COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y013	SEMESTER	1
COURSE TITLE	PHYSICS I (Mechanics)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS153/

(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 is the first systematic introduction to the basic concepts of Newtonian Mechanics and Fluid Mechanics by using Vector and Differential / Integral Calculus. It also includes introductory concepts of the Special Theory of Relativity.

With the successful attendance and completion of the course, the student is in position to:

- Describe the basic physical quantities and units of Mechanics in the context of Vector and Differential / Integral Calculus.
- Understand the relative dependencies of these physical quantities.
- Identify the conservation principles and the fundamental symmetries that govern the various mechanical systems.

- Explain the static or kinematical state of a system by all the forces applied to it.
- Calculate dynamical characteristics of the rigid body (moment of inertia) with basic integration techniques.
- To formulate the basic differential equations for the motion of a body.
- Explain and calculate the basic quantities of length, time or speed in different inertial systems.

- Organize systematically the data of a problem to find the solution for more complicated physical systems.
- Plot graphically the data and the results of a problem.
- Evaluate critically the results.

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Team work
Working in an interdisciplinary environment
Project planning and management

Respect for the natural environment
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Planning
New Technology skills
Creativity
Determination
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Linear motion - Curvilinear motion - Relative motion
- Introduction to the Special Theory of Relativity.
- One-body dynamics.
- Work, energy, many-body dynamics.
- Rigid body rotation around a fixed axis.
- Rolling, angular momentum and torque - Oscillations.
- The universal gravitation law.
- Fluid Dynamics.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of video Projectors, eclass platform, instructors websites</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Seminars</td><td>8</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>64</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Oral examination
Mid-term written examination</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- **Halliday, Resnick, Walker**: ***PHYSICS*** (Volume I) translated in Greek, Edited by C.N. Papanicolas, GUTENBERG (2012), Eudoxos Code Nr **33074351**
- **Giancoli**: **Physics for Scientists and Engineers** (Volume I), ΤΖΙΟΛΑ (2013), Eudoxos Code Nr **18549052**
- **H.D. Young: University Physics** (Volume I), ΠΑΠΑΖΗΣΗ (1994), Eudoxos Code Nr **68387875**

- Related academic journals:

- American Journal of Physics
- Nature
- Physics Education
- Physics Today
- Physics World
- Science
- The Physics Teacher

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y015	SEMESTER	1
COURSE TITLE	Computer Science I		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	2	
Laboratory practice	2	
		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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes,in the English language for Erasmus students
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS101/*

(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 students acquire the necessary knowledge in computer science and algorithms in order they design and create algorithms and codes which will help them to solve problems in mathematics and physics. With the completion of the course the students are able to design algorithms to solve problems in mathematics and physics and to create the related computer programs in C language. With the completion of the course the students are able to estimate the accuracy of the outcomes of the programs that they study, design and create. With the completion of the course the students are able to develop algorithms and codes for solving 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…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Decision-making Working independently Analytical and synthetic thinking New Technology skills Learning C / Matlab programming language ... Creativity Information management Problem solving	

(3) SYLLABUS

- Computer structure and operation, operating systems.
- Algorithms, program structure.
- Programming in C language.
- Controlling program flow, conditions, loops.
- Arrays, file processing, pointers, functions.
- Global and local variables.
- Examples, applications in physics.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, Eclass platform
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 / exercises	26
Individual Study/Study and Analysis of bibliography / Preparation	70
Laboratory practice	26
InteractiveTeaching	28
CourseTotal	***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 in Greek Open-ended questions, Problem solving Oral examination Laboratory reports

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography

Εισαγωγή στον Προγραμματισμό με την C, Ν. Μισυρλής, ΕΚΔΟΣΕΙΣ ΕΚΠΑ, 2007, 68403081.
C: Από την θεωρία στην εφαρμογή, Γ.Σ. Τσελίκης, Ν.Δ. Τσελίκας, 2016, 68383623
C Για Επιστήμονες και Μηχανικούς. Μια ερμηνευτική προσέγγιση, Harry H. Cheng, ΕΚΔΟΣΕΙΣ Α. ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε., 2012, 18548

- Related academic journals:

Journal of Computational Physics - Elsevier
Applied Mathematics and Computation
Mathematics and Computers in Simulation

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics Department		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y025	SEMESTER	2
COURSE TITLE	INTRODUCTION TO ASTROPHYSICS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS280/

(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 students familiarize themselves with the basic concepts of Astrophysics. With the completion of the course the student is able to Know about the radiation field characteristics, stellar magnitudes, brightness, distances, transfer equation of radiation. The students know the coordinate systems used in Astrophysics. Students acquire the necessary knowledge about the stellar structure, evolution and spectral classification of stars. The students acquire the basic knowledge of Physics about the star named Sun and the description of the Solar System. Students acquire the necessary knowledge about the Milky Way, the morphological types of Galaxies and the basic principles of Cosmology. Consequently, the student acquires the skill and ability: Explain basic concepts related to stars and galaxies. Classify the stars according to their characteristics and examine their evolution. To distinguish the Sun as quit Sun or active Sun. Discover the new facts about exploring the planets. Classify stellar spectra and galaxies according to their characteristics. Examine the basic principles governing the Universe.

General Competences

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

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

The course aims at the following general competences

Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility
New Technology skills
Creativity
Determination
Communication skills
Information management
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Basic concepts and characteristics of the field of radiation, stellar brightness and star magnitudes, Radiation transfer. Black body, radiation and star temperature.
- Distances of celestial bodies and coordinate systems.
- Spectroscopy of stars. Spectral classification of stars, Hertzsprung-Russel diagram.
- Energy generation inside stars, nebulae, birth of stars.
- Stellar structure.
- Stellar evolution, death of stars (supernovae, neutron stars - pulsars, black holes).
- Physics of the star Sun (structure, atmospheric layers, solar wind, active regions, solar activity).
- Solar system. Kepler’s laws. Description of the planetary system.
- Star clusters.
- Galaxy and Galaxies.
- Cosmology.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Exercises</td><td>13</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>82</td></tr>
<tr><td>Examination</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

1) Introduction to Astrophysics, C. E. Alissandrakis, Papazisis Publications, 2014, Athens, Greece, (IN GREEK)

2) Introduction to Modern Astronomy, C. Varvoglis – I. Siradakis AGIS- S. Gartaganis Publications, 2010, Thessaloniki, Greece, 1 (IN GREEK)

3) The Universe that I loved, E. Danezis and E. Theodosiou, Diavlos Publications, 2012, Athens, Greece, (IN GREEK)

4) Astrophysics: Structure and Evolution of the Universe: Stars Volume I: F. Shu, Crete University Press, 2009, Heraclion of Crete, Greece, (IN GREEK)

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y031**	**SEMESTER**	**3**
COURSE TITLE	**Theoretical Mechanics I**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	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:	No (recommended Physics I, Analysis I and Applications, Analysis II and Applications, Ordinary Differential Equations and Linear Algebra)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS137/ http://users.uoa.gr/~pjioannou/mech1

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

This course aims to present to the students the basic principles of Classical Mechanics and how problems of particle dynamics can be studied using Newton's laws and the integrals that arise from them.

At the end of the course, the students will be able to:

1. Choose ways to describe the motion of particles in various coordinate systems.
2. Write the equations of motion.
3. Solve these differential equations and determine the motion as a function of time.
4. Analyze, evaluate and describe qualitatively the results.
5. Apply the above to a number of problems such as those listed in the syllabus.

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Decision-making
Working independently
Analytical and synthetic thinking
Critical thinking
Time management
Creativity
Meeting Deadlines and Keeping Schedules
Problem solving

(3) SYLLABUS

- Kinematics of a point object.
- Inertial systems, Newton's laws, conservation laws, conservative forces, integrals of motion.
- Impulsive forces, collisions, moving coordinate systems (motion in a non-inertial system and applications).
- Systems with one degree of freedom (motion boundaries, study of equilibrium points with perturbation methods and phase diagrams, harmonic oscillator).
- Central forces (integrals of motion, circular orbits and their stability, inverse square forces, Kepler's laws).
- Scattering, many-body systems and their motion, the two-body problem, variable-mass systems.
- The gravitational field, gravitation from extended bodies, tidal forces.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
eclass platform where sets of problems are posted and solutions from students are uploaded</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Exercises</td><td>13</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>53</td></tr>
<tr><td>Laboratory practice</td><td></td></tr>
<tr><td>Writing reports/ essays</td><td>26</td></tr>
<tr><td>Midterm exam</td><td>3</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Homeworks, Problem solving
Mid-term written examination</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (given through the EYDOXUS platform):

- *Βιβλίο [68402150]: Εισαγωγή στη θεωρητική μηχανική, Τσίγκανος Κανάρης*
- *Βιβλίο [22695091]: ΚΛΑΣΙΚΗ ΜΗΧΑΝΙΚΗ, KIBBLE, T.W.B. & BERKSHIRE, F.H.*
- *Βιβλίο [8787]: ΘΕΩΡΗΤΙΚΗ ΜΗΧΑΝΙΚΗ ΤΟΜΟΣ Α' , ΧΑΤΖΗΔΗΜΗΤΡΙΟΥ ΙΩΑΝΝΗΣ*

- Other:

- *The Feynman lectures on Physics, Volume 1, Feynman, Leighton, Sands, Addison-Wesley pub.co.*
- *Classical Dynamics of Particles and Systems, Thornton & Marion, Brooks Cole, 5th edition*
- *Ιωάννου, Π., Αποστολάτος, Θ., 2016. Νευτώνεια Μηχανική. [ηλεκτρ. βιβλ.] Αθήνα: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Διαθέσιμο στο: http://hdl.handle.net/11419/6479*

COURSE OUTLINE

(1) GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Physics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>Y032</td><td>SEMESTER</td><td>3</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Physics III (Electromagnetism)</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures (theory and exercises)</td><td>6</td><td>6</td></tr>
<tr><td colspan="2"></td><td></td><td></td></tr>
<tr><td colspan="2"></td><td></td><td></td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">General Background</td></tr>
<tr><td>PREREQUISITE COURSES:</td><td colspan="3">No</td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes, in the English language for Erasmus students</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3">https://eclass.uoa.gr/courses/PHYS113/</td></tr>
</table>

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course aims to introduce the fundamental principles of Electromagnetism. Upon completion of the course the student will be able to: • Understand the concept of electrical and magnetic field as well as the physics quantities describing it (electric and magnetic field, potential, potential difference, field lines) • Be able to deal with electrostatic and magnetostatic problems for continuous linear, surface and volume densities of charges and currents using Coulomb, Gauss, Biot-Savart, and Ampère laws. Be able to calculate the field strength, potential and potential difference, and total energy of the system. • Understand the moving charge as a source of magnetic fields and the varying magnetic field as an electric field source. Be able to solve induction problems in electric circuits with varying magnetic fluxes, and with moving charge distributions. • Through the integral and differential form of Maxwell's equations to understand the first unification of forces in Physics, and the concept of the electromagnetic field. To be able to solve simple problems. • Have a qualitative understanding of the propagation of an electromagnetic field and be able to solve simple 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…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Adapting to new situations Decision-making Working independently Team work Production of new research ideas Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking	

Taking initiative/responsibility
Creativity
Determination
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

• Electric charge, Coulomb law, electric field, dynamic lines, potential, potential difference, insulated conductor. Law Gauss, examples • Spherical shell field. Capacity, capacitors. Current, resistance, Ohm law. Magnetic field, Laplace force, power in conductor, applications. • Current as the source of the magnetic field, Biot-Savart law. Law Ampère, applications • Induction, Faraday law, coefficient of induction. Circuit RL, RLC, mechanical oscillator analogy. • Maxwell laws in complete and differential form. Electromagnetic field energy, Poynting vector. • Qualitative explanation of the propagation of an electromagnetic field, electromagnetic waves.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below

Activity	*Semester workload*
Lectures	52
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	69
Writing reports/ essays	3
Course Total	***150***

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

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

1 *Θεμελιώδης Πανεπιστημιακή Φυσική, Τόμος ΙΙ, Ηλεκτρομαγνητισμός, ALONSO – FINN, Μετάφραση, Λ.Κ. Ρεσβάνης, Τ.Α. Φίλιππας, ΕΚΔΟΣΕΙΣ ΚΟΡΦΙΑΤΗΣ, 1979, Αθήνα*

2 *Πανεπιστημιακή Φυσική με σύγχρονη Φυσική, Τόμος Β Hugh D. Young, Freedman R., ΕΚΔΟΣΕΙΣ ΠΑΠΑΖΗΣΗ, 2010 Αθήνα*

3 *Φυσική, Μέρος ΙΙ, HALLIDAY- RESNICK, Α.Γ. ΠΝΕΥΜΑΤΙΚΟΣ, Επιστημονικές και Τεχνολογικές Εκδόσεις, 1992, Αθήνα*

4 *Φυσική για επιστήμονες και μηχανικούς Τόμος ΙΙ, D.C. Giancoli, (Επιμέλια): Α.Κεχαγιάς, Κ. Σφέτσος, Γ.Τσιπολίτης), ΕΚΔΟΣΕΙΣ ΤΖΙΟΛΑ, 2011, Θεσ/κη*

5 *Φυσική Τόμος ΙΙ 1η Έκδοση, D.Hallidey, R. ResnicK, ,J. Walker, Κ. Παπανικόλας, Α. Καραμπαρμπούνη Σ. Κοέν,Π. Σπυράκης, Ε. Στυλιάρης, Π. Τζανετάκης,Γ. Τζαμτζής, Γ. ΔΑΡΔΑΝΟΣ& ΣΙΑ Ε.Ε., 2013, Αθήνα*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y034**	SEMESTER	3
COURSE TITLE	MATHEMATICAL METHODS IN PHYSICS (Complex Analysis)		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English language for Erasmus students)
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS278/*

(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 provides a rigorous, systematic and an in-depth study of the theory of complex functions and its applications in physics problems.

