mechanisms governing their behavior
2. Understand the role of colloidal interactions in the stability of colloidal dispersions and the thermodynamic phase behavior as well as in the formation of out of equilibrium states such as glasses and gels
3. To understand Brownian motion, and the characteristics of diffusion

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

Introduction

Examples of Soft Matter systems: Polymers, Colloids, Biomaterials, Surfactants and Micelles, Liquid Crystals, Emulsions and Foams.

Polymers

1. Introduction
2. Types and names of polymeric systems

3. Basic examples in Polymer
4. Synthesis Macromolecular characterization, Chain architecture, Molecular weight, End-to-end distance and Radius of gyration
5. Solutions, concentration regimes, interactions
6. Phase behavior
7. Amorphous and Crystalline polymers. Elastomers
8. Polymer mixtures and copolymers

Colloids

1. Introduction
2. Types of colloidal systems
3. Colloidal Interaction, colloidal stabilization
4. Colloid-polymer mixtures
5. Dense suspensions and crystals
6. Colloidal glasses and gels

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	In Classroom
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point and video material from the internet
TEACHING METHODS	

Activity	***Semester workload***
Lectures	39
Homework	90
Course total	**129**

STUDENT PERFORMANCE EVALUATION	Students are evaluated by a final written exam in Greek that includes a combination of: - Questions on theory - Exercises including calculations Oral exam is foreseen for students with specific learning difficulties - Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Course notes (G. Petekidis)
2. R. J. Hunter, Foundations of Colloid Science, Oxford, University Press, New York, 2001
3. W.B. Russel, D.A. Saville, W.R.Schowalter, Colloidal Dispersions, Cambridge University Press, 1989
4. Panagiotou, Interfacial phenomena and Colloidal systems 1998.
5. D. F. Evans, H. Wennerström, The Colloidal Domain, Where Physics, Chemistry, Biology and Technology meet, 2nd Edition, John Willey and Sons, New York, 1999.
6. R. M. Fitch, "Polymer Colloids, A comprehensive introduction", Academic Press, London, 1997

- *Related academic journals:*

Soft Matter, Macromolecules, Langmuir, Journal of Colloid and Interface Science, Physical Review Letters, Physical Review E

ETY-481 Elements of Semiconductor Physics

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-481**	**SEMESTER**	**7th**	
COURSE TITLE	ELEMENTS OF SEMICONDUCTOR PHYSICS			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**	
		3	6	
COURSE TYPE	SPECIALIZED GENERAL KNOWLEDGE			
PREREQUISITE COURSES:	MATERIALS III: Microelectronic and Optoelectronic Materials (ETY-242)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES (reading course)			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY481/			

(2) LEARNING OUTCOMES

Learning outcomes

The course includes the study of Semiconductor Physics as well as of the operating principles of basic optoelectronic devices. The learning goals that students should have achieved at the end of the course are the following:

1. Enhanced basic understanding of semiconductor physics.
2. Understanding important optoelectronic devices such as the semiconductor diode laser and solar cell.
3. Preparation of the students for attending postgraduate level classes in the field of semiconductors and optoelectronics.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

1. Energy bands in semiconductors and carrier statistics
2. Carrier transport and P-N diode
3. Optical transitions in semiconductors
4. Quantum wells

5. Optical gain – Laser action
6. Waveguides
7. Solar cells

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point during lectures. Posting announcements using the course web-page.
TEACHING METHODS	

Activity	***Semester workload***
Lectures	39
Homework	70
Course total	**109**

STUDENT PERFORMANCE EVALUATION	Students have the choice to be evaluated by one of the following methods: the first involves a combination of graded homework, a presentation in the class and a final written exam on all material. The second involves the homework and the final exam, while the third is just taking the final exam. The exams are in Greek and typically involve the solution of 3 to 4 problems of semiconductor physics and devices. Students have the right to view their exam scripts after the grading results are published and ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- J. Singh, "Optoelectronics, Edition Tziola, 2016
- S.O. Kasap, Principles of Electronic Materials and Devices, Papasotiriou 2004, Athens.
- B.G. Streetman and S. Banerjee, Solid State Electronic Devices, Prentice Hall, (2000)
- R. F. Pierret, Semiconductor Device Fundamentals, Pearson (1996)
- S. M. Sze, Physics of Semiconductor Devices, Wiley, New York (1981)
- D. Wood, Semiconductor Optoelectronic Devices, Prentice-Hall, UK (1994)

ETY-483 Elements of Magnetic Materials

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-483	**SEMESTER**	7th
COURSE TITLE	ELEMENTS OF MAGNETIC 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		
PREREQUISITE COURSES:	MATERIALS V: CERAMIC AND MAGNETIC MATERIALS (ETY-362)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY483/		

(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 will provide students with the fundamental knowledge in the field of magnetism and magnetic materials. At the end of the course the student will be able

- to provide explanation for fundamental concepts and phenomena of magnetism.
- to apply those concepts to understand the nature of magnetic behavior of various materials.
- to propose methods for characterization of different magnetic materials
- to discuss various applications of magnetic materials in cutting edge technologies and devices.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…
…….

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

(3) SYLLABUS

- Magnetostatics
- Classification of magnetic materials
- Magnetic measurements and characterization
- Magnetic order
- Magnetic domains
- Fine ferromagnetic particles
- Magnetic thin films
- Permanent magnets
- Magnetic recording
- Soft magnetic materials
- Giant magnetoresistance

(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*	Power Point , electronic correspondence (e-mail) for 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	26
Tutorials	13
Project-essay writing	30
Homework	81
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.*	The evaluation process described in the course website includes • An optional test • A written report on a project selected by the student from a list. • A final written examination that includes a combination of - Short-answer questions - Problem solving - Theory questions requiring a topic development Students retain the right to view their exam scripts after grades are published and ask questions.

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Notes are provided by the lecturer (in the Greek language) on the course website that cover the course in its entirety. The following books can be used for reference to specific topics.

1. J.M.D. Coey, "Magnetism and Magnetic Materials", Cambridge Univ. Press, Greek translation: Public City (2012).
2. D. Jiles, "Introduction to Magnetism and Magnetic Materials", Chapman & Hall (1991).
3. S. Chikajumi, "Physics of magnetism" , Krieger (1978).
4. C. Kittel, "Introduction to Solid State Physics", Wiley, Greek translation: Pnevmatikos Publishing (1976).

- *Related academic journals:*

Journal of magnetism and magnetic materials

ETY-598 Bioorganic Nanostructures – Supramolecular Chemistry

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	DEPARTMENT OF MATERIAL SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-598**	**SEMESTER**	**6th**	
COURSE TITLE	BIOORGANIC NANOSTRUCTURES – SUPRAMOLECULAR 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**
			3	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*	SPECIALIZED GENERAL KNOWLEDGE			
PREREQUISITE COURSES:	GENERAL CHEMISTRY (ETY-121) ORGANIC CHEMISTRY (ETY-122), ENGLISH II (ETY-012).			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	HELLENIC (ENGLISH)			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY598/ https://598bionano.wordpress.com			

(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 will serve to introduce important notions and concepts in the field of supramolecular chemistry through examples that dictate supramolecular organization in Nature and their comparison with published works. The goals of this course are to familiarize students to the different types of chemical systems used for the assembly of complicated molecular architectures and functional molecules, to help students obtain the essential knowledge needed to critically examine modern scientific literature related to supramolecular chemistry, and show how the notions and tools of supramolecular chemistry are applied in other areas of chemistry and biology. Upon successful completion of the course, the students will be able to:

-Understand the basic definitions and principles of supramolecular chemistry, widely used for the construction of novel materials,

-Correlate nanostructure architecture with the chemical structure of its components,

-Identify non-covalent interactions employed in self-organization and use this knowledge to understand and design new molecules and nanostructures,

-Work in multidisciplinary environments requiring basic supramolecular chemistry understanding (within the framework of a diploma thesis or Erasmus).

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…*
	…….

- Analyzing research papers,
- Production of me research ideas,
- Working in interdisciplinary environments,
- Autonomous work,
- Team work.

(3) SYLLABUS

The course details the basic principles of supramolecular chemistry leading to spontaneous and programmed formation of (bio)nanostructures. The course extends the basic concepts of the role of non-covalent interactions (studied in previous courses such as General Chemistry and Organic Chemistry) and explores the essential role they play in Nature and all areas of modern supramolecular materials and biomaterials chemistry. The main themes are:

1. Nanotechnology: definitions, approaches, perspectives,
2. Supramolecular Chemistry: Definition and basic principles,
3. Non-covalent interactions/self-assembly,
4. Molecular recognition – host-guest chemistry,
5. Template-directed synthesis,
6. Dynamic covalent chemistry,
7. Self-organization: Amphiphiles, polymers, helical polymers, supramolecular polymers, peptides, proteins, oligonucleotides,
8. Mechanically-interlocked molecular architectures,
9. Molecular Machines
10. Presentation and analysis of research studies from current literature.