With the completion of the course the student is able to:

- Handle elementary functions of one complex variable, study its fundamental properties, such as analyticity and the types of singular points, and expand a complex function into Taylor or Laurent series.
- Handle mappings by elementary complex functions, and employ the conformal mapping method to solve physics problems (e.g., in fluid dynamics, electrostatics and heat flow).
- Calculate, under parameterization, path integrals in the complex plane, evaluate contour integrals using the residue theorem, and employ the method of residues to evaluate integrals of real functions.
- Evaluate integral transforms (Fourier/inverse Fourier, Laplace/inverse Laplace) of a function, and employ integral transforms to solve differential equations of mathematical physics.
- Employ the methods of stationary phase and steepest descend to evaluate the asymptotic behavior of integrals.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

The course aims at the following general competences

Working independently
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Complex numbers, elementary functions of a complex variable, multivalued functions - branches.
- Continuity, derivative of a complex function, analytic functions and Cauchy-Riemann equations, harmonic functions.
- Mapping by elementary functions, conformal mapping, and applications in physics.
- Complex power series, Taylor and Laurent series, classification of singularities, contour integral, Cauchy theorem and residue theorem, evaluation of integrals.
- Fourier and Laplace transforms, applications το partial and ordinary differential equations, stationary phase and steepest descent methods.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology), eclass platform
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*	(see table below)
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 in Greek Oral examination (when appropriate)

Activity	*Semester workload*
Lectures	39
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	85
Course Total	**150**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Εισαγωγή στη Μιγαδική Ανάλυση, Σ. Μερκουράκης, Τ. Χατζηαφράτης, ΕΚΔΟΣΕΙΣ ΣΥΜΜΕΤΡΙΑ, 2005, Αθήνα

2. Βασική Μιγαδική Ανάλυση, J. E. Marsden, M. J. Hoffman, Μετάφραση- επιμέλεια, Λ. Παπαλουκάς, ΕΚΔΟΣΕΙΣ ΣΥΜΜΕΤΡΙΑ, 1994, Αθήνα

3 Μιγαδικές συναρτήσεις και εφαρμογές, R. V. Churchill, J. W. Brown, Μετάφραση- επιμέλεια, Δ. Καραγιαννάκης, 2012, ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ

- Related academic journals:-

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y035**	**SEMESTER**	**3**
COURSE TITLE	**Introduction to Atmospheric 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**
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the Greek language for Erasmus students
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS232/*

(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 provides to the students, knowledge for comprehending the mechanisms which are related to the Physics of the Atmosphere. In particular, upon the successful completion of the course, the student will be able to:

- to describe the composition and structure of the Earth's atmosphere as well as of planets,
- to describe the physical and dynamic processes in the atmosphere,
- to define the interaction between the above processes as well as of the parameters which influence the above said interaction,
- to comprehend and describe thermodynamic processes in the atmosphere,
- to calculate the apparent temperature of the system Earth-Atmosphere,
- to describe the main mechanisms which control the system Earth – Atmosphere,
- to define the mechanisms and parameters which refer to radiative transfer,
- to calculate the radiative budget at the top of the atmosphere, the surface of the earth and as function of altitude,
- to describe the climatic system of planet Earth,
- to describe the greenhouse effect and estimate change in the radiation and energy budgets,
- to define and describe large scale (planetary) circulation patterns in the atmosphere,
- to define the forces which are exerted on an air mass and to describe the geostrophic balance,
- to explain the thermal wind and design forces applied on air mass,
- to analyze the forces on a rotating air mass,
- to describe and combine the physical, dynamic and chemical mechanisms which control the concentration of ozone in the stratosphere.

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary science knowledge
Decision-making
Independent work
Respect for the natural environment

Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Problem solving

3 SYLLABUS

- Composition and structure of the atmosphere, planetary atmospheres
- Solar and terrestrial radiation
- Photochemical processes in the atmosphere
- Atmosphere and the climatic system
- Thermodynamics and statics of the atmosphere
- Atmospheric motions

(3) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>85</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total
(25 ώρες φόρτου εργασίας ανά πιστωτική μονάδα)</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Mid-term written examination
Final written exams in Greek
Four problems of equal weight.
Solved problems uploaded at courses e-class platform.
Oral essay presentation (upon request of a student)</td></tr>
</table>

(4) ATTACHED BIBLIOGRAPHY

1. Atmosphere, C. Varotsos, Athanasopoulos Editions, 2008
2. Introductory courses in Atmospheric Physics, Ch. Zerefos, PAPASOTIRIOU Editions, 2009.
3. Introduction to Atmospheric Physics, C. Xaldoupis, KALLIPOS Editions, 2016.

Relevant scientific journals: ATMOSPHERIC ENVIRONMENT, ATMOSPHERE, METEOROLOGY AND ATMOSPHERIC PHYSICS, THEORETICAL AND APPLIED CLIMATOLOGY, JOURNAL OF ATMOSPHERIC SCIENCES

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	Y041	SEMESTER	4th	
COURSE TITLE	THEORETICAL MECHANICS II			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)			4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).				
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background			
PREREQUISITE COURSES:	No			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students			
COURSE WEBSITE (URL)	url of eclass https://eclass.uoa.gr/courses/PHYS288/			

(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 student acquires the necessary knowledge for the understanding of the least action principle, and the physical context of Lagrangian and Hamiltonian formulation.

With the completion of the course the student is able to

Describe various mechanical systems in Lagrangian and Hamiltonian formulation.
Recognize the symmetries and the corresponding conserved quantities in a mechanical system.
Combine the Lagrangian description of a system near equilibrium in order to reveal its normal modes.

Explain the physical context of the least action principle.
Calculate the normal modes and eigenfrequencies of a system near equilibrium.

Be able to explain the conserved quantities as a consequence of symmetries.
Be able to combine the Lagrangian description in order to analyze various mechanical systems.

General Competences

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

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

The course aims at the following general competences

Production of new research ideas
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- The principle of least action.
- Calculus of variations, Euler-Lagrange equations, Lagrangian of a charged particle in an electromagnetic field.
- Symmetries and Noether theorem, Lagrange multipliers and constraints.
- Normal modes of an oscillating system.
- Legendre transformation, Hamilton's equations, phase space flow, Poisson brackets.
- Symmetries and conserved quantities in Hamiltonian mechanics, canonical transformations.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>26</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>98</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
1. Theoretical Mechanics (P. Ioannou, T. Apostolatos) in greek
2. Theoretical Mechanics, Vol. 2 (J. Hatzidimitriou) in greek

- Related academic journals:
Physical Review Letters

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y044**	SEMESTER	4
COURSE TITLE	MATHEMATICAL METHODS IN PHYSICS II		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in English language for Erasmus students)
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS244/*

(2) LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The aim of the course is: 1 To familiarize the students with the use of the properties of function vector spaces. 2 To understand the notion and usefulness of expansions into basis functions of a function vector space (e.g., Fourier expansion). 3 To introduce basic types of partial differential equations of physics. 4 To solve boundary and initial value problems with the additional use of mathematical methods of the first two aims. With the completion of the course the student is able to: Employ the mathematical notions and techniques of the course to solve problems in various branches of physics, as well as of other physical sciences

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Working independently Team work Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Problem solving	

(3) SYLLABUS

- Inner product spaces (Cauchy-Schwarz inequality, Gram-Schmidt orthonormalization).
- Complete infinite-dimensional functional spaces (Bessel inequality, Parseval equality, basis of an infinite-dimensional space).
- Fourier series (Weierstrass theorem), linear operators in complete spaces (self-adjoint operators eigenvalue problems, spectral theorem of self-adjoint operators), Sturm - Liouville systems.
- Introduction to partial differential equations of mathematical physics (wave, diffusion, and Laplace equations), classification of partial differential equations, characteristic surfaces, boundary conditions, methods of solution.
- The homogeneous and inhomogeneous wave equation, solution in Cartesian, cylindrical and spherical coordinates.
- The diffusion equation subject to homogeneous and inhomogeneous boundary conditions in Cartesian, cylindrical and spherical coordinates.
- Green’s functions.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology),
eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td></td><td>-</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>85</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek

Oral examination (when appropriate)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1 Μερικές Διαφορικές Εξισώσεις, Σ. Τραχανά, ΙΤΕ ΠΑΝ/ΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ

2 Μαθηματικές Μέθοδοι Φυσικής, ΤΟΜ. ΙΙ, Ι. Βέργαδος, ΕΚΔΟΣΕΙΣ Σ. ΑΘΑΝΑΣΟΠΟΥΛΟΣ& ΣΙΑ Ο.Ε

3 Σημειώσεις των διδασκόντων στην η-τάξη.

- Related academic journals:-

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y046	SEMESTER	4
COURSE TITLE	THEORY OF SPECIAL RELATIVITY		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	url of eclass https://eclass.uoa.gr/courses/PHYS268/

(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 student acquires the necessary knowledge for the understanding of the principles of relativity, the notion of spacetime and four-vectors and the physical meaning of using the Lorentz transformations.

With the completion of the course the student is able to

Describe various physical quantities in the form of four-vectors.
Recognize the types of four-vectors.
Combine the physical quantities that are known in a frame of reference in order to compute them in another frame of reference.

Explain the difference of measurements in different frames of reference.
Calculate the transformed quantities by means of Lorentz transformations.

Be able to explain the relations between measurements in different frames.
Be able to combine the formulae in various types of problems related with relativistic velocities.

General Competences

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

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

The course aims at the following general competences

Production of new research ideas
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Tensors (covariant and contravariant four-vectors, metric).
- Spacetime (space-like, time-like, light-like four-vectors).
- Relativistic Kinematics and dynamics (Lorentz transformations, invariant quantities, four-velocity, four-acceleration, four-momentum).
- Paradoxes in special relativity and their analysis.
- Relativistic particle reactions (conservation of four-momentum).
- Special relativity and electrodynamics (covariant formulation of Maxwell equations, electric and magnetic field transformations).

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>26</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>98</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
1. Theory of Special Relativity Part B (M. Tsambarlis) in greek
2. Introduction to Special Relativity (W. Rindler) translated to greek

- Related academic journals:
Physical Review Letters

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	Y051		SEMESTER	5
COURSE TITLE	Electronics I			

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes,in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS146/

(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 student acquires the necessary knowledge concerning the semiconductor Physics, the Electronic Physics and the propagation of electromagnetic waves.

With the completion of the course the students are able to solve problems concerning semiconductors, transistors, filters, electronic circuits and electromagnetic propagation for telecommunication systems

With the completion of the course the students are able to describe accurately the operation of semiconductor contacts and transistors, as well as combine specific elements in order to study, design and produce complex electronic circuits.

With the completion of the course the students are able to understand and explain the basic concepts of Electronic Physics, Semiconductor Physics and electromagnetic propagation, as well as be able to apply them in simple electronic circuits.

With the completion of the course the students are able to compose concepts and laws that lead to solving complex problems of Electronic Physics as well as using the relevant mathematical expressions to solve them.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Production of new research ideas
Production of free, creative and inductive thinking
Analytical and synthetic thinking
New Technology skills
Creativity
Information management
Problem solving

(3) SYLLABUS

- Introductory concepts, signals and systems.
- Elements of circuit analysis and quadrupole theory, time and frequency domain analysis of circuits.
- Introduction to operational amplifiers, circuits and applications.
- Elements of semiconductor physics, diodes and applications.
- The bipolar junction transistors, operation and applications.
- The field effect transistor, operation and applications.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**Yes** Electronic communication with the students usingICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below
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 in Greek Open-ended questions, Problem solving

Activity	*Semester workload*
Lectures	39
Exercises	26
Individual Study/Study and Analysis of bibliography / Preparation	78
InteractiveTeaching	*7*
CourseTotal	***150***

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography

Εισαγωγή στην Ηλεκτρονική, Γ.Σ. Τόμπρας, Εκδ. ΔΙΑΥΛΟΣ, 2006, ΑΘΗΝΑ, 12173
Ηλεκτρονικά, Γ. Χαριτάντης, Εκδ. Π. Δεμερτζή

- Related academic journals:

Physical Review E
Physics Letters A
Electronics Letters
Springer Circuits, Systems and Signal Processing Journal
IET Optoelectronics

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	**Y053**	SEMESTER	5	
COURSE TITLE	Quantum Mechanics I			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)			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:	No			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students			
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS151/			

(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 goal of the course is to provide understanding of and familiarity with the concepts of quantum mechanics, along with the ability to process the basic principles and to solve simple, mostly one-dimensional problems. Upon successful completion of the course, students will be: • In command of the basic principles that govern quantum phenomena. • Able to understand the difference between the quantum and classical descriptions of physical systems and observables. • Able to use the mathematical foundations of Quantum Mechanics and the corresponding fundamental equations for solving 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…* *…….*
The course aims at the following general competences: • Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Team work • Production of free, creative and inductive thinking • Analytical and synthetic thinking • Critical thinking • Problem solving	

(3) SYLLABUS

- Introduction to quantum mechanics, Schrödinger’s equation.
- Principles of quantum mechanics, observables, mean values, uncertainty.
- Time evolution of systems and observables.
- The uncertainty principle, energy-time uncertainty.
- Particles in one-dimensional potentials, the one-dimensional harmonic oscillator.
- One-dimensional scattering problems.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below

Activity	*Semester workload*
Lectures	39
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	85
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 exam in Greek

(5) ATTACHED BIBLIOGRAPHY

- **Quantum Mechanics,** S. Trachanas, Crete University Press.
- **Introduction to Quantum Mechanics,** K. Tamvakis, Leader Books.
- **A. Karanikas & P. Sphicas,** course notes posted on e-class.
- **V. Georgalas & G. Diamandis,** course notes posted on e-class.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	10Y054	**SEMESTER**	**5**
COURSE TITLE	**Electromagnetism I**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS125/

(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 successfully attending and completing the course of 'Electromagnetism I' the student is expected to obtain the necessary background and to develop skills that at the end of the semester should mature into specific abilities so that the student should be able to: ▪ Recognize and describe mathematically electrostatic and magnetostatic phenomena in vacuum and inside matter, i.e. dielectric and magnetic materials. ▪ Analyze and resolve basic and advanced problems so that their solution can be clearly anticipated. Clarify/evaluate the obtained results. ▪ Identify all the parameters involved in a problem, and most important to prioritize these parameters in terms of significance, recognizing those who have the most important contribution. ▪ Adopt assumptions and approximations, when necessary, to resolve a physical problem, while adequately documenting the correctness of the mathematical approach.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* / *Project planning and management* *Adapting to new situations* / *Respect for difference and multiculturalism* *Decision-making* / *Respect for the natural environment* *Working independently* / *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Team work* / *Criticism and self-criticism* *Working in an international environment* / *Production of free, creative and inductive thinking* *Working in an interdisciplinary environment* / *……* *Production of new research ideas* / *Others…* *…….*
The general skills that the student should acquire at the end of the semester mainly refer to: ▪ Analysis of clearly/self-consistently defined electrostatic and magnetostatic problems both in vacuum and under the presence of relevant materials. ▪ Development of 'critical thinking' to evaluate the clarity/self-consistency of a problem in both physical and mathematical terms. ▪ Handling existing knowledge through both 'inductive' and 'deductive' reasoning in problem analysis. ▪ Cultivation of self-consciousness and autonomy with the aim of efficiency in individual work. ▪ Promotion of 'free thinking' with the ultimate goal to introduce creative 'new proposals' that are in-line with existing knowledge.

(3) SYLLABUS

• Mathematical background: Delta function. Helmholtz theorem. Gauss theorem. Stokes theorem. Theorem of uniqueness. Laplace equation in Cartesian, cylindrical and spherical coordinates. General properties of solutions of Laplace's/Poisson's equation solutions/Relation with symmetries of the physical problem.

• Methods of solution: Boundary value problems in cartesian, cylindrical and spherical coordinates. Multipole expansion. Methods of Images. Method of Inversion.

• Electrostatics in vacuum. Scalar potential. Electric field. Generalized Coulomb's law for point, surface and volume/spatial charge densities. Gauss's law in integral and differential form/Symmetries of the physical problem. Parity under space inversion. Force on point, surface and volume/spatial charge densities. Work of the electric-force field. Conservation of energy in the electric-force field. Boundary conditions for the scalar potential and electric field.

• Electrostatics in matter. Electric polarization. Electric dipole/Force and torque. Multipole expansion of the scalar potential. Polarization mechanisms. Dielectrics. Bound charges of electric polarization. Electrical neutrality of dielectrics. Electrical displacement. Boundary conditions for the electrical displacement. Induced polarization: linear/nonlinear, homogeneous/heterogeneous, isotropic/anisotropic dielectrics. Permanent electrical polarization. Capacitors-Capacity. Poisson's/Laplace's equation for the scalar potential in dielectrics. Energy stored in dielectric materials. Force acting on dielectric materials.

• Magnetostatics in vacuum. Vector potential. Magnetic field. Generalized Biot-Savart Law for linear, surface and volume/spatial current densities. Ampere's law in integral and differential form/Symmetries of the physical problem. Parity under space inversion. Force on linear, surface and volume/spatial current densities. Work of the magnetic-force field. Conservation of energy in the magnetic-force field. Magnetic scalar pseudo-potential. Boundary conditions for the vector potential and magnetic field.

• Magnetostatics in matter. Magnetic polarization. Magnetic dipole/Force and torque. Multipole expansion of the vector potential. Polarization mechanisms. Magnetic materials. Bound currents of magnetic polarization. Magnetic induction. Boundary conditions for the magnetic induction. Induced magnetic polarization: linear/nonlinear, homogeneous/heterogeneous, isotropic/anisotropic diamagnetic, paramagnetic and ferromagnetic materials. Permanent magnetic polarization. Magnetic scalar pseudo-potential. Magnetic pseudo-charges. Multipole expansion of the magnetic scalar pseudo-potential. Poisson's/Laplace's equation of the magnetic pseudo-potential for the case of permanent magnets. Energy stored in magnetic materials. Force acting on magnetic materials.

• Law of induction. Maxwell's equations.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, e-class platform
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*	see table below
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 in Greek, Oral examination (when needed)

Activity	*Semester workload*
Lectures	39
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	82
Final written exams	3
Course Total	***150***

(5) ATTACHED BIBLIOGRAPHY

‘Introduction to Electrodynamics’, D. Griffiths, Cambridge University Press (2017)

‘Electrodynamics’, G. L. Pollack, D. R. Stump, Pearson (2005)

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y061**	**SEMESTER**	**6**
COURSE TITLE	**Introduction to Nuclear and Particle 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**
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS122/

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course is the first systematic introduction to the fundamental aspects of Nuclear and Particle. It provides the students with the knowledge of the basic building blocks of matter and the fundamental symmetries involved in the strong nuclear interactions that is essential of both scientific subjects. With the successful attendance and completion of the course, the student is in position to: • Describe the Fermionic and Bosonic character of matter based on the Strandard Model. • Understand the fundamental interactions among particles of matter. • Determine the stability or disintegration of nuclear matter based on conservation principles and fundamental symmetries. • Know the basic characteristics of nuclear structure and the radiation associated to its change. • Explain the existence of various subatomic particles based on the Standard Model and describe their interactions with Feynman diagrams. • Assess if a process is conserved or not based on fundamental symmetries and conservation laws. • Calculate the stability of nuclei against potential decays based on the liquid-drop model and the energy balance of nuclear reactions. • Evaluate nuclear radiation characteristics • Explain fundamental subatomic phenomena in basic and applied level • Evaluate theoretical models in comparison with experimental data • Organize the approach to questions and problems in a methodical and organized manner

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences 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
Respect for the natural environment
Criticism and self-criticism
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility
Creativity
Determination
Communication skills
Information management
Self control skills
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Characteristic scales and units, the standard model, quarks & leptons, conservation principles, relativistic kinematics.
- The field concept, interactions via boson exchange, Yukawa theory, Feynman diagrams, virtual particles, antiparticles, electromagnetic and weak interactions and their unification.
- Chromodynamics, strong interactions, symmetries (parity, charge conjugation, time reversal), static quark model, hadron classification.
- Properties of nuclei, valley of β-stability, semi-empirical formula, mirror nuclei.
- Charge distribution, scattering of electrons from nuclei, radioactivity, α-decay, tunneling effect.
- Nuclear potentials, deuterium, mean field theory, independent particle model, L-S coupling, nuclear shell model.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of video Projectors, specialized instrumentation (eg radiation detectors)
eclass platform, instructors websites, use of online databases</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>65</td></tr>
<tr><td>Seminars</td><td>15</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>65</td></tr>
<tr><td>Educational Visits</td><td>5</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving
Oral examination</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- *W.N. Gottingham & Greenwood (in translation), Introduction to Nuclear Physics, G & K. Dardanos Publishers, Athens 2002*
- *D.H. Perkins (in translation), Introduction to High Energy Physics, G & K. Dardanos Publishers, Athens 2002*

- Related academic journals:

- *Nature*
- *Scientific Reports*
- *Science*
- *Physical Review Letters*
- *Physical Review C*
- *Physical Review D*
- *Journal of High Energy Physics*
- *Journal of Instrumentation*
- *Nuclear Instruments and Methods in Physics Research A*
- *Nuclear Instruments and Methods in Physics Research B*
- *European Physics Journal A*
- *Journal of Physics G*
- *Physics Letters B*
- *Nuclear Physics A*
- *Nuclear Physics B*
- *arXiv.org Preprints*
- *Procedia*
- *IAEA Technical Reports*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y062**	SEMESTER	6
COURSE TITLE	INTRODUCTION TO SOLID STATE 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
Lectures (theory and exercises)	5	6

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in the English language for Erasmus students)
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS296/

(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 offers to the student the necessary knowledge for the understanding of basic concepts and methods of solid state physics, based on the microscopic structure of matter. With the completion of the course the student is able to: • Understand the crystal structure of solid matter and, more specifically, the concepts of Bravais lattice, unit cell, reciprocal lattice, as well as the principles of diffraction from periodic structures with applications on simple crystalline structures. • Distinguish the types of crystal bonds and calculate the cohesive energy of inert-gas and ionic crystals, as well as of metals using the quantum description of the free electron gas (metallic bonding-jellium model) in one, two and three dimensions. • Describe analytically the lattice vibrations and their dispersion relations in monoatomic or diatomic crystals and, also, understand the concept of phonons. • Understand the importance of periodicity of the structure and the potential in the formation of electronic energy bands in crystalline solids and be able to solve/interpret related simple problems/phenomena. • Analyze energy band diagrams of solids and, based on these diagrams, distinguish the materials into metals, semiconductors and insulators. Also, to calculate the energy band structure of solids by simple approximate methods. • Combine knowledge from classical mechanics, electromagnetism, quantum and statistical physics for the description of crystalline solids.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences: • Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Analytical and synthetic thinking • Critical thinking • Problem solving

(3) SYLLABUS

- The structure of solid matter. Bravais lattices. Unit cell.
- Reciprocal lattice. Diffraction from periodic structures. Bragg's law.
- Attractive and repulsive interactions in solids - cohesion (inert-gas and ionic crystals, metals).
- Lattice vibrations. Exact solution of the monoatomic and diatomic linear chain. Phonons.
- Electron states in a periodic potential. The Kronig - Penney model. Metals, semiconductors and insulators.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology).
Computer-aided lectures, use of overhead projectors, eclass platform.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>82</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Introduction to Solid State Physics, C. Kittel, SCIENTIFIC EDITIONS A. G. PNEVMATIKOS 1979, Athens
Solid State Physics, P. Varotsos and C. Alexopoulos, EDITIONS A. & S. SAVVALAS 1995, Athens
Solid State Physics, H. Ibach, H. Luth, EDITIONS P. & S. ZITI 2011, Thessaloniki

- Related academic journals: Physics Today, Scientific American

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	**Y065**	SEMESTER	6	
COURSE TITLE	Quantum Mechanics II			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)			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:	No			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students			
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS247/ https://eclass.uoa.gr/courses/PHYS143/			

(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 offers students advanced knowledge of quantum mechanics and mathematical techniques for the solution of complex physics problems at atomic scales or lower. Upon successful completion of the course, students will be: • Capable of using the Dirac formalism. • Familiar with the concepts of creation and destruction operators and their applications to the quantum simple harmonic oscillator as well as to a charged particle in a constant magnetic field. • In command of mathematical and physical aspects of quantum angular momentum. In particular, students will know the algebra and states of angular momentum, for both orbital angular momentum and spin. They will also be able to add angular momenta and to calculate the Clebsch-Gordan coefficients. • Able to analyze central potentials and will have solved the Schroedinger equation for Hydrogen-like atoms. • Familiar with key physics phenomena (Zeeman effect, Stark effect, the fine and superfine structure of the Hydrogen atom). • In command of the connection between spin and statistics, the interpretation of the Pauli exclusion principle, and its application to systems of identical particles. • Capable of using basic approximation methods such as: time-independent perturbation theory, including for systens exhibiting degeneracy, and the variational principle.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences: • Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Analytical and synthetic thinking • Problem solving	

(3) SYLLABUS

- Many-body Schrödinger’s equation, quantum mechanics in three dimensions.
- Orbital angular momentum, central potentials and the hydrogen atom.
- Dirac’s notation, harmonic oscillator (creation and annihilation operators), Schrodinger’s and Heisenberg’s picture.
- Angular momentum and spin, addition of angular momenta, identical particles and Pauli’s exclusion principle.
- Interaction of charged particles with electromagnetic fields, Zeeman effect, time-independent perturbation theory.
- The real hydrogen atom.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below

Activity	*Semester workload*
Lectures	39
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	85
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 exam in Greek

(5) ATTACHED BIBLIOGRAPHY

- **Κβαντομηχανική,** S. Trachanas, Πανεπιστημιακές εκδόσεις Κρήτης
- **Introduciton to Quantum Mechanics,** K. Tamvakis, Leader Books
- **Quantum Mechanics,** E. Merzbacher
- **Quantum Physics,** S. Gasiorowicz
- **K. Sfetsos,** course notes posted on e-class.
- **A. Karanikas & P. Sphicas,** course notes posted on e-class.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y0312**	SEMESTER	1
COURSE TITLE	Analysis I and Applications		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes(in Greeklanguage for Erasmus students)
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS234/

(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 provides a rigorous, systematic and an in-depth introduction in the analysis of functions on the real line.

With the completion of the course the student is able to:

- use mathematical induction to prove mathematical statements.
- know the definition of a limit and be able to establish the convergence or divergence of simple real sequences and series.
- understand the completeness of the real line and be able to use it to prove the basic properties of continuous functions.
- able to compute the derivatives and integrals of elementary functions.
- expand a function in its Taylor series.
- know how to define the exponential function and know how to graph exponential and trigonometric functions and their inverses.
- know the definition of a Riemann integral and be able to determine the integrability of simple functions.

General Competences

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

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

The course aims at the following general competences

Working Independently
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Natural numbers. Mathematical Induction. Rational, irrational and real numbers. The principle of completion. Bounded sets. Supremum and infimum of sets.
- Sequences of real numbers. Limits and convergence of sequences. The number e.
- Infinite Series and theorems about their convergence to a limit.
- Limits of functions. Continuous functions and their basic properties.
- Derivative. Taylor’s theorem. Radius of convergence of a power series.
- Graphs of exponential and trigonometric functions and of their inverses.
- Riemann integral. Fundamental theorem of integral calculus. Calculation of simple integrals.

(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*	**Yes** Electronic communication with the students usingICT (Information and Communications Technology), eclassplatform
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*	(see table below)

Activity	*Semester workload*
Lectures	52 hrs
Exercises	26 hrs
Seminars	-
Individual Study/Study and Analysis of bibliography / Preparation	72 hrs
CourseTotal	**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 in Greek Oral examination (when appropriate)

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography:

1. Spivak, M. – Διαφορικός και ολοκληρωτικός λογισμός. Πανεπιστημιακές εκδόσεις Κρήτης,
2. Πηχωρίδη, Σ. Κ. Απειροστικός λογισμός, Σάμος 2006
3. Burkill J. C. – A first course in mathematical analysis. Cambridge University Press, 1991.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y0314	SEMESTER	1
COURSE TITLE	PHYSICS I BASIC 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
Laboratory practice	2.5	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background and Skills Development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS157/

(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 is the first laboratory introduction to the concepts of experimenting, obtaining and processing data to confirm basic laws and principles of Physics. It includes basic concepts of statistical analysis and processing of experimental uncertainties (errors) related to the measurement.

With the successful attendance and completion of the course, the student is in position to:

- Understand the instrumentation and methodology required to run an experiment.
- Choose the physical quantities to be measured for the confirmation of a physical law.
- Recognize the importance and severity of the individual uncertainties (errors) involved in the measurement.

- Carry out basic physics experiments successfully.
- Handle and process the measured data correctly.
- Calculate the uncertainties (errors) of derived physical quantities from the primary data with the error propagation theory.
- Express correctly the typical statistical and systematic uncertainties of the measurement.