(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*	Dedicated webpage, Book chapters, review articles, research papers, templates available on Moodle
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*	Seminar 60% (oral presentation of a research paper from current literature).

Activity	***Semester workload***
Lectures	39
Presentations	8
Office hours	8
Independent study	40
Course total	***95***

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.*	Paper 20% (written presentation of the research paper from current literature). Final exam 20% (short-answer questions).

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
1. Core Concepts in Supramolecular Chemistry and Nanochemistry, Jonathan W. Steed, David R. Turner and Karl J. Wallace. John Wiley & Sons, Ltd: Chichester. 2007.
2. Supramolecular chemistry: Concepts and perspectives, J.-M. Lehn, VCH, Weinheim 1995.
3. "Application of supramolecular chemistry", Schneider, H.J., , CRC Press 2012.

- Related academic journals:
Nature, Science, Nature Communications, Chemical Communications, RSC Advances, JACS, Angewandte Chemie International Edition, Supramolecular Chemistry, ...

EIGHT SEMESTER

ETY-207 Exploitation of Research Outpout and Entrepreneurship

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-207**	**SEMESTER**	**8th**
COURSE TITLE	EXPLOITATION OF RESEARCH OUTPOUT AND ENTREPRENEURSHIP		
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 & SKILLS DEVELOPMENT		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY207/		

(2) LEARNING OUTCOMES

Learning outcomes

At the end of the course students are expected:

- To familiarize themselves with the mechanisms of berth, maturation and diffusion of intellectual property.
- To know how intellectual property policy shapes the research process.
- To know the research and innovation policies in Greece and in the EU.
- To learn in practice how academic institutions transfer technology in the market, either in the form of spin-offs or through licensing.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 5 (comprehensive, specialised, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge).

General Competences

The course is formed in such a way, that during lectures and especially during the preparation of the written assignment (homework), that students will train themselves in:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Creative and inductive thinking

- Team work

(3) SYLLABUS

Συνοπτική θεματολογία/Περιεχομένου μαθήματος:

1. The research process and the birth of knowledge,
2. The global process of knowledge diffusion,
3. Technology matureness and the dilemma of technology protection,
4. Knowledge and intellectual property diffusion through research consortia,
5. The effect of patent filing in forming the public research policy and the dissemination of the academic knowledge.
6. National and regional research and economic growth policies – smart specialization startegy,
7. The new research structures and policies in the EU – Horizon Europe 2021-2027,
8. The role of universities in the creation of spin-offs and startups in the local economic growth.
9. Lectures for executives form technology transfer offices, for researchers who have "passed the entrepreneurial Roubicon", as well as from executives from industry.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	Face-to-Face & Distance Learning
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, of Board and Supportive learning through teleconference tools,
TEACHING METHODS	***Activity*** / ***Semester workload*** Lectures: 52 Written assignment (Homework) and oral presentation in the class of their written assignment: 40 **Course total: 92**
STUDENT PERFORMANCE EVALUATION	Students are evaluated by: 9. Their participation in the class 10. The quality of written assignment (homework) relevant to the course's syllabus. 11. The oral presentation in the class of their written assignment. 12. The final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Greenhalgh, C. and Rogers, M. (2010), Innovation Property and Economic Growth, Princeton Univ. Press, ISBN: 9780691137995
2. Swann, G.M. (2009), The Economics of Innovation: An Introduction, Edward Elgar Publishing, ISBN: 978 1 848440067.

- Related academic journals:

1. International Journal of Research in Marketing
2. Curriculum Open-access Resources in Economics
3. Technological Forecasting & Social Change
4. International Journal of Industrial Organization
5. Research Policy
6. Strategic Management Journal
7. The Journal of Technology Transfer
8. Technovation

ETY-410 Automation Laboratory

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-410**	**SEMESTER**	**8th**
COURSE TITLE	Automation Laboratory		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
		3	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*	SPECIAL BACKGROUND		
PREREQUISITE COURSES:	Computers I: Introduction to Programming (ETY-114)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY410/		

(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*

- Understand basic programming concepts by writing data collection programs, in visual programming languages such as LabVIEW / Vee and their successful implementation.
- Understanding the basic "Troubleshooting" procedures
- Ability of students to run LabVIEW / Vee programs written by the teacher or others for data collection, manipulation and storage.
- Connection of various measuring devices with the computers running LabVIEW / Vee
- Collection and storage of data using LabVIEW / Vee programs written by the students.
- Transfer data to Excel and other data analyzing programs for further analysis (data statistics, graphing)

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…
……

- Can organize and carry out teamwork
-Collect and organize new knowledge and measurements and present them to third parties.

(3) SYLLABUS

The aim of the course is to practice and familiarize students with "visual" programming methods that allow the creation of graphic / user interface for collecting, handling and processing data collected from various instruments during experimental measurements, such as: oscillographs, pulse generators, analog / digital converters, automated translation stages, variety of field measuring instruments. Students learn basic programming steps with LabVIEW / Agilent Vee and will be able to read, use, and modify programs written by the teacher and others. LabVIEW / Agilent Vee will be used on Windows XP, Vista operating environments.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures and laboratory problems performed face to face.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use Power Point, Support for learning by using multimedia (videos) and reliable scientific web resources to display additional information when needed.
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***
Delivery of course material through lectures.	12
Laboratory exercises	24
Visits to research laboratories	2
Study at home. solving exercises, reading theory.	80
Course total	***122 hours***

STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Student assessment in the course is based on - student performance in understanding and creativity of solving technical programming problems and interconnection issues when performing laboratory exercises 30%. - Assessment of written individual laboratory exercises (4 in total) 70% Students have the right to see their written works after the grading results are published and to ask questions. The method of student assessment and course material (transparencies) is described in the first lecture and is mentioned on the course website: https://www.materials.uoc.gr/el/undergrad/courses/ETY410/

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

- «VEE Pro: practical graphical programming», Robert B Angus; Thomas E Hulbert, London, Springer, 2005.
- LabVIEW for Everyone: Graphical Programming Made Easy and Fun, Jeffrey Travis, James Kring, Jim Kring, ISBN:0131856723, Published by Prentice Hall, "Visual Programming," N. C. Shu, 1988.
- "Principles of Visual Programming Systems," S.-K. Chang, editor, 1990.

ETY-412 Solid State Chemistry

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-412**	**SEMESTER**	**8th**
COURSE TITLE	SOLID STATE 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**
	3	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*	SPECIAL BACKGROUND
PREREQUISITE COURSES:	MATERIAS I (ETY-141)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY412/ https://www.materials.uoc.gr/garmatas/teaching.html

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The learning goals of the course are:
1. Understanding of the basic principles regarding the crystal structures, bonding forces, and the electrochemical, optical and semiconducting properties of materials.
2. The crystal structure and physical properties of inorganic materials.
3. An overview of the synthetic methods and physicochemical techniques for the synthesis and characterization of materials.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…
…….

- Development of interdisciplinary and critical thinking

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

(3) SYLLABUS

1. Introduction to solid state chemistry, chemical classification of solids, dispersion forces, close packed structures, crystal structures, Bravais lattices and unit cells, Miller indices, symmetry operations and symmetry elements.

2. Bonding in solid, ionic, covalent and metallic crystals, typical structural types, intermolecular forces, ionic radius, ionic and molecular structures, lattice energy, ionic compound properties.

3. Structural defects (Schottky and Frenkel), chemical impurities and non-stoichiometric crystals, Vegard's law, non-stoichiometric oxide (FeO, TiOx) electronic properties, solid solutions.

4. Crystallography and diffraction techniques, X-ray diffraction in crystalline solids, Miller index assignment, crystal structure identification, crystallite size, atomic scattering factor, small-angle X-ray scattering.

5. Scanning and transmission electron microscopy (SEM/TEM), electron scattering, X-ray energy dispersive microscopy (EDS), electron energy loss spectroscopy (EELS), Auger spectroscopy, X-ray photoelectron spectroscopy (XPS), cathodoluminescence (CL), electron diffraction.

6. Ceramic materials synthesis, solid state reaction, combustion synthesis, pure crystals with vapour-phase transfer, vapor chemical deposition (CVD), atomic layer deposition (ALD), sol-gel method, citric method, hydrothermal and solvothermal synthesis, ceramic methods.

7. Inorganic composite materials and applications: Solid-state galvanic cells, lithium-ion batteries, fuel cells (PAFC, MCFC, SOFC), electrochromism.

8. Zeolites, mesoporous aluminosilicate frameworks, synthesis, chemical composition, crystal structure, catalytic properties.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Power Point, Supportive learning through the use of valid online scientific sources, *e.g. https://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-to-solid-state-chemistry-fall-2010* and *http://csi.chemie.tu-darmstadt.de/ak/immel/tutorials/symmetry*, in order to understand the basic principles of solid state chemistry and the properties of non-molecular solids.
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	30
Exercises	9
Homework	90
Course total	**129**

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*	Students are evaluated by a final written examination in Greek that includes a combination of: - Short-answer questions - Problem solving - Developing of topics - Oral examination (for students with learning disabilities) Students have the right to view their exam scripts after the grading results are published and to ask questions. The evaluation process of the students is described during the first lecture

given, and if and where they are accessible to students.	and presented on the web site of the course: https://www.materials.uoc.gr/el/undergrad/courses/ETY412/

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1) Anthony R. West, *Solid State Chemistry and its Applications*, 2nd Edition, Wiley, 2014.
2) Lesley E. Smart, Elaine A. Moore, *Solid State Chemistry: An Introduction*, 3rd Edition, Taylor & Francis Group, 2005.

- *Related academic journals:*

Journal of Solid State Chemistry
Inorganic Solid-State Chemistry

ETY-440 Laboratory of Manufacturing and Mechanical Design

(1) GENERAL

SCHOOL	School of Sciences and Engineering		
ACADEMIC UNIT	Department of Materials Science and Technology		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-440**	**SEMESTER**	**8th**
COURSE TITLE	Laboratory of Manufacturing and Mechanical Design		

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	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*	Special background and skills development
PREREQUISITE COURSES:	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY440/

(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 completion of the course, students will:

1. Get acquainted with the a CAD design software
2. Obtain state-of-the-art specialized knowledge on the principles of design and manufacturing of two and three dimensional objects that consist the basis for innovative thinking
3. Obtain specialized skills in solving problems – required for research – such as skills in projecting and reproducing objects in space.

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*
- *Criticism and self-criticism*

(3) SYLLABUS

- Introduction to the Course
- Geometrical 2 dimensional structures – Different views
- Geometrical 3 dimensional structures – Cross Sectional Views
- Graphical Representations – Diagrams
- Introductions to Mechanical Design
- Basic elements of Mechanical Design
- Manufacturing of a mechanical design
- Design and rules of standardized mechanical elements
- Specialized mechanical design elements
- Computer-Aided Design (CAD)

(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 2D and 3D CAD software packages

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	50 hours
Laboratory Practice	50 hours
Course total	**100 hours**

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.

- *Short-answer questions*
- *Problem solving*
- *Laboratory work*

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography: None*

ETY-445 Fluid Dynamics

(1) GENERAL

SCHOOL	School of Sciences and Engineering		
ACADEMIC UNIT	Department of Materials Science and Technology		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-445**	**SEMESTER**	**8th**
COURSE TITLE	Fluid Dynamics		

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	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*	Special background
PREREQUISITE COURSES:	Differential Equations I (ETY-211)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY445/

(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 completion of the course, students will:

1. Get acquainted with mathematical description of balance of mass, energy and momentum
2. Understand of various physical parameters of fluid mechanics needed for solving problems.
3. Understand the differences between Newtonian and Non-Newtonian fluids and their importance
4. Understand of the importance and applicability of fluid dynamics in processing materials
5. Gain basic and advanced knowledge that result in critical understanding of the theory and principles of fluid dynamics.
6. Obtain specialized skills in solving problems in fluid dynamics – skills that required for research in order to develop new concepts and processes that can be integrated into different fields.

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*
- *Criticism and self-criticism*

(3) SYLLABUS

Introductory Concepts (fluids and soft matter, polymers, colloids, etc)
Basic element of vector calculus
Principal of mechanics of Newtonian fluids (liquids, laminar flows)
Molecular definition of viscosity
Conservation of Momentum, microscopic and macroscopic balances of forces and momentum
Non-Newtonian fluids
Dimensionless analysis
Boundary layers, hydrodynamics, external flow, friction coefficient
Special topics (turbulent flow, energy, time dependent flows)

(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*	None
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	30 hours
Study and analysis of bibliography	50 hours
Course total	**80 hours**

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.*	- *Short-answer questions* - *Problem solving* - *Public presentation*

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:* Fundamentals of Fluid Mechanics", by Munson, Okiishi, Huebsch, Rothmayer (7th Edition, Wiley

ETY-446 Electron Microscopy

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-446**	**SEMESTER**	**8th**
COURSE TITLE	ELECTRON MICROSCOPY		

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	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*	SPECIAL BACKGROUND
PREREQUISITE COURSES:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY446

(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 is an introductory course in theory and practical use of the electron microscope, including transmission electron microscopy (TEM) and scanning electron microscopy (SEM). It consists of lectures that focus on the theory, fundamental operating principles, specimen preparation techniques, X-ray microanalysis and electron diffraction on electron microscopes.

Students at the end of the course are expected:

- To know the basic principles that govern the scattering of electrons and the operation of electromagnetic lenses.
- To understand the basic principles that characterize the scattering and diffraction of electrons.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…*

- Development of interdisciplinary and critical thinking

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

(3) SYLLABUS

1. Introduction to electron microscopy: scanning (SEM) and transmission (TEM) electron microscopy -conventional and high-resolution imaging.
2. Electron scattering and diffraction.
3. Wave-particle duality of electrons.
4. Electron diffraction: reciprocal lattice, selected area electron diffraction, beam scattering, image analysis.
5. Dark-field and bright-filed TEM images.
6. Energy-dispersive X-ray spectroscopy (EDS).
7. Principles and practice of electron microscope operation and specimen preparation.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Power Point
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
Homework	90
Course total	**129**

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 by final written examination in Greek that includes a combination of: - Developing of topics - Answering essay questions - Oral examination (for students with learning disabilities) Students have the right to view their exam scripts after the grading results are published and to ask questions. The evaluation process of the students is described during the first lecture of the course.

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1) Powerpoint slides of the course.
2) Marc De Graef, Introduction to Conventional Transmission Electron Microscopy, Cambridge University Press (2003).
3) Stanley L. Flegler, John W. Heckman, Karen L. Klomparens, Scanning and Transmission Electron Microscopy: An Introduction, Oxford University Press (1995).

- *Related academic journals:*

International Journal of Microscopy
Journal of Microscopy
Nature Materials

ETY-447 Computational Materials Science

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-447	**SEMESTER**	8th
COURSE TITLE	COMPUTATIONAL MATERIALS SCIENCE		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
		5	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, SKILLS DEVELOPMENT, SPECIALIZED GENERAL KNOWLEDGE		
PREREQUISITE COURSES:	COMPUTERS I – INTRODUCTION TO PROGRAMMING (ETY - 114)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://theory.materials.uoc.gr/courses/yey/		

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

By the end of the course, students are expected to:

1. Know the basic techniques used for the theoretical study of materials using computers.
2. Become familiar with appropriate modeling and simulation methods for understanding the materials structure - properties relationship as well as the processes involved in several materials science problems.
3. Acquire a fundamental background in state-of-the-art programming, modelling and simulation of materials.
4. Develop scientific computing and software related technical skills.
5. Acquire hands-on experience in modeling complex phenomena and in solving challenging problems in materials science.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6 as an advanced first cycle course and to level 7.

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…*

.....

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

(3) SYLLABUS

1. Introduction to materials models for computer simulations
Length and time scales hierarchy in modeling materials structure and processes (quantum mechanical, atomistic, mesoscopic, continuum).

2. Fundamental background for classical simulations
Brief review of classical mechanics, statistical physics, methods of numerical integration and solution of differential equations.

3. Atomic-level simulations
Interatomic interaction potentials. Molecular dynamics method. Monte Carlo method. Initial conditions, crystal lattice construction, defects. Boundary conditions. Methods for constant temperature or/and pressure simulations.

4. Results analysis
Equilibrium properties, structural, mechanical, dynamical properties. Specific materials properties calculation with realistic interaction potentials and comparison with experiments.

5. Introduction to first principles calculations
The basics of density functional theory. Structural and elastic properties calculations.

6. Mesoscopic and continuum simulations
Coarse-grain method. Space discretization. Finite difference and finite element methods. Applications (e.g., dislocation dynamics, electromagnetic wave propagation). Cellular automata.

7. Combining methods
Concurrent and hierarchical combination of models. Multiple scale simulations.

(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*	Computer programming and use of specialized software in laboratory education, use of ICT in communication with students, lecture presentations, use of digital resources for further understanding taught material.
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	26
Laboratory practice	39
Office hours	26
Study hours	78
Course total	***169***

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*	Student performance evaluation consists of mandatory exercises handed out and graded during the course of the semester and a final project with in class presentation at the end of the semester.