- Organize systematically the data obtained from the experiment.
- Graphically plot the measured data and the derived results.
- Critically evaluate and confirm the physical principle of the experiment.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Team work
Working in an interdisciplinary environment
Project planning and management
Respect for the natural environment
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Planning

New Technology skills
Creativity
Determination
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- The experimental methodology, measurement, experimental uncertainty, instrumentation, accuracy, results, graphical representations.
- Preparation and design of experiments, error propagation.
- Introduction to new technologies, interface, sensors PC, S / W (Logger Pro).
- Least square method, Error Calculation.
- A1. Applications of the Error Theory, Calculations.
- A2. Experimental procedures: The Simple Pendulum
- A3. Familiarization with the laboratory software.
- A4. New technologies in measurements.
- A5. Electrical circuits
- A6. Body dimensions and mass measurement: Density calculation, buoyancy and error propagation.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of video Projectors, eclass platform, instructors websites
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*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Oral examination Mid-term written examination

Activity	*Semester workload*
Seminars	8
Individual Study/ Study and Analysis of bibliography / Preparation	47
Laboratory practice	20
Course Total	**75**

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography*

- **PHYSICS I Laboratory Guide,** Collective Work, Edited by E. Stiliaris, Department of Physics, National & Kapodistrian University of Athens (2018)

- *Related academic journals:*

- American Journal of Physics
- Physics Education
- The Physics Teacher

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y0317	SEMESTER	1
COURSE TITLE	**Probabilities, Statistics and Applications of 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
Lectures (theory and exercises)	4	6
Laboratory practice		
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 BACKGOUND
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes,in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/MATH190/

(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 student acquires the necessary knowledge to understand the basic theory of probabilities and statistical analysis of experimental data. In relation to physical problems, the basic analytic and computational methodologies are introduced in order to solve probability and statistical problems With the completion of the course the student is able to: • Describe and relates the theoretical distributions with specific problems • Select the adequate statistical method according to the defined data and the problem structure • interpret the results deriving from the application of statistical methods • generalise conclusions related with the sample • calculate various statistical parameters and confidence intervals • find the relationship between two variables based on sampling data • develop analytical/computational method to solve physical problems • evaluate and compare the results derived from different methods

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Adapting to new situations Decision-making Working independently Working in an international environment Working in an interdisciplinary environment Project planning and management Criticism and self-criticism Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management Taking initiative/responsibility New Technology skills	

Learning C / Matlab programming language ...
Learning word/excel/ppt/ origin/spss
Creativity
Information management
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Basic probability definitions, combinatorics for probability selection with and without replacement.
- Random variables and distributions, discrete and continuous distributions,asymptotic results, central limit theory
- Descriptive statistics,data grouping,measures of central tendency and variance.
- Hypothesis Tests, significance tests for the mean value and variance of normal populations,significance test of the correlation coefficient, goodness of fit tests.
- Computational applications: Introduction to Monte Carlo methods and computational applications in estimating probabilities.
- Introduction to parameter estimation methods,computational implementation and applications of the method of moments, mean value, variance, higher moments, omputational implementation and applications of the least square method.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, Eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>27</td></tr>
<tr><td>Exercises</td><td>25</td></tr>
<tr><td>Seminars</td><td></td></tr>
<tr><td>Individual Study/Study and Analysis of bibliography / Preparation/Exams</td><td>98</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>CourseTotal</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek using problem solving and open ended questions
Oral exams when it is required.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- ***Suggested bibliography***
1. Introduction to Probabilities and Statistics , C. Damianos, N. Papadatos, C.. Charalabidis, 2010, Symmetria Publisher
2. Lessons of Applied Statistics, Livada I and D. Asimakopoulos, 2010, Athanasopoulos Publisher
3. Elements of Probabilties with emphasis on statistics and informatics, J. Kontogiannis and S. Toubis, 2015, Heallink
4. Probabilities and Statistics for engineers, Milonas N. and Papadopoulos V., 2017, Tziola Publisher

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y0321**	**SEMESTER**	**2**
COURSE TITLE	**Ordinary Differential Equations and Linear Algebra**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/MATH586/*

(2) LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*

The purpose of this course is the strict, systematic and in deep development of the theory of the Ordinary Differential Equations as well as their applications in specific problems in the field of Physics. With the successful attending and completing of the course, the student is in position to:

- Being able to solve in closed form first order differential equations of various specific forms (separable differential equations, first order linear differential equations, Bernoulli, Ricatti, exact first order differential equations).
- Being able to apply the fundamental theorem of existence and uniqueness for initial value problems.
- Being able to make the qualitative analysis of a differential equation: to find and draw the equilibrium points, to make the phase diagram, to study the bifurcation points and draw the bifurcation diagram.
- Being able to apply solving techniques for second order linear differential equations (general theory, method of order reduction, method of variation of parameters, method of undetermined coefficients).
- Being able to apply the power series method in order to solve second order linear differential equations.
- Being able to solve boundary value problems Sturm - Liouville.
- Being able to apply the Laplace transformation in order to solve initial value problems.

Linear Algebra: The main objective of this course is to familiarize the students with the basic notions, methods and techniques of Elementary Linear Algebra and to provide them with the tools needed for problem solving, especially in the field of Physics.
This course is divided into the following parts with basic goals:
1. Basic Matrix Theory: The students should get familiar with the concept of the matrix and its relevant notions, such as the determinant of a square matrix and its basic properties. The students should be able to easily carry out the basic operations on matrices and calculate the inverse of a non-singular square matrix using either row or column operations or by means of determinants. The students must also be able to apply these techniques to the solution of systems of linear equations.
2. Vector Spaces and linear mappings: The students should be in a position to understand the concept of a linear space and give examples of vector spaces taken from several disciplines of mathematics. It is very important for them to understand the notions of linear dependence or independence of a given set of vectors and use the appropriate criteria in order to assert whether a set of vectors is linearly independent or not. The concept of a basis of a vector space is of fundamental importance and the students should be in a position to consider it as a maximal linearly independent set of vectors.
Another basic concept which the students should get familiar with is that of a linear mapping between vector spaces. The relation between linear maps and their corresponding matrices (with respect to given bases of the vector spaces) is also fundamental and the students should be capable of recognizing it.
3. Eigenvalues, eigenvectors and diagonalizable matrices: The students should be able to calculate the characteristic polynomial of a square matrix and determine its eigenvalues and their corresponding eigenvectors. It is matter of great importance that the students should be able to

assert whether a given square matrix is diagonalizable or not. Last but not least the students should be able to apply this theory to several interesting problems, such as that the explicit determination of the n^{th} term of a sequence defined recursively (for instance the Fibonacci sequence) or the solution of a linear system of differential equations with constant coefficients

General Competences

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

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

The course aims at the following general competences

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
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility
New Technology skills
Learning C / Matlab programming language ...
Learning word/excel/ppt/ origin/spss
Creativity
Determination
Communication skills
Information management
Self control skills
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- 1st order differential equations of special forms.
- Existence of solutions, unambiguous solutions, scalability of solutions, well-defined problems.
- 2nd order linear differential equations: General theory of homogeneous and non-homogenous differential equations.
- Mathematical series.
- Sturm-Liouville Problems.
- Laplace Transformation.
- Brief introduction to the qualitative theory of common differential equations.
- Linear spaces.
- Linear transformations.
- Determinants.
- Eigenvalues and eigenvectors.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology),
eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>72</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek

(oral examination when appropriate)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

1. Συνήθεις Διαφορικές Εξισώσεις, Ν. Αλικάκος, Γρ. Καλογερόπουλος, ΣΥΓΧΡΟΝΗ ΕΚΔΟΤΙΚΗ ΕΚΔΟΣΕΙΣ ΣΥΜΜΕΤΡΙΑ, 2003, Αθήνα

2. Στοιχειώδεις Διαφορικές Εξισώσεις και Προβλήματα Συναριακών Τιμών, ,W. E. Boyce, R.C. Di Prima, Μετάφραση- επιμέλεια, Λ. Παπαλουκάς, ΠΑΝΕΠΙΣΤΗΜΙΑΚΕΣ ΕΚΔΟΣΕΙΣ ΕΜΠ, 2015, Αθήνα

3. ΜΙΑ ΕΙΣΑΓΩΓΗ ΣΤΗ ΓΡΑΜΜΙΚΗ ΑΛΓΕΒΡΑ, ΒΑΡΣΟΣ ΔΗΜΗΤΡΗΣ, ΔΕΡΙΖΙΩΤΗΣ ΔΗΜΗΤΡΗΣ, ΕΜΜΑΝΟΥΗΛ ΓΙΑΝΝΗΣ, ΜΑΛΙΑΚΑΣ ΜΗΧΑΛΗΣ, ΜΕΛΑΣ ΑΝΤΩΝΗΣ, ΤΑΛΕΛΛΗ ΟΛΥΜΠΙΑ, 2012, Εκδότης: "σοφία"

4. Γραμμική άλγεβρα, Δονάτος Γεώργιος Σ., Αδάμ Μαρία Χ., 2008, Εκδότης: Γ. ΔΑΡΔΑΝΟΣ - Κ. ΔΑΡΔΑΝΟΣ Ο.Ε.

COURSE OUTLINE

(1) GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Physics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>Y0323</td><td>SEMESTER</td><td>2</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">ANALYSIS II and APPLICATIONS</td></tr>
<tr><td colspan="2">INDEPENDENT TEACHING ACTIVITIES
if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="2">Lectures (theory and exercises)</td><td>6</td><td>6</td></tr>
<tr><td colspan="2">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="3">General background</td></tr>
<tr><td>PREREQUISITE COURSES:</td><td colspan="3">No</td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td><td colspan="3">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="3">Yes, in the English language for Erasmus students</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="3">eclass platform:

https://eclass.uoa.gr/courses/MATH147</td></tr>
</table>

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

In this course the student acquires the basic knowledge on multivariable and vector valued functions. This mathematical knowledge is necessary for the understanding of the physical laws and the ability to deal with problems that appear in all physics classes in the following semesters.

With the completion of the course the student is able to:

Understand the formulation of physical phenomena that take place in the real three-dimensional space and laws that the variables involved are vectors.

Approximately elaborate on useful and complicated expressions by expanding in appropriate parameters.

Make use of differential and integral calculus to resolve problems in the three-dimensional space, as well as, restricted on subsets (curves and surfaces) of it.

General Competences

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

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

The course aims at the following general competences

Working independently

Team work

Production of free, creative and inductive thinking

Analytical and synthetic thinking

Time management

Problem solving

(3) SYLLABUS

- Vectors, vector functions, inner and outer product, lines, planes, surfaces, arc length, unit tangent vector, TNB frame, multivariable functions, derivatives, limit, continuity.
- Partial derivatives, chain differentiation, directional derivative, tangent planes, linearization, differentials, extrema and saddle points.
- Lagrange multipliers, partial derivatives of functions under constraints, Taylor's theorem for multivariable functions.
- Curvilinear coordinate systems, norm, gradient, divergence and curl.
- Double and triple integrals in Cartesian and other coordinates, applications to the evaluation of areas, moments of inertia and centers of mass, change of variables (Jacobian determinants).
- Integration of vector fields, line and surface integrals, path independence, potential functions and conservative fields, Green, Gauss and Stokes theorems and applications.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**Yes** eclass platform
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*	see workload table below
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 in Greek

Activity	*Semester workload*
Lectures	52
Seminars	26
Individual Study/ Study and Analysis of bibliography / Preparation	72
Course Total	***150***

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography :

Διανυσματικός Λογισμός, Marsden J., A. Tromba, ΙΤΕ ΠΑΝ/ΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ,

Απειροστικός Λογισμός *(σε έναν Τόμο),* B. Tomas, ΙΤΕ ΠΑΝ/ΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ,

Απειροστικός Λογισμός σε πολλές μεταβλητές, Τ. Χατζηαφράτης, ΕΚΔΟΣΕΙΣ Σ.ΑΘΑΝΑΣΟΠΟΥΛΟΣ& ΣΙΑ Ο.Ε,

Εφαρμοσμένος Απειροστικός Λογισμός, Λ.Ν. Τσίτσας, ΕΚΔΟΣΕΙΣ Σ.ΑΘΑΝΑΣΟΠΟΥΛΟΣ& ΣΙΑ Ο.Ε,

Μαθηματικά ΙΙ, Β’ έκδοση, Θ. Μ. Ρασσίας, ΕΚΔΟΣΕΙΣ ΑΘ. ΤΣΟΤΡΑΣ

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y0323**	**SEMESTER**	**2**
COURSE TITLE	Physics II (Heat 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**
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS168/

(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 provides the student with an introduction to the kinetic theory of gases as well as the fundamental principles of thermodynamics. It also provides knowledge related to Geometric optics (reflection, refraction, mirrors, lenses, prisms), oscillations and waves (i.e., wave equation, planar and spherical waves, superposition of waves, interference, diffraction and polarization). In this context, the case of sound waves and the Doppler effect are discussed.

With the completion of the course the student is able to

Determine the physical quantities that characterize the thermodynamic equilibrium, describe the laws of thermodynamics as well as the basic cyclic processes (e.g., Carnot, Otto, etc.).
Describe and prove the laws of reflection and refraction based on appropriate basic principles (Heron, Fermat, Huygens).
Describe wave propagation through the wave differential equation and recognize in the case of one dimension (tensioned string) the energy density and momentum density that a wave carries.

Explain the law of gases based on kinetic theory and calculate the characteristic velocities of the molecules (mean, root mean squared and probable) by the Maxwell-Boltzmann distribution.
To calculate using geometric optics the path of the rays passing through mirrors, lenses and refractive surfaces.
To examine the phenomenon of dispersion in waves and to discover the main physical quantities necessary for its description (group and phase velocities, normal or anomalous dispersion).

Analyze complex problems in physics and determine the basic physical quantities that describe them.
Organize concepts and physical laws in order to propose solutions to problems of thermodynamics, geometric optics and waves.
Differentiate the description of physical phenomena from different theories and evaluate their results for the measured physical quantities.

General Competences

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

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

The course aims at the following general competences

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

Decision-making
Working independently
Production of new research ideas
Respect for the natural environment
Criticism and self-criticism
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility
New Technology skills
Creativity
Communication skills
Information management
Problem solving

(3) SYLLABUS

- Ideal gas, kinetic theory of gases, Maxwell distribution, temperature, internal energy, heat capacity.
- Work, heat, first and second law of thermodynamics, reversible processes, entropy, thermal engines.
- Oscillations and waves, wave equation, plane and spherical waves.
- Superposition, interference, diffraction, polarization, sound waves, Doppler effect.
- Geometrical optics (reflection, refraction), mirrors, lenses, prisms.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below
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 examinations in Greek related to problem solving. Oral examinations (where required) related to problem solving. Mid-term written examination dealing with problem solving. Solutions to the exam problems are accessible to students at the meeting where they are invited to see their papers.