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:

- A.N. Andriotis, Computational Physics, 2nd Edition, Anikoula Editions, Athens (2016).
- J.M. Thijssen, Computational Physics, Cambridge University Press, Cambridge, New York (1999).
- D. Raabe, Computational Materials Science: the Simulation of Materials Microstructures and Properties, Wiley-VCH, Weinheim, New York (1998).
- M. P. Allen, D.J. Tildesley, Computer Simulation of Liquids, Clarendon Press, Oxford (1990).
- D. Frenkel, B. Smit, Understanding Molecular Simulation: from Algorithms to Applications, Academic Press, San Diego, (1996).
- K. Ohno, K. Esfarjani, and Y. Kawazoe, Introduction to Computational Materials Science: from Ab Initio to Monte Carlo Methods, Springer-Verlag, Berlin, New York (1999).
- K. Binder, D.W. Heermann, Monte Carlo Simulation in Statistical Physics: an Introduction, Springer, Berlin, New York (1997).
- K. Binder, Monte Carlo and Molecular Dynamics Simulations in Polymer Sciences, Oxford University Press, Oxford, New York (1995).
- D.C. Rapaport, The art of Molecular Dynamics Simulation, Cambridge University Press, Cambridge, New York (2004, 1998).

ETY-448 Special Chapters in Computational Materials Scienc

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-448**	**SEMESTER**	**8th**
COURSE TITLE	Special Chapters in Computational Materials Science		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
		5	5
COURSE TYPE	SPECIALIZED BACKGROUND, SKILLS DEVELOPMENT, SPECIALIZATION		
PREREQUISITE COURSES:	-		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY448/		

(2) LEARNING OUTCOMES

Learning outcomes

The course aims to introducing basic numerical analysis concepts that are used in studies of physical mechanisms that govern the response of materials to various conditions. Moreover, the course aims at understanding the behaviour of materials while learning suitable computational tools to model various systems and processes.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

The course consists of two parts. In the first part, key concepts of basic numerical methods are presented. In the second part, the student is introduced to basic applications to specific materials (metals, insulators, semiconductors) and specific conditions.

A. Basic concepts of computational methods.

1. Principles of numerical analysis.
2. Partial Differential Equations (PDEs).
3. Solving PDEs using Finite Difference methods.

B. Applications to modelling of natural processes that are described by PDEs. An indicative list of topics covered includes:

1. Heat transfer equation in one dimension.
2. Propagation of Electromagnetic Waves.
3. Irradiation of surfaces by lasers.
4. Mechanical properties of materials.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point in lectures and use of interactive website for instructor-student communication. Most part of the course will take place using personal computers in a computer lab.
TEACHING METHODS	
STUDENT PERFORMANCE EVALUATION	Students are evaluated by homework and a final project. Students have the right to view their papers after the grading results are published and to ask questions.

Activity	***Semester workload***
Lectures	26
Homework	52
Laborory work	39
Course total	**117**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- A.N. Andriotis, Computational Physics, Athens (1995).
- M. Thijssen, Computational Physics, Cambridge University Press, Cambridge, New York (1999).
- *Burden R., and Faires D., 'Numerical Analysis', Brooke and Cole, Pacific Rode, USA, (2001)*

Related academic journals:

Physical Review B
Journal of Chemical Physics
Computational Materials Science

ETY-450 Polymer Physics

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-450**	**SEMESTER**	**8th**
COURSE TITLE	POLYMER PHYSICS		

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*	SPECIALZED GENERAL KNOWLEDGE
PREREQUISITE COURSES:	MATERIALS II – POLYMERS, COLLOIDS (ETY-243)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY450/

(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*

Detailed discussion of basic properties of polymers, statics and dynamics. The course assumes elementary knowledge on the topic. The full list of topics is shown below but not all are covered. After the discussion of statics and elements of macromolecular motion, some special topics are covered depending on the interests of students.

The learning goals of the course are:
1. Familiarization of students with basic parameters and scaling theories of polymers.
2. Analysis of polymer properties, comparison of theoretical predictions and experimental measurements
3. Understanding the importance of polymers in the production of several everyday life products.

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…*
	……

- Development of analytical, interdisciplinary and critical thinking
- Develop methodology for the simplification and solution of difficult problems with practical significance
- Production of free, creative and inductive thinking

(3) SYLLABUS

Macromolecules and Characteristic Length, time and energy scales
Characteristics of glasses, crystals, networks, melt.
Statistics of Polymer Chains
Polymer Chain Elasticity
Polymer Solutions and Solvent Quality - Characteristic Sizes and Phase Diagram
Polymer blends
Macromolecular motion, Coarse-Graining, Viscoelasticity and Diffusion
Dynamics of Unentangled Chains (Rouse and Zimm models), Predictions for Rheology and Diffusion
Dynamic Light Scattering, Dynamic Structure Factor
Networks and Gels
Dynamic Mechanical Spectroscopy and Time Temperature Superposition
Entangled Chains-Entanglements: Reptation and the deGennes-Doi-Edwards model

(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*	
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
Exercises	14
Homework	60
Course total	**99**

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 with homework problems, project, presence in class and response to questions, and final exam in Greek which involves solution of problems. Oral examination is offered to students with learning disabilities. Students have the right to see their exam after the grades are announced and ask questions. The course evaluation is discussed during the first class and posted on the web. https://www.materials.uoc.gr/el/undergrad/courses/ETY450/

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Instructor's notes (on the web, in Greek)
M. Rubinstein, R. H. Colby, Polymer Physics, Oxford, NY, 2003.
G. Strobl, The physics of polymers, Springer, NY, 1997.
M. Doi, Introduction to polymer physics, Oxford, NY, 1995.

- *Related academic journals:*

Macromolecules
Soft Matter
Polymer
ACS Macro Letters
Journal of Polymer Science: Polymer Physics

ETY-452 Polymer Synthesis

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-452**	**SEMESTER**	**8th**
COURSE TITLE	Polymer Synthesis		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
		3	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*	Special background, Specialized		
PREREQUISITE COURSES:	MATERIALS II: POLYMERS & COLLOIDS (ETY-243)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY452/		

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

In this course the basic polymerization methods used in polymer synthesis are described. The mechanisms of the polymerisation methods and the kinetics of the reactions are discussed in detail. The effect of the reaction kinetics on the reaction rate and the polymer characteristics are also discussed. Finally, the basic macromolecular characterization techniques are presented. The students choose contemporary research topics in polymer synthesis for presentation (Project-Compulsory).

The learning objectives of the course are the following:

- Understanding the effect of the polymerization method on the polymer characteristics.
- Consolidate the basic principles of the polymerization kinetics and be able to predict the macromolecular characteristics.
- Familiarize the students with the macromolecular characterization techniques
- Gain experience in studying the international scientific literature and present scientific topics

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…*

- Development of interdisciplinary and critical thinking
- Search for, analysis and synthesis of data and information, with the use of the necessary technologies
- Working independently
- Team work
- Project planning and management
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. Basic Concepts – Polymer Nomenclature
2. Classification of polymers
3. Polymer Microstructure: Monomer architecture, orientation, tacticity, isomers
4. Average molecular weights - Properties
5. Size and shape of macromolecules
6. Types of polymerization reactions
7. Condensation or step-growth polymerization
   - Type of step reactions
   - Molecular weight and polydispersity
   - Kinetics of condensation polymerization
   - Examples
   - Industrial methods of condensation polymerization
8. Addition of Chain-growth Polymerization
   - Free-radical polymerization
   - Mechanism of free-radical polymerization
   - Molecular weight and polydispersity
   - Kinetics of free-radical polymerization
   - Examples
   - Industrial methods of free-radical polymerization
   - Copolymerization
   - Copolymerization Kinetics
9. Anionic Polymerization
   - Mechanism of anionic polymerization
   - Molecular weight and polydispersity
   - Kinetics of anionic polymerization
   - Macromolecular architectures accessible via anionic polymerization
10. Group Transfer Polymerization
11. Cationic Polymerization
    - Mechanism of cationic polymerization
    - Molecular weight and polydispersity
    - Kinetics of cationic polymerization
12. Polymer modification reactions
13. Polymer Characterization
    - Determination of molecular weight and molecular weight distribution
    - Determination of polymer composition
    - Determination of polymer tacticity

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Power Point, communication via the departmental website and e-mail. Use of valid online scientific sources to find references and present related topics to the 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*	

Activity	***Semester workload***
Lectures	39
Exercises	12
Homework study	39
	24

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*		
		114
	Course total	39
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The students are evaluated via 4 sets of exercises (one on each polymerization method) during the semester, a final written examination in Greek, which includes a combination of problem solving and questions on developing related topics, and a project/presentation on a related topic from the international literature at the end of the semester. Students with learning disabilities are examined orally. The students have the right to check their exam script after the grades are announced and ask the tutor questions on the exam. The evaluation process is presented in detail to the students orally and in written form, together with the course syllabus, during the first lecture and is uploaded on the course web site: https://www.materials.uoc.gr/el/undergrad/courses/ETY452/	

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Allcock, H.R.; Lampe, F.W. Contemporary Polymer Chemistry, 2nd ed., Prentice Hall, Englewood Cliffs, 1990.
2. Hiemenz, P.C. Polymer Chemistry: The Basic Concepts, Marcel Dekker, NY, 1984.
3. Young, R.J.; Lovell, P.A. Introduction to Polymers, 2nd ed., Chapman & Hall, 1996.
4. Stevens, M.P. Polymer Chemistry: An Introduction, 2nd ed., Oxford Univ. Press, 1990.

- *Additional bibliography:*

1. Brandrup, J. and Immergut, E.H., eds., Polymer Handbook, 3rd ed., John Wiley & Sons, New York, 1989.
2. Odian, G. Principles of Polymerization, 3rd ed., John Wiley & Sons, New York, 1991.
3. Rempp, P.; Merill, E.W. Polymer Synthesis, 2nd ed., Huthig & Wepf, Basel, 1991.
4. Cowie, L.M.G. Polymers: Chemistry and Physics of Modern Materials, 2nd ed., Chapman & Hall, Padstow, Cornwall, UK, 1998.
5. Flory, P.J. Principles of Polymer Chemistry, Ithaca, HY, Cornell University Press, 1953.
6. Σιμιτζή, Ι. Χρ. Επιστήμη Πολυμερών, Έκδοση Εθνικού Μετσοβείου Πολυτεχνείου, Αθήνα, 1994.
7. Παναγιώτου Κ. Επιστήμη και Τεχνολογία Πολυμερών, Εκδόσεις Πήγασος 2000, Θεσσαλονίκη, 1996.
8. Seymour, Raymond B. and Carraher, Charles E., Giant Molecules, John Wiley and Sons, Inc., New York, 1990.

- *Related academic journals:*

1. Macromolecules, American Chemical Society
2. Polymer Chemistry, Royal Society of Chemistry
3. Langmuir, American Chemical Society
4. Chemistry of Materials, American Chemical Society
5. Biomacromolecules, American Chemical Society
6. Advanced Materials, Wiley
7. Advances in Polymer Science, Springer-Verlag
8. Polymer, Elsevier
9. Journal of Colloid and Interface Science, Elsevier
10. Journal of Material Chemistry, Royal Society of Chemistry
11. Journal of the American Chemical Society, American Chemical Society
12. Angewandte Chemie International Edition, Wiley

ETY-454 Rheology and Polymer Processing

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-454**	**SEMESTER**	**8th**
COURSE TITLE	Rheology and Polymer Processing		
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	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*	SPECIAL BACKGROUND		
PREREQUISITE COURSES:	DIFFERENTIAL EQUATIONS (ETY-211)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)			

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The course includes a simple description of processing of polymeric systems.

The learning goals of the course are:

1. Familiarization of students with various methods of polymer processing.
2. Addressing simple problems of polymer processing with synthesis of knowledge from polymers and transport phenomena
3. Understanding the importance of polymers in the production of several everyday life products.

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…*
	……

- Development of analytical, interdisciplinary and critical thinking
- Develop methodology for the simplification and solution of difficult problems with practical significance
- Production of free, creative and inductive thinking

(3) SYLLABUS

1. Molecular origin of viscosity, entropic origin of elasticity.
2. Non-Newtonian fluids and linear viscoelasticity.
3. Constitutive equations and non-Newtonian phenomena.
4. Introduction to polymer processing.
5. Flow of polymer melts in conduits.
6. Examples of polymer processing operations (extrudate swell and melt fracture, extrusion of thermoplastics, calendaring, blow molding).
7. Special topics (main forces – excluded volume, van der Waals, electrostatic, hydrodynamic, hydrogen bonding, applications in rheology of polymer melts and solutions, hard and soft spheres, concentration dispersions and microstructure, thixotropy, sedimentation, rheometry, extensional rheology).

(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*	
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
Exercises	14
Homework	60
Course total	**99**

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 with homework problems, project (dependent on students interest), participation (mandatory) in class and response to questions, and final exam in Greek which involves solution of problems. Oral examination is offered to students with learning disabilities. Students have the right to see their exam after the grades are announced and ask questions. The course evaluation is discussed during the first class and posted on the web. https://www.materials.uoc.gr/el/undergrad/courses/ETY340/

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. E. Mitsoulis, Basic principles of polymer processing (in Greek), NTUA 1999
2. Z. Tadmor, C. G. Gogos, Principles of polymer processing, Wiley, New York 1979
3. D. G. Baird, D. Collias, Polymer processing: principles and design, Wiley, New York 1998
4. F. A. Morrison, Understanding rheology, Oxford, New York 2000
5. R. G. Larson, The structure and rheology of complex fluids, Oxford, NY 1999
6. C. Macoscko, Rheology, WCH, NY 1994
7. J. Vlachopoulos, N. D. Polychronopoulos, Understanding rheology and technology of polymer extrusion, Polydynamics Inc., Ontario, Canada 2019.
8. M. M. Denn, Polymer melt processing, Cambridge, NY 2008

9. N. Wilkinson, A. J. Ryan, Polymer processing and structure development, Kluwer, NY 1999.

- *Related academic journals:*

Journal of non-Newtonian Fluid Mechanics
Journal of Rheology
Rheologica Acta
Polymer Engineering and Science

ETY-462 Ceramic Materials and Properties

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-462	**SEMESTER**	**8th**
COURSE TITLE	CERAMIC MATERIALS 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	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*	Special background
PREREQUISITE COURSES:	ETY-362
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/462

(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.

It develops the basic concepts of Ceramic Materials Science. In addition to an important theoretical background in the field of ceramics, it offers students the opportunity to see the applications and possibilities of using these materials in a wide range of applications, ranging from classical applications of everyday life to advanced state-of-the-art applications, such as sensors and spacecraft units.
The course also teaches characterization and analysis techniques, which are important for the student in the industry, both in the product line and in the field of development research. following:
1. familiarizing students with ceramic materials
2. consolidation of the structural mechanisms for the creation of ceramic materials with defined properties
3. using this knowledge to properly apply ceramic materials in the various fields.

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?

- Develop interdisciplinary and critical thinking
- Search, analyze and synthesize data and information using the necessary technologies
- Promote free, creative and inductive thinking
- Independent work

(3) SYLLABUS

- Definition - properties of ceramic materials
- Thermal Properties

- Optical Properties
- Plastic Shaping - Viscous Flow - Pressure
- Elasticity - Inelasticity - Strength
- Trends
- Electrical Conductivity
- Dielectric Properties: Linear and Nonlinear
- Magnetic Properties

(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, video presentations**
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures	39
Homework	50
Presentation	50
Course total	**129**

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 by a final written examination that includes a combination of: - Multiple-choice questions - Short-answer questions - Problem solving And a presentation of a topic related to ceramics Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

1) Barsoum M., Fundamentals of Ceramics, 2003 Institute of Physics Publishing Bristol and Philadelphia

2) W. David Kingery, H. K. Bowen, Donald R. Uhlmann, Introduction to Ceramics 2nd edition, John Wiley & Sons (1976)

3) Supportive learning through valid online scientific sources: www.eke.gr, www.acers.org

ETY-464 Special Chapters on Ceramic Materials

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-464**	**SEMESTER**	**8th**
COURSE TITLE	Special Chapters on Ceramic 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	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*	Special background		
PREREQUISITE COURSES:	Materials V: Ceramic and Magnetic Materials (ETY-362)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY464/		

(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.

The instructor selects the material in this course in order to introduce students to contemporary research topics in advanced ceramic materials of great technological resonance.

The learning goals that students should have achieved at the end of the lesson are:
1. familiarizing students with advanced ceramic materials
2. consolidation of the structural mechanisms for the creation of ceramic materials with defined properties important to the modern age.
3. using this knowledge to properly apply ceramic materials in the various fields.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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?

- Develop interdisciplinary and critical thinking
- Search, analyze and synthesize data and information using the necessary technologies
- Promote free, creative and inductive thinking
- Independent work

(3) SYLLABUS

The following is a limited list of such topics but the instructor has the option to choose outside them as well.