Activity	***Semester workload***
Lectures	52
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	72
Course Total	***150***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *Teaching notes (available in the website of the course in eclass).*
- *Physics (D.Hallidey, R. Resnick, J. Walker) In Greek: Φυσική (Ενιαίο), D.Hallidey, R. Resnick, J. Walker, Κ. Παπανικόλας, Γ. Τζαμτζής, Α. Καραμπαρμπούνης, Σ. Κοέν, Π. Σπυράκης, Ε. Στυλιάρης, Π. Τζανετάκης, ΕΚΔΟΣΕΙΣ Γ. ΔΑΡΔΑΝΟΣ-Κ. ΔΑΡΔΑΝΟΣ Ο.Ε., 2014, Αθήνα (Κωδ. Ευδ. 41959145)*
- *Physics for Scientists and Engineers (D.C.Giancoli) In Greek: Φυσική για Επιστήμονες και Μηχανικούς, Τόμος Α (4η έκδοση), D.C.Giancoli (Επιμέλεια): Α. Κεχαγιάς, Κ. Σφέτσος, Γ. Τσιπολίτης, ΕΚΔΟΣΕΙΣ Α.ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε, 2011, Αθήνα (Κωδ. Ευδ. 18549052)*
- *Introduction to Heat and Thermodynamics (I. Grammatikakis) In Greek: Εισαγωγή στη Θερμότητα και τη Θερμοδυναμική, Ι. Γραμματικάκης, LIBERAL BOOKS ΜΟΝΟΠΡΟΣΩΠΗ ΕΠΕ, 2012, Αθήνα (Κωδ. Ευδ. 50659197)*
- *University Physicswith Modern Physics (H. Young, R. Freedman) In Greek: Πανεπιστημιακή Φυσική με σύγχρονη Φυσική, Τόμος Β΄ (2η έκδοση), H. Young, R. Freedman, ΕΚΔΟΣΕΙΣ ΠΑΠΑΖΗΣΗ, 2010, Αθήνα (Κωδ. Ευδ. 68387930)*
- *Physics, Vol. A, Mechanics-Thermodynamics (H. Ohanian) In Greek: Φυσική, Τόμος Α' : Μηχανική – Θερμοδυναμική, H. Ohanian, μετάφραση Α. Φίλιππας, ΕΚΔΟΣΕΙΣ Σ. ΑΘΑΝΑΣΟΠΟΥΛΟΣ και ΣΙΑ, 1991, Αθήνα (Κωδ. Ευδ. 45333)*
- *Physics, Vol. B' (D.Hallidey, R. Resnick, J. Walker) In Greek: Φυσική Τόμος Β', D.Hallidey, R. ResnicK, J. Walker, Κ. Παπανικόλας, (Γενική Επιμέλεια), Γ. Τζαμτζής (συντονισμός), Α.Καραμπαρμπούνης Σ. Κοέν, Π. Σπυράκης, Ε. Στυλιάρης, Π. Τζανετάκης, ΕΚΔΟΣΕΙΣ Γ. ΔΑΡΔΑΝΟΣ-Κ. ΔΑΡΔΑΝΟΣ Ο.Ε., 2013, Αθήνα (Κωδ. Ευδ. 33074361)*
- *Physics for Scientists and Engineers (R. Serway, J. Jewett) Φυσική για Επιστήμονες και Μηχανικούς: Μηχανική, Ταλαντώσεις και Μηχ. Κύματα, Θερμοδυναμική Σχετικότητα, R. Serway, J. Jewett, ΕΚΔΟΣΕΙΣ ΚΛΕΙΔΑΡΙΘΜΟΣ, 2012, Αθήνα (Κωδ. Ευδ. 22750100)*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y0324**	**SEMESTER**	**2**
COURSE TITLE	**PHYSICS II BASIC 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**
Laboratory practice	2.5	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background and Skills Development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS179/

(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 provides the student with the opportunity to practice experimental arrangements and to complement his knowledge of understanding physical magnitudes associated with motion of bodies, such as speed, acceleration, mass, power, work, energy, momentum, spin, and the thermodynamic magnitudes of temperature and pressure to be used by statistical distributions to solve problems.

With the completion of the course the student is able to

- Identifies the physical laws involved in the experiments underway.
- Identifies the instruments of the experimental devices and the sizes they measure.
- Identifies operating limits and instrument errors.
- Recognizes the appropriate software for capturing experimental values of the sizes.

- Selects the appropriate instruments for experimental arrangements.
- Performs experiments and collects experimental data.
- Calculates the values of the physical sizes involved in each experimental process.

- Composing experimental arrangements.
- Analyzes experimental data, computes sizes and presents them using tables and graphs.
- Evaluates the results of measurements in relation to the corresponding Engineering laws.
- Explains the physical sizes and laws involved in the respective experiments.
- Supports his conclusions in writing.

General Competences

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

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

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

The course aims at the following general competences

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

Adapting to new situations

Decision-making

Working independently

Team work

Working in an interdisciplinary environment

Production of new research ideas

Project planning and management

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

Analytical and synthetic thinking

Critical thinking

Time management

Planning

Taking initiative/responsibility

New Technology skills

Learning word/excel/

Creativity

Determination

Communication skills

Information management

Self control skills

Meeting Deadlines and Keeping Schedules

Flexibility / Adaptability

Problem solving

(3) SYLLABUS

- Harmonic oscillator.
- Atwood engine (using photogates).
- 2^{nd} and 3^{rd} Newton's laws of motion, impulse and collisions.
- The Cavendish experiment.
- Rigid body rotation, moments of inertia, static and kinetic friction.
- Natural and rotational pendulum.
- Ideal gas processes using sensors and computers.
- study of statistical distributions

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	(see table below)

Activity	***Semester workload***
Exercises	
Seminars	6
Individual Study/ Study and Analysis of bibliography / Preparation	25
Laboratory practice	20
Writing reports/ essays	24
Course Total	**75**

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 in Greek Open-ended questions, Problem solving Oral examination Writing essays Laboratory reports

(5) ATTACHED BIBLIOGRAPHY

- - Φυσική (1η έκδοση) (Τόμος 1) D. Halliday, R. Resnick, J. Walker (γεν. Επιμέλεια)Κ. Παπανικόλας, Α.ΚαραμπαρμπούνηςΣ. Κοέν, Π. Σπυράκης
- ΠανεπιστημιακήΦυσική, ΤόμοςΑ, Hugh D. Young
- Φυσική για επιστήμονες & μηχανικούς, Τόμος Α, Giancoli

COURSE OUTLINE

(1) GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="4">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="4">Physics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="4">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>Y0333</td><td colspan="2">SEMESTER</td><td>3</td></tr>
<tr><td>COURSE TITLE</td><td colspan="4">Physics III Basic Laboratory</td></tr>
<tr><td colspan="3">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</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="3">Laboratory practice</td><td>2.5</td><td>3</td></tr>
<tr><td colspan="3">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="4">General Background και Skills Development</td></tr>
<tr><td>PREREQUISITE COURSES:</td><td colspan="4">No</td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td><td colspan="4">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="4">Yes, in the English language for Erasmus students</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="4">https://eclass.uoa.gr/courses/PHYS204</td></tr>
</table>

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The course offers to the student via a series of laboratory experiments,the necessary knowledgefor the comprehension and deeper understanding of the theory of Thermodynamics, Optics and Wave Mechanics as well as deepen their knowledge about experimental methods and instruments, which will be used in problem solving. Additionally, the university students are teaching the basic principles of Physics at school students.

By successfully attending and completing the course, the student should:

To use prism and grating spectrometers for the spectral analysis of light and the measurement of light wavelength and the dispersion relation of the glass refraction index.

Measure the propagation velocity of elastic waves in solid rods and the normal modes - eigenfrequencies (Fourier analysis). Measure the Young modulus.

Determine the focal length of convex lenses and relevant aberration errors (spherical, chromatic).

Define and analyze light polarization by using suitable optical elements (polarizers, retardation plates) and measure the Brewster angle and the optical activity of materials. Familiarize with the notions linear, cyclic, elliptical polarized light. Measure the angle of rotation of the polarization plane.

Use Michelson interferometer for the understanding of optical interference phenomena. Measure the wavelength of monochromatic light, and the refraction index of air and glass.

Familiarize with notions of Thermodynamics, taking experimental measurements (pressure, temperature, volume)by using computers and Logger Pro software. Study experimentally isothermal compression and expansionand the Otto cycle(adiabaticcompression, isochoric heat absorption, adiabatic expansion, isochoric heat dissipation).

Study wave phenomena by using microwaves (reflection, refraction, polarization, interference,diffraction, standing waves). Familiarize with notions like phase and path difference, near field- Fresnel diffractionand καιdistantfield - Fraunhofer diffraction. Use software to construct plotsand compareexperiment withtheory.

Study the Doppler effect using χρησιμοποιώντας (ultra)sound waves. Confirm the variation offrequency perceived by stationary observeras a function of the speed of the source.Calculate the speed of (ultra)sound in air. Use software to construct plots.

Determine the correct physical quantities from the sets of the experimentalmeasurements, based on data reduction and error analysis.

General Competences

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

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

With successful completion and examination of the course, the aim is that the student acquires the following general competences and skills:

Analysis and synthesis of data and information, with the use of the necessary technology. Working independently. Team work. Criticism and self-criticism. Time management. Planning. Taking initiative/responsibility. New Technology skills. Learning software for processing measurements and text like Logger Pro, excel, origin, word, excel. Communication skills. Information management. Self control skills. Meeting Deadlines and Keeping Schedules. Teaching skills

(3) SYLLABUS

Prism and grating spectrometers. Study of isothermal process of a gas and the Otto cycle. Measurement of the speed of longitudinal waves and elastic constants in solids. Normal modes - Fourier analysis. Measurement of convex lenses focal distance and relevant aberration errors. Dispersion. Study of polarized light. Measurement of rotation capacity by polarimeter. Measurements with Michelson interferometer. Study of wave phenomena with microwaves. Study of Doppler effect in air. Reflection, refraction, polarization, interference, diffraction, standing waves.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology). Computer-aided lectures.E-class:

https://eclass.uoa.gr/courses/PHYS204</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Laboratorypractice</td><td>20</td></tr>
<tr><td>Individual study.Study and analysis of bibliography. Preparation.</td><td>20</td></tr>
<tr><td>Writing reports/ essays</td><td>25</td></tr>
<tr><td>Presentations</td><td>10</td></tr>
<tr><td>Course Total</td><td>75</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Oral examination.
Laboratory reports.
Essay presentation

The course consists of 8 laboratory exercises (experiments). For each, there is oral examination during the conduction of the experiments by the students. Students have to prepare and submit a laboratory report one week after the experiment. Furthermore, the university students are presenting as a small course/presentation at school students the basic principles of Physics. The final grade includes the oral examination of each experiment, the presentation and the laboratory reports.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography:

Laboratory Guide: PHYSICS III Laboratory Thermodynamics - Wave mechanics - Optics, NKUA, 2018

R. Serway, Physics for Scientists and Engineers, ΜετάφρασηΛ. Ρεσβάνη, ΤόμοςIII, Θερμοδυναμική - Κυματική - Οπτική, 1991

L. Kinsler, A. Frey, A. Coppens, and J. Sanders, Fundamentals of acoustics, John Wiley.

H. J. Pain, Φυσική των ταλαντώσεων και των κυμάτων, Συμμετρία, Αθήνα, 1991.

M. Alonso, E. Finn, Θεμελιώδης Πανεπιστημιακή Φυσική, Τόμος ΙΙ, Πεδία και Κύματα, Μέρος 3 Κύματα, 1979, Εκδόσεις Αναστάσιος Φίλιππας.

F. A. Jenkins and H. E. White, Principles of Optics, McGraw-Hill, New York, 1976.

Ν. Παναγέας: Εφαρμογή νέων τεχνολογιών στα εργαστήρια Θερμοδυναμικής, Διπλωματική Εργασία, Αθήνα 2010.

Χ. Τρικαλινός, Μοριακή Φυσική Θερμοδυναμική, αυτοέκδοση, Αθήνα, 2009.

A. K. Kikoin and I. K. Kikoin, Molecular Physics, Mir Publishers, Moscow, 1978.

A. N. Matveev, Molecular Physics, Mir Publishers, Moscow, 1985.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y0338	SEMESTER	3
COURSE TITLE	COMPUTATIONAL 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
Lectures (theory and exercises)	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*General Background*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS192/

(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 students acquire the necessary knowledge, skills and competences for the numerical solution of complex problems and the simulation of complex phenomena. Using examples mostly from physics, the course introduces the students to algorithmic thinking and provides them with the basic methodologies to solve problems that cannot be addressed analytically as well as the methods to evaluate the results uncertainties. With the completion of the course the student is able to: • Evaluate numerically roots of equations and systems. • Employ numerical interpolation and fitting procedures on experimental data • Calculate derivatives and integrals • Solve differential equations • Perform Mont Carlo simulations • Evaluate the results of the calculations and estimate the uncertainties of the numerical solutions • Propose the appropriate numerical scheme according to the problem
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences: 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 Analytical and synthetic thinking Critical thinking Time management New Technology skills Learning C / Matlab programming language ... Learning root or equivalent Creativity Self control skills Meeting Deadlines and Keeping Schedules Problem solving

(3) SYLLABUS

- Numerical calculations and uncertainties
- Numerical solution of algebraic equations of one variable
- Numerical solution of systems of algebraic equations
- Polynomial interpolation
- Numerical differentiation
- Numerical integration
- Numerical solution of ordinary differential equations.
- Numerical solution of partial differential equations.
- Introduction to Monte Carlo methods.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below
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 in Greek Open-ended questions, Problem solving. Oral examination, when necessary. Written essays with submission deadlines.

Activity	*Semester workload*
Lectures	26
Exercises	*26*
Individual Study/ Study and Analysis of bibliography / Preparation	40
Writing reports/ essays	55
Exams	3
Course Total	***150***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

Αριθμητική Ανάλυση, Ν. Μισυρλής, ΕΚΠΑ (2017)

Αριθμητικές Υπολογιστικές Μέθοδοι στην Επιστήμη και τη Μηχανική, Prozrikidis C, ΕΚΔΟΣΕΙΣ ΤΖΙΟΛΑ (2006)

Αριθμητική Ανάλυση με εφαρμογές σε MATHEMATICA και MATLAB, Γ. Παπαγεωργίου, Χ. Τσίτουρας, ΕΚΔΟΣΕΙΣ Α. ΤΣΟΤΡΑΣ (2015)

Υπολογιστική Φυσική, Κ. Αναγνωστόπουλος, Ηλεκτρονικό Βιβλίο (2016)

Σημειώσεις Διδασκόντων

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y0343	SEMESTER	4
COURSE TITLE	Physics IV Basic 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
Laboratory practice	2	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background and Skills Development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes,in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS201/

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
In this laboratory course the students, through the corresponding laboratory experiments, consolidate the necessary knowledge concerning electromagnetism and modern physics which have already been taught in previous courses. Additionally, the university students are teaching the basic principles of Physics at school students. With the completion of the course the students are able to describe the operation of the experimental devices and at the same time, to understand and be able to explain in detail the theoretical background and the physical phenomena that are being studied. With the completion of the course the students are able to understand and explain in detail the basic concepts of Electromagnetism and modern Physics, where the laboratory experiments are based. With the completion of the course the students are able to evaluate the experimental results and propose methods and ways to make their outcomes more accurate.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Team work Production of free, creative and inductive thinking Analytical and synthetic thinking Planning New Technology skills Creativity Communication skills Information management Meeting Deadlines and Keeping Schedules Problemsolving Teaching skills	

(3) SYLLABUS

- Magnetic field of circular conductors and coils, Biot-Savart law.
- Study of RLC resonance circuit – use of oscilloscope.
- Power generation, Lenz's law (motor, generator, stroboscope).
- Motion of electrons in a homogenous magnetic field, measurement of charge-to-mass ratio.
- Hall effect, conductors, carriers calculation.
- Spectroscopy, spectral lines and Bohr’s theory.
- Photoelectric effect.
- Transformers: operation and current-voltage characteristics.