- Copper Perovskites: High Critical Temperature Superconductors
- Manganites: Giant and Colossal Magnetoresistance
- Piezoelectric Materials
- Ferroelectric Materials
- Rapid Ionic Conduits

(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 and videos**
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	

Activity	***Semester workload***
Lectures	39
Homework	50
Presentation	50
Course total	**129**

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 by a final written examination in Greek that includes a combination of: - Multiple-choice questions - Developing of topics - Short-answer questions And a presentation of a topic related to ceramics Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

Selected articles from international scientific journals

ETY-470 Synthesis and Characterisation of Colloidal Dispersions

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-470**	**SEMESTER**	**8th**	
COURSE TITLE	Synthesis and Characterisation of Colloidal Dispersions			
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**	
		3	5	
COURSE TYPE	ELLECTIVE COURSE			
PREREQUISITE COURSES:	Materials II : Polymers – Colloids (ETY-243)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY470/			

(2) LEARNING OUTCOMES

Learning outcomes

The course is an introduction to synthesis and characterization of colloidal dispersions aiming in providing a bit more advanced knowledge on the two topics compared to ETY-243. The learning goals that students should have achieved at the end of the lesson are the following:

1. Familiarize with main types of synthesis of colloidal particles and the methods used for their characterization.
2. Understand how the main experimental tools (scattering, microscopy, rheology etc.) work and how they are used to probe dilute and concentrated dispersions of colloidal particles

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

Introduction
Synthesis of colloidal dispersions
Emulsion polymerization, synthesis of latex particles, microgels
Dispersion polymerization
Poly-condensation polymerization
Characterization of colloidal particles: Sizes and polydispersity
Particle surface characterization, wetting phenomena
Dispersion characterization: Particle stability, agglomeration and aggregation, Sedimentation

Experimental techniques for characterization: Optical microscopy Light scattering Electrochemical methods Rheology

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face to face in classroom
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point and video material from the internet
TEACHING METHODS	***Activity*** / ***Semester workload*** Lectures: 39 Homework: 90 Course total: **129**
STUDENT PERFORMANCE EVALUATION	Students are evaluated by a final written exam in Greek that includes a combination of: - Questions on theory - Exercises including calculations Oral exam is foreseen for students with specific learning difficulties - Students have the right to view their exam scripts after the grading results are published and to ask questions.

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

1. Course notes (Prof. G. Petekidis)
2. R. J. Hunter, Foundations of Colloid Science, Oxford, University Press, New York, 2001
3. W.B. Russel, D.A. Saville, W.R. Schowalter, Colloidal Dispersions, Cambridge University Press, 1989
4. K. Panagiotou, Interfacial phenomena and Colloidal systems 1998.
5. D. F. Evans, H. Wennerström, The Colloidal Domain, Where Physics, Chemistry, Biology and Technology meet, 2nd Edition, John Willey and Sons, New York, 1999.
6. R. M. Fitch, "Polymer Colloids, A comprehensive introduction", Academic Press, London, 1997

- *Related academic journals:*

Soft Matter, Macromolecules, Langmuir, Journal of Colloid and Interface Science, Physical Review Letters, Physical Review E

ETY-480 Heterostructures, Nanostructures and Semiconductor Nanotechnology

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	POSTGRADUATE		
COURSE CODE	**ETY-480**	**SEMESTER**	**8th**
COURSE TITLE	Heterostructures, Nanostructures and Semiconductor Nanotechnology		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
		3	5
COURSE TYPE	SPECIAL BACKGROUND		
PREREQUISITE COURSES:	Materials III (ETY 242)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/grad/courses/ETY480/		

(2) LEARNING OUTCOMES

Learning outcomes
The course is an introduction to the Semiconductor Nanotechnology, focusing on the physics of nanostructured semiconductors, exemplified in the various applications they find in modern technology, revolving around the broader field of optoelectronics. Special emphasis is given in handling problems of practical interest that require the use of computer and of basic computational methods. *The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.*
- Search for, analysis and synthesis of data and information, with the use of the necessary technology - Production of free, but structured, creative and inductive thinking - Working independently

(3) SYLLABUS

- Quantum Heterostructures

Introduction to quantum wells and superlattices. Characteristic lengths and times. Electronic States and quantum heterostructures. Shell method. Excitons in quantum wells. Heterojunctions for doping modulation. Valence band electronic structure. kp method. Kane model. Luttinger-Kohn model for quantum wells. Optical transitions and selection rules. Stark effect. Vertical transport in quantum heterostructures.

- Semiconductor nanostructures

Types of low dimensional semiconductors: quantum dots and quantum wires. Qualitative and quantitative

description of physical properties. (a) spherical quantum dots, (b) core-shell quantum dots, (c) epitaxial quantum dots, (d) cylindrical quantum wires, (e) quantum wires with dots, (f) branched wires. Methods for spontaneous growth and assembly of low dimensional semiconductors. Quantum dot lasers.

- Semiconductor nanotechnology

Limitations of microelectronics and the role of nanotechnology. Cornerstones of nanotechnology. Fabrication of devices: Optical (nano-LASER and nano-LED), and Electrical (Nano-diodes). Assembly nanowires and quantum dots in two dimensions. Properties and Obstacles. Technological applications.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point during lectures. Posting announcements using the course web-page. Communicating with emails.
TEACHING METHODS	

Activity	***Semester workload***
Lectures	39
Homework	80
Course total	**119**

STUDENT PERFORMANCE EVALUATION	The evaluation is based on several sets of homework during the semester and a final take-home exam. The exams, homeworks and textbook material are all in English.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1) S.L Chuang, Physics of Optoelectronic Devices, John Wiley &Sons, New York (1995)
2) D. Bimberg, M. Grundmann, N.N. Ledentsov, Quantum Dot Heterostructures, John Wiley & Sons, Chichester (1998)

ETY-488 Special Chapters of Magnetic Materials

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-488	**SEMESTER**	8
COURSE TITLE	SPECIAL CHAPTERS OF MAGNETIC 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	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*	SPECIAL BACKGROUND
PREREQUISITE COURSES:	(MATERIALS V: CERAMIC AND MAGNETIC MATERIALS) ETY-362
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY488/

(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*

At the end of the course, students are expected:

- To familiarize themselves with the physics of applied magnetism
- to be able to apply this knowledge in understanding the behavior of various magnetic materials
- To be able to propose methods for characterization of different magnetic materials
- To have a good understanding of the applications of magnetic materials in cutting edge technologies and devices
- To know methods of collecting information on specialized topics in micro-magnetism in order to conduct independent research.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…*

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

(3) SYLLABUS

- Experimental methods for characterization of magnetic materials
- Magnetic order and critical phenomena
- Quantum theory of magnetism-itinerant electron ferromagnetism
- Magnetization dynamics
- Magnetoelectronic materials
- Magnetic recording materials
- Magnetoresistance- sensors
- Spintronics

(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*	Power Point , electronic correspondence (e-mail) for 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*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	The evaluation process described in the course website includes • An optional test • A written report on a project selected by the student from a list. • A final written examination that includes a combination of - Short-answer questions - Problem solving - Theory questions requiring a topic development Students retain the right to view their exam scripts after grades are published and ask questions.

Activity	***Semester workload***
Lectures	26
Tutorials	13
Project-essay writing	30
Homework	81
Course total	*150*

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Notes are provided by the lecturer (in the Greek language) on the course website that covers the

course in its entirety. The following books can be used for reference to specific topics.

5. J.M.D. Coey, "Magnetism and Magnetic Materials", Cambridge Univ. Press, Greek translation: Public City (2012).
6. B.D. Cullity and C.D. Graham, "Introduction to Magnetic Materials", 2nd edition, Willey and IEEE.
7. D. Jiles, "Introduction to Magnetism and Magnetic Materials", Chapman & Hall (1991).
8. Stephen Blundell, "Magnetism in Condensed Matter", Oxford University Press (2001)
9. S. Chikajumi, "Physics of magnetism" , Krieger (1978).
10. C. Kittel, "Introduction to Solid State Physics", Wiley , Greek translation: Pnevmatikos Publishing (1976).

- Related academic journals:

Journal of magnetism and magnetic materials

ETY-490 Photonic Materials

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES & ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIAL SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	undergraduate		
COURSE CODE	**ETY-490**	**SEMESTER**	**8th**
COURSE TITLE	Photonic 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	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*	Special background		
PREREQUISITE COURSES:			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek / English		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/grad/courses/METY490/		

(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 at the end of the course:

- They will possess advanced knowledge and skills (critical understanding of theories and principles) in the field of modern Photonics, with emphasis on modern applications, like in telecommunications and nano-photonics.
- They will be able to use the knowledge they acquired in a way that shows a professional approach to their work.
- They will be able to gather and interpret elements of the subject to form scientifically documented opinion, both on scientific and social/ethical issues. (e.g. risks of new technologies to human health).
- They will be able to communicate information and solutions to the subject of the course (modern photonic materials) to both a specialized and non-specialized audience.
- They will have developed those knowledge-acquiring skills, which they need to pursue further studies with a high degree of autonomy.

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…*
	……

Autonomous and group work. Analytic and synthetic ability for solving complex problems. Critical thinking. Bibliographic study, analysis, synthesis and presentation of modern research work.

(3) SYLLABUS

- *Light and matter, light waves, absorption and emission, optical properties of matter*
- *Modern lasers: operation principles, new technologies and applications*
- *Optics of short laser pulses: theory and applications*
- *Nonlinear optics: materials, systems and spatio-temporal phenomena*
- *Optical fibers – Telecommunications*
- *Photonic crystals*
- *Metamaterials*
- *Terahertz photonics*

(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 delivery 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*	
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Language: Greek / English Evaluation methods: Written exam 40%, Research project 60%.