(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*	**Yes** Electronic communication with the students usingICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclassplatform
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*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Oral examination Writing essays Essay presentation Laboratory reports

Activity	*Semester workload*
Individual Study/Study and Analysis of bibliography / Preparation	18
Laboratorypractice	16
Writing reports/ essays	25
Presentations	6
InteractiveTeaching	*10*
CourseTotal	***75***

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography

R.A. SerwayPhysics, Τόμος ΙΙ, Ηλεκτρομαγνητισμός,
DavidJ.Griffiths, Εισαγωγή στην Ηλεκτροδυναμική, Πανεπιστημιακές Εκδόσεις Κρήτης, 2012

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	Y0345		SEMESTER	4
COURSE TITLE	Physics IV (Modern 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
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS183/

(2) LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The course aims at introducing the fundamental principles of Modern Physics (quantum mechanics, atomic and subatomic physics) as well as in the perception of scientific methodology (theory-experiment) that led to the great discoveries in the field of physics. Upon completion of the course the student will be able to: With the completion of the course the student is able to •To know and apply relativistic definitions of quantities such as momentum and energy. • To recognize and understand the experimental results that contradict the predictions of classical physics and highlight the particle nature of light and the wave nature of the particles. • Understand the meaning of a wave function of a particle and its connection to the probability of finding it in space. • Understand the solutions of Schrödinger's equation for simple one-dimensional problems and their consequences (such as quantum energy, tunneling effect). • Use Heisenberg's Uncertainty Principle, mainly for estimates of size classes. • Calculate typical quantities of atoms with one electron. • Analyze the cumulative properties of multi-electron atoms. • Describe qualitatively the structure of molecular bonds and spectra. • Describe the characteristics of nuclear matter. • Calculate typical quantities in nuclear reactions •Understand the combined progress and synergy of experiment and theory that led to the Standard Model of Elementary Particles • Understand and apply conservation laws to particle physics. • Combine the above knowledge to draw qualitative and quantitative solutions/answers on complex physics problems. • Evaluate the results of his/her calculations.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Adapting to new situations Decision-making	

Working independently Team work Production of new research ideas Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Taking initiative/responsibility Creativity Determination Meeting Deadlines and Keeping Schedules Flexibility / Adaptability Problem solving

(3) SYLLABUS

• Relativistic energy and momentum of particles. Quantization of energy and momentum, invariant mass. Black body radiation. Photoelectric effect. Compton effect. Bremsstrahlung radiation. Creation - destruction of particle-antiparticle pair.

• De Broglie waves. Heisenberg's uncertainty principle. Two slit experiment. Probability density. Wave function, Schrödinger equation, problems with infinite and finite potential wells.

• Bohr's model. The quantum mechanical atomic model. The hydrogen atom.

• Angular momentum and Spin. Magnetic Moments. Fine structure.

• The exclusion principle. Atomic spectra. Lasers and their applications.

• Molecular bonds. Metals and Semiconductors. Superconductivity. Nuclear properties. Nuclear Structure. Nuclear decays.

• Fission process. Fusion process. Elementary particles and interactions. Accelerators. Particle interaction with matter. Detectors.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Seminars</td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>69</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Writing reports/ essays/exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exam in Greek, with problem solving covering the entire course.

Oral examinations where appropriate.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

Modern Physics, Beiser Arthur, ΕΚΔΟΣΕΙΣ Γ. ΔΑΡΔΑΝΟΣ-Κ. ΔΑΡΔΑΝΟΣ Ο.Ε (2001)

University Physics, Part B, HughD. Young, ΕΚΔΟΣΕΙΣ ΠΑΠΑΖΗΣΗ ΑΕΒΕ (1994)

Physics for Scientists and Engineers Part B, Giancoli, ΕΚΔΟΣΕΙΣ ΤΖΙΟΛΑ & ΥΙΟΙ (2011)

Physics Part B, D. Hallidey, R. ResnicK, J. Walker, ΕΚΔΟΣΕΙΣ Γ. ΔΑΡΔΑΝΟΣ-Κ. ΔΑΡΔΑΝΟΣ Ο.Ε (2013)

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y0347**	**SEMESTER**	**4**
COURSE TITLE	**States and properties of matter.**		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	**General background.**
PREREQUISITE COURSES:	**No**
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	**Greek**
IS THE COURSE OFFERED TO ERASMUS STUDENTS	**Yes, in the English language for Erasmus students**
COURSE WEBSITE (URL)	**e-class: https://eclass.uoa.gr/courses/PHYS196/ and https://eclass.uoa.gr/courses/PHYS197/**

(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*

Synoptically:

The aim of this course is to introduce students to -- and deepen their knowledge about:

(α΄) States of matter. By successfully attending and completing the course, the student should:

Learn the states of matter in the visible universe.

Familiarize with different categories of solids (periodic and quasi crystals, amorphous, fractals).

Understand self-similarity, whish e.g. can be found in quasi crystals and fractals.

Move from the world of ideal gases to real gases and liquids.

Learn in brief what is plasma, the most common state of matter in the visible universe.

Familiarize with elementary particles in order to discriminate bosons and fermions. Be introduced to Bose- Einstein condensate.

Learn to use phase diagrams and state equations.

Familiarize with crystals and crystal lattices in 1, 2, 3 dimensions.

Study states or phase transitions.

For the first time be introduced systematically to symmetry: symmetry types, operations, point in molecules and lattices.

Learn the size of atoms and molecules, the bonds between atoms and hybridization.

(β΄) Properties of matter:

Understand the notions of elasticity, plasticity, rupture as well as the relevant microscopic mechanisms.

Learn the fundamental notions of stress and strain and their interconnections.

Understand the mechanism of coupling among perpendicular directions in elasticity and how to apply the principle of superposition.

See how Navier-Stokes equation arrives from general deformation as well as understand the physical meaning of its terms.

Understand viscoelasticity, the deformation mechanisms of fluids and the variety of their responses to stresses.

Understand the notions of flux and flux density as well as the common description of the transport phenomena.

Learn the laws of transport phenomena.

Understand the notion of surface tension and when the later is important.

Discover the multitude of everyday phenomena related to surface tension.

Understand the cohesive and coherent forces.

Understand the Laplace pressure, and to get familiar with wetting, capillarity and capillary condensation.

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…
…….

With successful completion and examination of the course, the aim is that the student acquires the following general competences and skills:

Search for, analysis and synthesis of data and information. Working independently.
Criticism and self-criticism. Production of free, creative and inductive thinking. Analytical and synthetic thinking. Critical thinking New Technology skills

(3) SYLLABUS

(α΄) States of matter. Analytically:

Introduction to the states of matter. "Elementary particles": bosons and fermions. States of matter. Phase or state transitions. Phase diagrams. Bose - Einstein condensate. Plasma. Classification of solid into periodic and quasi crystals, amorphous and fractals. Self-similarity. Classification of liquids and gases into ideal and real. Shape of atomic orbitals. Symmetries. Bonds between atoms. Hybridization.

Solids. Basics notions of crystal lattices and crystals. Symmetry of lattices and molecules. Symmetry types, operations, point groups in molecules and lattices. Classification of point groups. Crystal lattices in 1, 2, 3 dimensions. Crystals. Inverse lattice. Lattice lines, lattice planes, Miller indices. Carbon allotropic forms.

Real gases and liquids. Size of atoms and molecules. Virial state equation. van der Waals state equation. van der Waals in Virial form. Isothermal compressibility. Cubic expansion coefficient. Ideal gas laws. Ideal gas isotherms. Real gas theoretical isotherms. Experimental isotherms. Gas - liquid phase transition. Latent heat. Lennard-Jones potential energy.

(β΄) Properties of matter. Analytically:

Linear elasticity, strain and stress tensors, Young and Lamé equations, elastic deformation energy, elastic waves, Navier equation, Navier-Stokes equations, viscoelasticity, Maxwell and Kelvin-Voigt models.

Surface tension, Laplace pressure, cohesion and adhesion, wetting, contact angle, Young-Dupré equation, capillarity, Jurin's law, capillary condensation, Kelvin equation.

Transport phenomena, flux and flux density, diffusion of mass, Ficks laws, thermal conduction, Fourier law, convection, thermal resistance, diffusion of momentum, Brownian motion, fluctuations-dissipation theorem.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Lessons are mainly taught on the greenboard, with encouragement of questions, observations and objections by the students. This is a constructive process. A projector is used when it is necessary to display an image or a video.

There is e-mail communication with students.

There is a regularly renewed e-class website:
https://eclass.uoa.gr/courses/PHYS196/
Among other things, all examination papers of older examinations can be found, solved, there.
There is a regularly renewed e-class website:
https://eclass.uoa.gr/courses/PHYS197/

Video lectures for part (α΄), from the year 2015 can be found at the website: https://delos.uoa.gr/

The e-book States of matter, open access for everybody, can be found at the Kallipos repository:
Κ. Σιμσερίδης [C. Simserides], 2015.
ΚΑΤΑΣΤΑΣΕΙΣ ΤΗΣ ΥΛΗΣ [States of matter]. Αθήνα [Athens]: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών [HEALLINK]. Γλώσσα [Language]: Ελληνικά [Greek]. Pages 271. URI: http://hdl.handle.net/11419/2117
ISBN: 978-960-603-289-9 Eudoxus ID: 320167</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>42</td></tr>
<tr><td>Exercises</td><td>10</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>90</td></tr>
<tr><td>Use of MATLAB</td><td>5</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek with open-ended questions and problem solving.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography: (title, author, publisher, year, place, Eudoxus code)

1. Καταστάσεις της Ύλης [States of Matter], Κ. Σιμσερίδης [C. Simserides], ΚΑΛΛΙΠΟΣ [Kallipos], 2015, Αθήνα [Athens], 320167 (ηλεκτρονικό σύγγραμμα) [(e-book)]

2. Φυσικοχημεία [Physical Chemistry], Atkins, ΙΤΕ Πανεπιστημιακές Εκδόσεις Κρήτης, 2016, Ηράκλειο, 41954666

3. Επιστήμη και Τεχνολογία Υλικών [Materials Science and Engineering], 9η εκδοση, W. D. Callister, ΕΚΔΟΣΕΙΣ ΤΖΙΟΛΑ & ΥΟΙ Α.Ε., 2017, Θεσσαλονίκη [Thessaloniki], 50655973

4. Φυσικοχημεία Ι - Οι καταστάσεις της ύλης [Physical Chemistry I - States of Matter], Θ. Σκουλικίδης, ΕΚΔΟΣΕΙΣ Μ. ΑΘΑΝΑΣΟΠΟΥΛΟΥ, 1991, Αθήνα, 22769174

5. Μηχανική των Υλικών [Mechanics of Materials], F. Beef, R. Johnston, J. Dewokf, D. Mazurek, ΕΚΔΟΣΕΙΣ Α. ΤΖΙΟΛΑ & ΥΙΟΙ Α.Ε., 2015, Θεσσαλονίκη [Thessaloniki], 50655975

6. Παραμόρφωση της Ύλης, Σημειώσεις διδάσκοντα, Ι. Λελίδης,

Related academic journals: There are too many to cite here in condensed matter physics, molecular physics, with numerous interdisciplinary applications.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y0355	SEMESTER	5
COURSE TITLE	**Statistical Physics I**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (occasionally English for ERASMUS students)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS140/

(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 develops concepts in classical laws of thermodynamics and their application, introducing postulates of statistical mechanics which lead to a statistical interpretation of thermodynamics within the framework of microcanonical, canonical, grand canonical and isobaric-isothermal ensembles. The developed methods of statistical mechanics are then used to describe the statistics for ideal classical, Bose-Einstein, Fermi-Dirac and photon gases. Selected physical examples, covering different realizations of matter at a macroscopic level, are discussed in some detail. With the completion of the course the student is able to: • define thermodynamic quantities in terms of microscopic description; • recognize the relevant conditions characterizing the equilibrium properties of macroscopic systems • describe thermodynamically non-interacting systems with many degrees of freedom; • explain statistical physics and thermodynamics as logical consequences of the postulates of statistical mechanics; • solve selected problems employing principles of statistical mechanics; • apply techniques from statistical mechanics to a wide range of situations; • use the tools, methodologies, language and conventions of statistical physics to test and communicate ideas and explanations; • to understand the physical explanations hiding behind experimental observations; • develop a feeling for the appropriate strategy to analyze efficiently the thermodynamic behavior of macroscopic systems.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *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…* *…….*
By successfully attending and completing the course the student will acquire the following skills: • Ability to search, analyze and compose data and information, using the appropriate technological tools. • Ability to work autonomously. • Train free, creative and inductive thinking. • Train analytical and synthetic thinking. • Ability to solve problems.	