Activity	***Semester workload***
Lectures	36
Practice	3
Homework	20
Course total	***59***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, 2nd edition Wiley*
- *Photonics, A. Yariv and P. Yeh, 6th edition Oxford University Press*

- Related academic journals:

ETY-491 Biological materials and composite biomaterials

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-491**	**SEMESTER**	**8th**	
COURSE TITLE	Biological materials and composite biomaterials			
INDEPENDENT TEACHING ACTIVITIES			**WEEKLY TEACHING HOURS**	**CREDITS**
			3	6
COURSE TYPE	GENERAL BACKGROUND			
PREREQUISITE COURSES:	Biochemistry and molecular biology (ETY-232)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY491/			

(2) LEARNING OUTCOMES

Learning outcomes

The course outline includes the study of biomaterials and composite biomaterials, their physicochemical and mechanical properties, their degradation mechanisms, their biocompatibility criteria and evaluation, the biological responses following an implantation. The learning goals that students should have achieved at the end of the lesson are the following:

1. To become familiar with biomaterials and composite biomaterials
2. To consolidate the notions of the structural mechanisms used by Nature to create materials with defined properties
3. To use this knowledge towards the design of biocompatible materials
4. To be conceptually prepared to perform a diploma thesis in a research laboratory in the area of biomaterials, tissue engineering and regenerative medicine

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

1. Materials for Biomedical Applications
2. Chemical Structure of Biomaterials
3. Physical Properties of Biomaterials
4. Mechanical Properties of Biomaterials
5. Biomaterial Degradation
6. Biomaterial Processing
7. Surface Properties of Biomaterials
8. Protein Interactions with Biomaterials
9. Cell Interactions with Biomaterials
10. Biomaterial Implantation and Acute Inflammation
11. Wound Healing and the Presence of Biomaterials
12. Immune Response to Biomaterials

13. Biomaterials and Thrombosis
14. Infection, Tumorigenesis and Calcification of Biomaterials

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, Supportive learning through the use of valid online scientific tools
TEACHING METHODS	
STUDENT PERFORMANCE EVALUATION	Students are evaluated by a final written examination in Greek that includes critical development of topics. Students have the right to view their exam scripts after the grading results are published and to ask questions.

Activity	***Semester workload***
Lectures	39
Homework	90
Course total	**129**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Book "Biomaterials – The interface between Biology and Materials Science", J.S. Temenoff, A.G. Mikos, Edition Utopia, ISBN: 978-618-5173-27-2 (book translated in greek language)

  The text book covers 100% of the examination matter.

  Additional bibliography:

  - B. D. Ratner, A. S. Hoffman, F. J. Schoen, J. E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", Academic Press, 2004
  - J. S. Temenoff, A. G. Mikos, "Biomaterials: The Intersection of Biology and Materials Science", 2008
  - J. B. Park, J. D. Bronzino, "Biomaterials - Principles and Applications", CRC, 2002
  - D. F. Williams, "Fundamental Aspects of Biocompatibility", Volume 1, CRC, 1981
  - D. F. Williams, "Biocompatibility of Orthopedic Implants", CRC, 1982
  - D. F. Williams, "Techniques in Biocompatibility Testing", CRC, 1986

- Related academic journals:

ETY-494 Introduction to Biomedical Engineering

(1) GENERAL

SCHOOL	School of Sciences and Engineering		
ACADEMIC UNIT	Department of Materials Science and Technology		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-494**	**SEMESTER**	**8th**
COURSE TITLE	Introduction to Biomedical Engineering		

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	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*	Special background
PREREQUISITE COURSES:	Biochemistry & Molecular Biology (ETY-232) or Molecular Cellular Biochemistry (ETY-335)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY494/

(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 completion of the course, students will:

1. Get acquainted with the mammalian physiology from the engineering an physics perspective
2. Get acquainted with the mechanical forces exerted on cells and tissues, and the mechanisms of transmission of the mechanical signal and its conversion into a biochemical signal.
3. Get familiarized with examples of applications of Biomedical Engineering to various branches of Medicine.
4. Obtain gain basic and advanced knowledge in biomedical engineering that entails a critical understanding of theories and principles of engineering, biology and medicine
5. Obtain specialized problem-solving skills in biomedical engineering, which are required in research and/or innovation in order to develop new knowledge and processes and integrate knowledge from different fields.

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*
- *Criticism and self-criticism*

(3) SYLLABUS

- Basic concepts of vascular engineering and cardiovascular physiology.
- Interaction of Mechanical and Genetic Factors in Atherosclerosis.
- Bioreology. Viscosity and Viscoelastic Properties of Blood.
- Cellular Engineering and Mechanotransduction.
- Mechanical Properties of Cell Membrane.
- Stem Cell Engineering and New Therapeutic Applications.
- Viscoelastic Properties of the Extracellular Matrix of the Cell.
- Artificial blood and polymer solutions that simulate the Rheological Properties of Blood.
- Tissue engineering of joints.
- Examples and Applications of Biomedical Engineering.

(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*	None
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	30 hours
Study and analysis of bibliography	50 hours
Course total	**80 hours**

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.*	- *Short-answer questions* - *Problem solving* - *Public presentation* - *Written work*

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Fundamentals of Fluid Mechanics", by Munson, Okiishi, Huebsch, Rothmayer (7th Edition, Wiley)

ETY-500 Symmetry in Materials Science

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**ETY-500**	**SEMESTER**	**8th**
COURSE TITLE	Symmetry in Materials Science		
INDEPENDENT TEACHING ACTIVITIES		**WEEKLY TEACHING HOURS**	**CREDITS**
		3	5
COURSE TYPE	GENERAL BACKGROUND		
PREREQUISITE COURSES:	Applied Mathematics (116) Solid-State Physics: Introduction (305)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	http://theory.materials.uoc.gr/courses/sms/		

(2) LEARNING OUTCOMES

Learning outcomes

By the end of the course, students are expected to

1. Become familiar with the mathematical foundations of Materials Science as well as mathematical toolbox that is necessary for the theoretical study of materials, as well as for the design of characterization experiments.
2. Know the key concepts of discrete group theory, the application of group theory to the symmetry of molecules and crystalline solids, as well as the effect of symmetry on the electronic and vibrational states in materials.
3. Be albe to predict the effect of symmetry on the absorption spectra of materials and on the response of materials to external fields.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

1. Group Theory: Point group, molecular symmetry. Representations and characters.
2. Applications of point groups: Normal modes of virations, infrared- and Raman spectroscopy, molecular orbitals.
3. Space groups and crystal symmetries. Applications: Wyckoff positions, diffraction, electron wave-functions in solids.
4. Crystallography: Methods of crystal structure determination from X-ray diffraction data of powders and single-crystals.
5. Symmetry and Response. Mechanical properties. Stress and strain tensors and elastic constants. Electrical properties. Themoelectric and Piezoelectric effects.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY.	Face-to-Face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of Power Point, Supportive learning through the use of valid online scientific tools, *eg*. phononwebsite in order to understand phonons. Extensive use of simualtions in the computer lab.
TEACHING METHODS	
STUDENT PERFORMANCE EVALUATION	Students are evaluated by homework and a final project. Students have the right to view their papers after the grading results are published and to ask questions.

Activity	***Semester workload***
Lectures	39
Homework	52
Guided problem solving	-
Course total	**91**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *I J. D. Vergados, Group and Representaion Theory, World Scientific (2016).*
- P. Atkins and R. Friedman, Molecular Quantum Mechanics, 4th_Edition 2005
- A. S. Nowick, Crystal properties via group theory, Cambridge University Press 1995
- R. E. Newnham, Properties of Materials: Anisotropy|Symmetry|Structure, Oxford University Press 2005.
- M. S. Dresselhaus, S. Dresselhaus, A. Jorio, Group Theory, Springer, 2008.
- P. W. M. Jacobs, Group theory with applications in chemical physics, Cambridge University Press, Cambridge, 2005.
- M. A. Armstrong, Groups and Symmetry, Springer, 1997.
- P. W. Atkins, Physical Chemistry, chapter 15 ("Molecular Symmetry"), Oxford University Press, Oxford, 6th edition, 1999.
- L. D. Landau and E. M. Lifshitz, Theory of Elasticity, chapter 1, Butterworth-Heinemann, Oxford 1986.
- Chemical Applications of Group Theory, 3rd Ed. , F. Albert Cotton, Wiley 1990
- Infrared and Raman spectra of crystals, G. Turrell, Academic Press, 1972
- Infrared and Raman Spectra of Inorganic and Coordination Compounds 6th Ed, K. Nakamoto Wiley 2008
- X-Ray Structure Determination: A Practical Guide, 2nd Ed, G. H. Stout L. H. Jensen, Wiley 1989
- Richard C. Powell, Symmetry, Group Theory, and the Physical Properties of Crystals, Springer 2010.
- Molecular Symmetry and Group Theory, M. Sigalas, L. Antonoglou, N. Charistos, AUTH, 2015 (in greek).
- D.L. Rousseau, R.P. Bauman, S.P.S. Porto, (1981), Normal mode determination in crystals. *J. Raman Spectroscopy*., 10: 253-290. doi:10.1002/jrs.1250100152

Related academic journals:

Physical Review B
Journal of Chemical Physics
Acta Crystallographica

ETY-512 Computational Materials Science II: Electronic Structure

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING		
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-512	**SEMESTER**	8th
COURSE TITLE	COMPUTATIONAL MATERIALS SCIENCE II: ELECTRONIC STRUCTURE		

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	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*	SPECIAL BACKGROUND, SKILLS DEVELOPMENT, SPECIALIZED GENERAL KNOWLEDGE
PREREQUISITE COURSES:	SOLID STATE PHYSICS: AN INTODUCTION (ETY-305) and one of OE1
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES
COURSE WEBSITE (URL)	http://theory.materials.uoc.gr/courses/est/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

By the end of the course, students are expected to:

1. Become familiar with the modern theory of electronic structure, and more specifically with DFT (Density Functional Theory), by employing large software packages.
2. Know the basic principles of solving quantum mechanical problems in materials science as well as how to perform computational experiments in order to study properties of standard materials.
3. Develop scientific computing and software related technical skills.
4. Acquire hands-on experience in first principles calculations for solving challenging problems in materials science.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6 as an advanced first cycle course and to level 7 as a second cycle course.