(3) SYLLABUS

- Thermodynamics, foundations and associated laws.
- Foundations of classical statistical physics.
- Isolated system, microcanonical ensemble.
- System in a thermal bath, canonical ensemble.
- System in a thermal bath at constant pressure, isobaric-isothermal ensemble
- Open system, the grand canonical ensemble.
- Quantum statistics, Bose-Einstein and Fermi-Dirac distributions.
- Ideal quantum gases, degenerate Fermi-gas, Bose-Einstein condensation.
- Black-body radiation.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors,
e-class platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>52</td></tr><tr><td>Exercises</td><td>26</td></tr><tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>72</td></tr><tr><td>Course Total</td><td>150</td></tr></table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exam in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- F. Mandl, «Στατιστική Φυσική», Α.Γ. ΠΝΕΥΜΑΤΙΚΟΣ, Επιστημονικές και Τεχνολογικές Εκδόσεις
- Ε.Ν. Οικονόμου, «Στατιστική Φυσική & Θερμοδυναμική», ΙΤΕ Παν/μιακές ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ
- Σ. Ευαγγέλου, «Στατιστική Φυσική Ι & ΙΙ», ΕΚΔΟΣΕΙΣ ΠΑΠΑΖΗΣΗ
- M. Kardar, "Statistical Physics of Particles", Cambridge University Press

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y0356**	SEMESTER	5
COURSE TITLE	Core Laboratory I		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background και Skills Development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS206/

(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 student acquires the necessary knowledge for the deep understanding of several topics of the basic obligatory courses, of specializations offered by the Department. With the completion of the course the student is able to Recognize and understand topics and subjects related to Astrophysics, Astronomy, Mechanics, Environmental Physics, Meteorology, Electronics, Computers, Telecommunications and Control. In addition, the laboratory exercises offer the knowledge that is needed to understand the basic specialization courses. Distinguish, explain and recognize basic concepts of Physics related to Astrophysics, Astronomy, Mechanics, Environmental Physics, Meteorology, Electronics, Computers, Telecommunications and Control, through the laboratory experiments. Evaluate and judge the accuracy of the results, and reach qualitative and quantitative conclusions from the laboratory results, in the scientific areas of Astrophysics, Astronomy, Mechanics, Environmental Physics, Meteorology, Electronics, Computers, Telecommunications and Control.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Team work Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management Planning New Technology skills Learning word/excel/ppt/ origin/spss Creativity Communication skills Meeting Deadlines and Keeping Schedules Problem solving	

(3) SYLLABUS

- Introduction to basic concepts and instrumentation in electronics, electrical and electronic circuits.
- Signals and systems, introduction to operational amplifiers and applications.
- Radiation of stars (sun), measurement of star properties.
- Evolution of stars, star clusters, age and distance measurement, the expansion of the universe and the Hubble's constant.
- Measurements and study of basic atmospheric parameters: short and long wave solar and earth radiation. Temperature and humidity.
- Atmospheric Radiation, Atmosphere

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>25</td></tr>
<tr><td>Laboratory practice</td><td>30</td></tr>
<tr><td>Writing reports/ essays</td><td>20</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>75</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Open-ended questions, Problem solving
Oral examination
Laboratory reports</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- *Core Laboratory I Guide*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y0367	SEMESTER	6
COURSE TITLE	Core Laboratory II		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*General Background , Skills Development*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS211/

(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, as well as in the Core Laboratory II course, the student acquires the necessary knowledge for the deep understanding of several topics of the basic obligatory courses, of specializations offered by the Department. With the completion of the course the student is able to Recognize and understand topics and subjects related to Nuclear and Particle Physics, Solid State Physics, Electronics, Computers, Telecommunications and Control. In addition, the laboratory exercises offer the knowledge that is needed to understand the basic specialization courses. Distinguish, explain and recognize basic concepts of Physics related to Nuclear and Particle Physics, Solid State Physics, Electronics, Computers, Telecommunications and Control, through the laboratory experiments. Evaluate and judge the accuracy of the results, and reach qualitative and quantitative conclusions from the laboratory results, in the scientific areas of Nuclear and Particle Physics, Solid State Physics, Electronics, Computers, Telecommunications and Control.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Team work Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management Planning New Technology skills Learning word/excel/ppt/ origin/spss Creativity Communication skills Meeting Deadlines and Keeping Schedules Problem solving	

(3) SYLLABUS

- Basic concepts of semiconductors and semiconductor devices, p-n junction and applications.
- Bipolar-junction and field-effect transistors in linear and nonlinear operation mode, applications.
- The energy gap of germanium.
- Electron diffraction from polycrystalline graphite.
- Geiger-Muller detectors, detection and absorption of β and γ radiation
- Scintillator detectors, interaction of γ radiation with matter, dosimetry.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>25</td></tr>
<tr><td>Laboratory practice</td><td>30</td></tr>
<tr><td>Writing reports/ essays</td><td>20</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>75</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Open-ended questions, Problem solving
Oral examination
Laboratory reports</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- *Core Laboratory II Guide*

COURSE OUTLINE

(1) GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="3">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="3">Physics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="3">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>Y3100</td><td>SEMESTER</td><td>8</td></tr>
<tr><td>COURSE TITLE</td><td colspan="3">Astrophysics Laboratory</td></tr>
</table>

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in English for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS242/

(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 covers the fundamentals of the dynamics and evolution of space plasma environments, the physical processes that link the Sun to planetary magnetospheres, and the geospace phenomena resulting from the variable coupling of the solar wind with the terrestrial magnetosphere. With the completion of the course the student should be able to: - Identify characteristic field and particle flux changes and combine them to draw conclusions about the physical processes in planetary magnetospheres driven by various solar and interplanetary disturbances. - Use modern software for simulating and analyzing N-body numerical models of galaxies. - Become familiar with the emission and the kinematics of gas in galaxies in order to derive galaxy masses. - Manage, process and visualize experimental data from scientific instrument measurements as well as apply basic signal analysis techniques to them through the MATLAB programming language. - Compute basic parameters of numerical models, including density profiles, potential and kinetic energies. - Convert the measured flux density into gas mass, create the rotation curve of a galaxy, and compute the dynamical mass of a galaxy (including the dark matter). - Compare energy spectra of charged particles, draw conclusions on the dynamic evolution of charged particle flux and energy, distinguish and evaluate various acceleration and plasma loss processes. - Evolve N-body numerical models in time and analyze their properties. - Measure galaxy masses, to determine what fraction of the mass corresponds to gas/stars and dark matter, and to understand the consequences of the existence of dark matter. -Simulate simple hydrodynamic flows using the PLUTO code (Mignone et al 2007, The Astrophysical Journal Supplement Series, Volume 170, pp. 228-242).

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Analysis and synthesis of data and information Decision-making Working independently Team work Analytical and synthetic thinking Critical thinking New Technology skills Communication skills	

Information management Meeting Deadlines and Keeping Schedules Flexibility / Adaptability Problem solving

(3) SYLLABUS

- Introduction to MATLAB
- Van Allen Belts: Variability of energetic electrons
- Electromagnetic oscillations in the terrestrial magnetosphere
- Measuring mass of galaxies - dynamics and mass of molecular gas
- Sagittarius A *: An oversized black hole in the center of our Milky Way and S stars
- Sagittarius A *: Determination of the mass of the black hole in the center of the Galaxy through the orbital features of S stars
- Numerical N-Body Simulations and Galaxy Creation
- Astrophysical flow 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*	**Yes** Use of email and e-class platform. Use of MATLAB.
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*	see table below
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.*	Open-ended questions, Problem solving Writing reports Yes.

Activity	*Semester workload*
Laboratory practice / Exercises	33
Individual Study/ Study and Analysis of bibliography / Preparation	21
Writing reports	21
Course Total	**75**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography
Space Weather - Physics and Effects: Volker Bothmer and Ioannis A. Daglis, Springer, 2007
Waves, particles and storms in geospace: Georgios Balasis, Ioannis A. Daglis, Ian R. Mann, Oxford University Press, 2016
Galactic Dynamics, Binney & Tremaine, Princeton University Press, 1987

- Related academic journals:
Annales Geophysicae
Journal of Geophysical Research: Space Physics
Geophysical Research Letters
Space Weather
Planetary and Space Science
Space Science Reviews
Monthly Notices of the Royal Astronomical Society
Astrophysical Journal
Astronomical Journal
Astronomy & Astrophysics

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3102**	**SEMESTER**	**6**
COURSE TITLE	**Observational Astrophysics**		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background και Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in English, for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/modules/announcements/index.php?course=PHYS160

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

1. Main aim of the course

The main aim of the course is to provide knowledge of basic methods and instruments used for the observation of astronomical objects (solar system, stars, planets, galaxies, cosmology).

2. Learning Outcome

By the end of the course, the student will

- have a comprehensive knowledge of the basic methods of Observational Astrophysics and Astronomical Instrumentation,
- be able to explain and use the basics of astronomical observation, including the planning and execution of observations (participation in observational run at the Gerostathopoulion Observatory) and the design and function of astronomical instruments,
- be able to interpret at least at a basic level and qualitatively the results of astronomical observations in different wavelengths, and infer physical processes that may be at play.

The preparation and presentation of an essay on a selected related subject gives the opportunity to the student to acquire experience with scientific bibliography, with evaluating, comparing, organizing and composing information and finally deriving conclusions.

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Critical thinking
Time management
Creativity
Planning
New Technology skills
Communication skills
Information management
Meeting Deadlines and Keeping Schedules
Problem solving

(3) SYLLABUS

(i) Introduction – basic astronomical measurable quantities, coordinate systems, measurement of time.
(ii) Electromagnetic radiation collection and detection - Telescopes (ground-based, or on satellites) and detectors in the entire electromagnetic spectrum (gamma-rays, X-rays, ultraviolet, optical, infrared, microwave, radio).
(iii) Basic methods: photometry, spectroscopy, astrometry, polarimetry and interferometry.
(iv) Basics of data analysis – basics of astrostatistics, data mining, big data
(v) Effects of the Earth's atmosphere and of the interstellar medium on observations and measurements.
(vi) Instrumentation for the detection of non-electromagnetic information carriers (neutrinos, cosmic rays, gravitational waves)
(vii) Application of observational techniques and methods for the measurement of physical parameters, such as mass, distance, dark matter, kinematics and dynamics of systems, redshifts, chemical composition, magnetic fields etc.

The course includes observational experience at the Gerostathopoulio University Observatory, and experimental displays in the Astronomy and Applied Optics lab.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below
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 in Greek (or in English for Erasmus students) Writing essays Essay presentation

Activity	***Semester workload***
Lectures and Exercises	52
Individual Study/ Study and Analysis of bibliography / Preparation	69
Observational experience	8
Writing reports/ essays	20
Presentations	1
Course Total	**150**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

Lecture slides/notes provided in e-class

Observational Astrophysics (in Greek) by Alysandrakis, K., Nindos, A. and Patsourakos S., 2015, available at https://repository.kallipos.gr/handle/11419/5507

Additional bibliography in English provided for Erasmus students

- Related academic journals:

Astronomy and Astrophysics
Nature
Science
Annual Reviews of Astronomy and Astrophysics
Astrophysical Journal
Monthly Notices of the Royal Astronomical Society

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	**Y3104**		**SEMESTER**	**7**
COURSE TITLE	**STELLAR ASTROPHYSICS**			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		**WEEKLY TEACHING HOURS**		**CREDITS**
Lectures (theory and exercises)		4		6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).				
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background /Specialised Knowledge			
PREREQUISITE COURSES:	No			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students			
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS233/			

(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 students acquire the necessary knowledge regarding interstellar medium, variable stars, double stars, cataclysmic variables, and X-ray binaries. It also includes the formation, evolution, and structure of galaxies and the Milky Way. In addition, students familiarize themselves with the concept of dark matter and specifically with the modern theories for its distribution and nature as well as with the observational evidence for its existence. Finally there is a section on Active Galactic Nuclei. Recognize the way the basic laws of Physics come into play in star formation, structure and evolution. Recognize between various star classes Understand spectroscopic differences in stars Calculate stellar spectra using the principles of radiative transfer. Understand the different evolutionary paths between stars of small and large mass. Distinguish the differences between stars at the end of stellar evolution: white dwarfs, neutron stars and black holes. Explain astrophysics in terms of basic 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…* *…….*
The course aims at the following general competences Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management Planning Taking initiative/responsibility New Technology skills Learning word/excel/ppt/ origin/spss Creativity Determination Communication skills Information management Meeting Deadlines and Keeping Schedules Flexibility / Adaptability Problem solving	

(3) **SYLLABUS**

- Stellar atmospheres.
- Radiative transfer and spectral formation.
- Stellar interiors.
- Life cycle of a star: Birth, evolution and death (white dwarfs, supernova remnants, neutron stars, black holes).

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures/ Exercises</td><td>52</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>98</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(5) **ATTACHED BIBLIOGRAPHY**

- Suggested bibliography

1) Αστροφυσική, τόμος Β', Δομή και εξέλιξη του σύμπαντος: Γαλαξίες, Ηλιακό σύστημα, F. Shu, ITE ΠΑΝ/ΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ, 2009, ΗΡΑΚΛΕΙΟ ΚΡΗΤΗΣ

- Related academic journals:

Physical Review Letters

Astrophysical Journal

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3105**	**SEMESTER**	**8**
COURSE TITLE	**Plasma Astrophysics**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	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 και Specialised Knowledge
PREREQUISITE COURSES:	No (recommended Mechanics I, Electromagnetism I)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS135/*

(2) LEARNING OUTCOMES

Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
This course aims to introduce the student to basic concepts of Plasma Physics and Astrophysics. It also gives him the opportunity to go beyond a qualitative presentation in the quantitative use of the basic theoretical tools for further modeling of the relevant physical phenomena. At the end of the course, each student will be able to: 1. Identify the basic spatial and temporal scales that characterize a plasma. 2. Combine knowledge of basic courses (mainly Mechanics I, Electromagnetism I) to describe the dynamics of plasma at the level of individual particle motion as well as magnetized fluid (magnetohydrodynamics). 3. Understand how the basic conservation laws can be derived through kinetic theory and how they are combined with Maxwell's laws. 4. Apply the above to a plethora of astrophysical problems, analyze, and qualitatively/quantitatively describe the results.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Decision-making Working independently Analytical and synthetic thinking Critical thinking Time management Creativity Meeting Deadlines and Keeping Schedules Problem solving

(3) SYLLABUS

- Plasma ionization, Debye length, mean free path, plasma-Larmor-collision frequencies.
- Motion of electric charges in electromagnetic fields.
- Adiabatic invariants, magnetic mirror, applications: van Allen radiation belts, Earth- and planet-magnetospheres, space weather.
- Kinetic theory.
- Derivation of the basic equations of magnetohydrodynamics (MHD).
- MHD applications: Magnetic pressure, magnetic buoyancy, heating of the solar corona, dynamo theory for the generation of magnetic fields, magnetic reconnection, models of plasma structures in the laboratory, in space physics and in astrophysics (solar prominences, solar jets, coronal mass ejections, coronal loops, flares, etc).
- Solar wind and the model of E.N. Parker.
- Polytropic model for the solar wind, Mach-Bernoulli equations, critical point, solution topology, solar wind models with thermal conductivity.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) eclass platform where sets of problems are posted and solutions from students are uploaded
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*	see table below
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 in Greek Homeworks, Problem solving

Activity	***Semester workload***
Lectures	52
Exercises	13
Individual Study/ Study and Analysis of bibliography / Preparation	56
Writing reports/ essays	26
Exams	3
Course Total	***150***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (given through the EYDOXUS platform):

- *Βιβλίο [68404097]: Αστροφυσική Πλάσματος, Τσίγκανος Κανάρης*
- *Βιβλίο [18549044]: Φυσική Πλάσματος, Βλάχος Λουκάς*

- Other:

- *Fundamentals of Plasma Physics, Paul Bellan*
- *The Physics of Plasmas, Richard Fitzpatrick*
- *The Physics of Plasmas, T. J. M. Boyd, J. J. Sanderson*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y3200	SEMESTER	8
COURSE TITLE	Telecommunications and Electronic Physics 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
Laboratory practice	3	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*Special Background, Specialised Knowledge and Skills Development*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes,in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS245/