General Competences

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

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

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

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

(3) SYLLABUS

1. Introduction to DFT.
   Schrödinger equation for polyelectronic systems and methods for its solution. Exchange and correlation potential. Calculation of molecules energy and reactions enthalpy.
2. Crystalline solids.
   Density and bulk modulus calculation using Bloch theorem. Energy bands.
3. Surfaces.
   Extension of theory to semi-periodic structures. The concept of surface tension. Influence of adsorbed molecules on surface properties. Adsorption enthalpy.
4. Magnetic materials. The role of spin in the magnetic properties of materials, such as iron, as well as in the cohesion of nonmagnetic molecules, such as H_2O. The concept of density of states and its calculation. Oscillations of simple molecules.
5. Experimental techniques.
   Basic principles of experiments for the depiction of the electronic structure, such as STM (Scanning Tunneling Microscope) and their simulation. Electronic band structure calculations in metals, insulators, and semiconductors.
6. Reaction speeds.
   TST (Transition State Theory) and nudged elastic band method for the calculation of the speed of a chemical reaction. Application to diffusion constants calculation.

(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*	Computer programming and extensive use of specialized software in laboratory education, use of ICT in communication with students, presentations, use of digital resources for further understanding taught material.
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
Study hours	78
Office hours	26
Course total	***143***

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*	Student performance evaluation consists of mandatory exercises handed out and graded during the course of the semester and a final project with in class presentation at the end of the semester.

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Antonios N. Andriotis, Computational Physics, Volume II, 1999.
- Frank Jensen, Introduction to Computational Chemistry, Wiley-VCH, 2nd edition 2006.
- Efthimios Kaxiras, Atomic and Electronic Structure of Solids, Cambridge University Press, 2003.
- Richard M. Martin, Electronic Structure: Basic Theory and Practical Methods, Cambridge University Press, 2004.
- Jos M. Thijssen, Computational Physics, Cambridge University Press, 1999.

ETY-570 Special Topics on Soft Matter

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES AND ENGINEERING		
ACADEMIC UNIT	DEPARTMENT OF MATERIALS SCIENCE AND TECHNOLOGY		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	ETY-570	**SEMESTER**	8th
COURSE TITLE	SPECIAL TOPICS ON SOFT MATTER		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**	**CREDITS**
		3	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*	SPECIAL BACKGROUND, SPECIALIZED		
PREREQUISITE COURSES:	MATERIALS II: POLYMERS & COLLOIDS (ETY-243)		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK (OR ENGLISH)		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES		
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY570/		

(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 targets to delve into certain subjects related to soft materials, covering the spectrum from synthesis and characterization to structural and dynamical properties and soft matter processing.

The learning goals of the course are the following:

- Deepen the students' knowledge on specific, and more specialized, topics on soft matter, not covered by the other courses of the field.
- Ability to solve targeted problems and become familiar with soft matter data
- Understand the applications of soft matter in new technologies.
- Prepare the students for carrying out their diploma work and / or postgraduate studies in soft matter.
- Expose the students to a highly intellectual environment and teaching by distinguished visiting Professors.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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…* *……*

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

(3) SYLLABUS

For 2019, the course comprised a brief review of the main characteristics of soft matter (length, time and energy scales) followed by a discussion of some of the following topics, according to the students' interests:

- Modern methods of polymer synthesis and characterization
- Synthesis and characterization of colloids
- Mechanochemistry methods
- Supramolecular chemistry
- *Microscopic thermal motion – mesoscopic polymer models*
- *Polymer melts and relation with other soft materials*
- *Semiflexible polymers and liquid crystals*
- *Polymer Blends and Polymer Mixtures*
- *Copolymers*
- *Branched Polymers*
- *Rheometry and non-linear response (Shear and Extensional Flow)*
- *Crystalline polymers*
- *Slow dynamics and heterogeneities*
- *Glass Transition*
- Hard and soft spheres, interactions
- Colloidal crystallization and glass transition
- Colloidal gels and colloid-polymer mixtures
- Viscoelasticity and diffusion of colloids

(4) TEACHING and LEARNING METHODS – EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Use of Power Point, communication via the website of the course and e-mail. Use of prominent online scientific sources to find references and present related topics to the 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	36 ώρες
Tutorials	24 ώρες
Homework	60 ώρες
Course total	***110***

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,*	The students are evaluated by sets of exercises/problems during the semester and by a final written examination in Greek (or English in case of an English speaking tutor) which includes a combination of problem solving and questions on developing related topics. Students with learning disabilities are examined orally. The students have the right to check their exam script after the grades are announced and ask the tutor questions on the exam. The evaluation process is presented in detail to the students, together with the course syllabus, during the first lecture and is uploaded on the course

other *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	website: https://www.materials.uoc.gr/el/undergrad/courses/ETY570/

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography:

1. M. Rubinstein and R. H. Colby, *Polymer Physics*. Oxford University Press, 2003.
2. J. D. Ferry, *Viscoelastic Properties of Polymers*, Wiley, 1980
3. M. Doi, S.F. Edwards, *The theory of polymer dynamics*, Oxford University Press, 2007
4. J. Mewis, N. J. Wagner, Colloidal suspension rheology, Cambridge, 2012

Related academic journals:

- Macromolecules
- ACS Macro Letters
- Soft Matter
- Journal of Rheology
- Polymer Chemistry
- Journal of Polymer Science A: Polymer chemistry

ETY-580 Optoelectronics & Laser

(1) GENERAL

SCHOOL	SCIENCES AND ENGINEERING			
ACADEMIC UNIT	MATERIALS SCIENCE AND TECHNOLOGY			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	**ETY-580**	**SEMESTER**	**8th**	
COURSE TITLE	OPTOELECTRONICS & LASER			
INDEPENDENT TEACHING ACTIVITIES			**WEEKLY TEACHING HOURS**	**CREDITS**
			3	5
COURSE TYPE	SPECIAL BACKGROUND			
PREREQUISITE COURSES:	MATERIALS III: Microelectronic and Optoelectronic Materials (ETY-242)			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	GREEK			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	YES			
COURSE WEBSITE (URL)	https://www.materials.uoc.gr/el/undergrad/courses/ETY580/			

(2) LEARNING OUTCOMES

Learning outcomes

- To get acquainted with the basic principles of microelectronics and optoelectronics.
- To know the basic principles of solid state physics as well as their application to microelectronics and optoelectronics
- To familiarize with basic microelectronic and optoelectronic devices such as the transistor diode and the diode laser.
- To know the principle of laser operation
- To solve using computational methods problems related to operating conditions (current, voltage, emission) of basic microelectronic and optoelectronic devices.

The course according to the European Qualifications Framework for Lifelong Learning belongs to level 6.

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

(3) SYLLABUS

1. Brief review of the optical properties of semiconductors, quantum wells and waveguides
2. General presentation of diode lasers and other optoelectronic devices
3. Conditions for lasing action
4. Operating principles of diode lasers
5. Special reflectors and cavities for diode lasers
6. Optical gain in quantum wells
7. Tunable semiconductor laser

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY.</td><td>Face-to-Face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</td><td>Use of Power Point during lectures. Posting announcements using the course web-page. Communicating with emails.</td></tr>
<tr><td>TEACHING METHODS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Homework</td><td>80</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course total</td><td>119</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION</td><td>The evaluation is based on several sets of homework during the semester and a final take-home exam.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- L. Coldren and S. Corzine, Diode lasers and photonic integrated circuits, Wiley Series in Microwave and Opitcal Engineering, John Wiley & Sons (1995)
- G. P. Agrawal and N. K. Dutta, Semiconductor Lasers, 2nd Edition, International Thomson Publishing (1993)
- J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill (1995)