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
In this laboratory course the students are using the knowledge from the courses of the specific research area in order to study, design and implement complex systems concerning the signal's propagation and processing and the electronic physics, as well. With the completion of the course the students are able to understand each relative problem which should be solved and they choose the correct methodology in order to obtain the result. With the completion of the course the students are able to design and implement the appropriate system, they can examine the accuracy of the measurements and they can identify the major factors which affect the results. With the completion of the course the students are able to combine their theoretical knowledge in order to create systems with specific characteristics. They assess the obtained outcomes in order to judge the effectiveness of these systems in practice.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Planning New Technology skills Learning C / Matlab programming language ... Creativity Communication skills Information management Meeting Deadlines and Keeping Schedules Problem solving

(3) SYLLABUS

- Introduction to simulation tools of telecommunication systems, continuous and discrete signals, Fourier transform.
- Convolution, autocorrelation and correlation of signals.
- Fourier transform, sampling.
- Design, implementation and measurement of filters.
- Field Effect Transistors (FET)

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/Study and Analysis of bibliography / Preparation</td><td>20</td></tr>
<tr><td>Laboratory practice</td><td>27</td></tr>
<tr><td>Writing reports/ essays</td><td>15</td></tr>
<tr><td></td><td></td></tr>
<tr><td>InteractiveTeaching</td><td>13</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>CourseTotal</td><td>75</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Open-ended questions, Problem solving
Oral examination
Writing essays
Laboratory reports</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography:

1. *Εισαγωγή στην Ηλεκτρονική, Γ.Σ. Τόμπρας, Εκδ. ΔΙΑΥΛΟΣ, 2006, ΑΘΗΝΑ, 12173*
2. *Σήματα και Συστήματα, Oppenheim, Willsky, Nawab, Εκδόσεις Γρηγόριος Χρ. Φουντας, Αθήνα, 2011, 12273250*
3. *Σήματα και Συστήματα Συνεχούς και Διακριτού χρόνου, Μάργαρης Αθανάσιος, Εκδόσεις Α. Τζιόλα & Υιοί Α.Ε. Θεσσαλονίκη, 2011.*
4. *Σημειώσεις, Ε. Νισταζάκης, Ι. Τίγκελης*
5. Συστήματα Επικοινωνίας 5η Έκδοση, S. Haykin, M. Moher, Εκδόσεις Παπασωτηρίου και ΣΙΑ Ι.Κ.Ε., Αθήνα, 2010
6. *Εργαστηριακός οδηγός και ασκήσεις ηλεκτρονικής, Ε. Νισταζάκης, Εκδόσεις Κάλλιπος, Αθήνα, 2016*

- Related academic journals)

IEEE Communication Letters
IEEE/OSA Journal of Lightwave Technology
Elsevier, Journal of Optics & Laser Technology
IEEE/OSA Journal of Optical Communications and Networking
IET Optoelectronics
Springer Circuits, Systems and Signal Processing Journal
MDPI Applied Sciences

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	**Y3201**		**SEMESTER**	**7**
COURSE TITLE	**Electronics II**			

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	2	
Laboratory practice	2	
		6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background - Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes,in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/

(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 student acquires the necessary knowledge concerning Electronic Physics. With the completion of the course the students are able to • describe accurately the operation of circuits amplifiers and design elements of circuits amplifiers • combine specific elements in order to study, design and produce complex digital circuits. • understand and explain the basic concepts of Electronic Physics and electromagnetic propagation, as well as be able to apply them in digital circuits. • compose concepts and laws that lead to solving complex problems of Electronic Physics as well as using the relevant mathematical expressions to solve them.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Working independently Team work Project planning and management Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management Planning Taking initiative/responsibility New Technology skills Creativity Determination Communication skills Information management Meeting Deadlines and Keeping Schedules Flexibility / Adaptability Problem solving

(3) SYLLABUS

- Power conversion/power supply.
- Wave shaping/wave shapers (linear, non-linear).
- Amplification/amplifiers, practical amplifying devices, operational models, performance characteristics of practical amplifiers.
- Basics of analysis/design of small signal amplifiers.
- Basics of analysis/design of large signal amplifiers.
- Basics of amplifier design for integrated circuits.
- Basics of analysis/design of digital functions, circuits and systems.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, eclass platform
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*	see table below
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 in Greek Writing essays - Laboratory reports

Activity	***Semester workload***
Lectures/ Exercises	26
Laboratory practice	26
Individual Study/Study and Analysis of bibliography / Preparation	72
Writing reports/ essays	26
CourseTotal	***150***

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography
- Προτεινόμενη Βιβλιογραφία:
Ηλεκτρονικά ΙΙ,Γ. Χαριτάντης,ΕΚΔΟΣΕΙΣ ΑΡΑΚΥΝΘΟΣ,2007,Αθήνα

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	Y3202	SEMESTER	7	
COURSE TITLE	Computers II			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*		WEEKLY TEACHING HOURS	CREDITS	
Lectures (theory and exercises)		2		
Laboratory practice		2		
			6	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).				
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background, specialised knowledge			
PREREQUISITE COURSES:	No			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students			
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS292/			

(2) LEARNING OUTCOMES

<table>
<tr><td>

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*

</td></tr>
<tr><td>

In this course the student acquires the necessary knowledge for the understanding of digital computer architecture, organization and operation.

With the completion of the course the student is able to
Describe the digital computer architecture and organization as well as basic data structures and algorithms.
Define computer operation and algorithmic complexity.
Design basic digital computing systems.
Produce data structures with software.
Organize data structures and algorithms that lead to the problem solving with computers.
Combine computers and algorithms for solving complex physics problems.
Evaluate the results of the computing implementations in solving physics problems.

</td></tr>
<tr><td>

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…
…….

</td></tr>
<tr><td>

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Team work
Project planning and management
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility
New Technology skills
Learning C / Matlab programming language ...
Learning word/excel/ppt/ origin/spss
Creativity
Determination
Communication skills
Information management
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

</td></tr>
</table>

(3) SYLLABUS

- Computer arithmetic: 1’s and 2’s complement, floating point representation, addition/subtraction, methods for 2’s complement multiplication, non/restoring division, convergence division.
- Computer architecture, combinatorial circuits: de/multiplexers, decoders, adders/subtractors, array multipliers, sequential circuits: Registers, counters, finite state machines.
- Computer organization: CPU, memory and peripheral organization, addressing modes, machine language, subroutines and stack.
- Theory and implementation in C code of the following data structures and algorithms: Lists, stacks, binary trees, merge, quick, heap.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	(see table below)
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 in Greek Mid-term written examination Writing essays Laboratory reports

Activity	*Semester workload*
Lectures/ exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	70
Laboratory practice	26
Writing reports/ essays	28
Course Total	***150***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
1. Data Structures in C, N. Misirlis, NKUA Publications, 2017, Athens, Code: 77112308
2. Notes

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3205**	SEMESTER	6
COURSE TITLE	SIGNALS AND SYSTEMS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	*Special Background και Specialised Knowledge.*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS251/*

(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 provides the student with knowledge about signals carrying information (analog and digital) as well as their interaction with systems (primarily linear)

With the completion of the course the student is able to

Describe and handle different types of signals, in the time and frequency domain, as well as compute the output signal of a linear system when the input to the system is another signal

To explain the fundamental concepts of signals, their different descriptions (e.g., Fourier series), the operation of convolution between two signals, the corresponding description in the frequency domain, the perform the computation of the output of a linear system on the basis of these techniques, as well as the transformation from continuous to discrete time (sampling)

To be able to analyze and comprehend the nature of signals and systems, to judge which parameters are of particular importance, to compare the effectiveness of different computation techniques.

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Analytical and synthetic thinking
New Technology skills
Information management
problem solving

(3) SYLLABUS

- Introduction to signals and systems.
- Convolution.
- Fourier analysis in the continuous time-domain and applications.
- Laplace transform: Properties and applications.
- Sampling.
- Fourier analysis in the discrete time-domain and applications.
- System simulations and applications in MATLAB.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>*Activity*</th><th>*Semester workload*</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>72</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>**Course Total**</td><td>***150***</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

1 Signals and Systems of Continuous and Discrete Time Μάργαρης Αθανάσιος

2 Signals and Systems Oppenheim, Willsky, Nawab

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3300**	**SEMESTER**	**8**
COURSE TITLE	**Environmental Physics 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**
Laboratory practice	3	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*General Background - Skills Development*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	Eclass URL: https://eclass.uoa.gr/courses/PHYS249/

(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 laboratory provides to the student the necessary knowledge in order to understand the processes occurring in the troposphere. In addition, the student applies various methods to calculate certain atmospheric parameters under different conditions. With the completion of the course the student is able to Evaluate and determine different atmospheric conditions and their corresponding parameters Explain and analyze atmospheric conditions in case studies. Analyze relative atmospheric conditions. Combine mathematical formulas in order to calculate various parameters. Evaluate the results and suggest solutions in case studies.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search, analyze and synthesize data and information, using the necessary technologies Autonomous work Teamwork Respect for the natural environment Promote free, creative and inductive thinking Analytical and synthetic thinking Critical Thinking Problem solving	

(3) SYLLABUS

- Meteorological charts analysis.
- Vertical wind distribution.
- Remote sensing in environmental studies.
- Mixing height calculation.
- Air pollution.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	(see table below)
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.*	Open-ended questions and problem solving questions Written examination during each laboratory exercise Homework Laboratory report

Activity	***Semester workload***
Individual Study/ Study and Analysis of bibliography / Preparation	35
Laboratory practice	15
Writing reports/ essays	25
Course Total	**75**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

Laboratory Guide

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y3304	SEMESTER	6
COURSE TITLE	**ATMOSPHERIC 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
Lectures (theory and exercises)	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background and specialised general knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS298/

(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 provides students with the knowledge to understand the basic concepts, principles and laws of fluid mechanics and thermodynamics related to atmospheric motion and thermodynamic processes. Especially, after the successful completion of the course, the student is able to:

- know the definitions and physical significance of the main meteorological parameters (e.g. pressure, density, temperature)
- know the spatial and temporal distribution and changes of these parameters
- understand the concepts, principles and theories related to the thermodynamic processes in the atmosphere (eg stability / instability, dynamic stability / instability)
- describe Newton's laws of motion, conservation of mass, momentum, spin and energy
- solve the basic equations (hydrostatic, ideal gas, etc.) of the atmosphere
- recognize the apparent and real forces affecting the movement of air masses
- understand the balance of these forces and the generation of winds
- resolve the equations of motion
- recognize spatial and temporal scales of atmospheric circulation
- determine the characteristics of the winds: geostrophic, gradient, cyclostrophic and thermal wind
- explain the difference between the streamlines of the wind field and the trajectories of the air masses
- explain the equation of continuity
- know the circulation theorem and the vorticity equation
- distinguish absolute, relative and potential vorticity
- know the divergence theorem and apply it
- distinguish small disturbances and recognize the waves of Kelvin-Helmholtz, Rayleigh-Taylor, Rossby
- distinguish various wave disturbances, such as internal -external gravity waves, sound and Lamb waves, planetary waves
- apply this knowledge to solving problems related to the content of the course
- evaluate the results of the 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…
…….

With its successful attendance and completion, the course aims to give the student the following skills:

Search for, analysis and synthesis of data and information, using the necessary technology
Working independently
Team work
Working in an interdisciplinary environment
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Basic concepts, forces, equations of motion, energy, mass conservation and simplified forms (incompressible, anelastic, Boussinesq) equation of state.
- Reference systems, coordinate systems, pressure and potential temperature as vertical coordinate, pressure gradient.
- Characteristic scales of atmospheric motions, scale analysis, simplified forms of basic equations, thermal wind, boundary layer and Ekman spiral.
- Vorticity, conservation of vorticity (absolute and relative), vorticity advection.
- Atmospheric stability (thermodynamic), dynamic stability/instability, small perturbations, Kelvin-Helmholtz, Rayleigh-Taylor and Rossby waves.
- Taylor-Goldstein equation, internal and external gravity waves, acoustic and Lamb waves, wave trapping in the atmosphere.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face teaching
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Yes The e-class system is used to provide notes, exercises, information and communication with students. Computer-aided teaching support.
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*	see table below
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 examinations at the end of the semester, in Greek language. Four issues equivalent to each other. The themes concern both theory and questions of understanding - critical thinking, as well as problem solving.

Activity	*Semester workload*
Lectures	26
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	98
Course Total	**150**

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. "Ειδικά Κεφάλαια Ατμοσφαιρικής Φυσικής και Χημείας", Κ. Βαρώτσος, ΕΚΔΟΣΕΙΣ Σ. ΑΘΑΝΑΣΟΠΟΥΛΟΣ & ΣΙΑ Ο.Ε., 2014
2. "Μαθήματα Μετεωρολογίας και Κλιματολογίας", Α. Φλόκας, ΕΚΔΟΣΕΙΣ ΠΕΛΑΓΙΑ ΖΗΤΗ & ΣΙΑ ΟΕ, 1997

- Related academic journals:

1. "An introduction to Dynamic Meteorology", James R. Holton and Gregory J. Hakim, Academic Press, 2013
2. "Dynamical Meteorology – An Introductory Selection", B.W. Atkinson, Routledge, 1990

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y3305.	**SEMESTER**	**7**
COURSE TITLE	**Atmospheric Boundary Layer 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**
Lectures (theory and exercises)	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background
PREREQUISITE COURSES:	No (recommended Fluid Dynamics)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language if there is interest from Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS290/

(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 Atmospheric Boundary Layer (ABL) course provides the student with advanced knowledge to understand the natural processes that contribute to the structure and development of the atmospheric boundary layer. The student understands how the basic conservation and transport laws (from fluid dynamics) are applied to describe and understand the atmospheric boundary layer and many of the phenomena that occur in it.

The basic laws equations are mainly given in algebraic form and the emphasis is on the physical interpretation of each term. The student understands the spatial patterns of the various physical parameters within it (such as wind, temperature, etc.) and learns how to solve problems - applications in the atmospheric boundary layer that comes in direct interaction with the surface.

Within the content of this course, it is difficult to understand and handle both mathematical equations and data. This is mainly due to the turbulent behavior of the physical properties of the atmosphere.

With the completion of the course the student is able to

- recognise the behavior of the ABL from a thermodynamic point of view and to select and apply the relevant laws according to the atmospheric conditions
- understand the spatial and temporal behavior of the basic physical parameters of the ABL.
- define the basic layers of ABL and describe and interpret their physical characteristics
- be familiar with the principles and criteria governing the stability / instability of the atmosphere, as well as their effect on the development of the ABL.
- analyze experimental measurements and extract quantitative results for atmospheric parameters and processes (eg, momentum and heat transfer) and draw conclusions about the effect of various factors (such as topography, roughness, synoptic condition, etc.) in the evolution of the atmospheric parameters.

- explain the basic concepts, principles and laws describing the physical processes of the ABL.
- identify and examine the basic terms of the fluid dynamics be valid in the different layers of the ABL, under different atmospheric conditions as well as in different areas (eg complex topography, different latitudes)
- calculate various physical parameters with the appropriate equations.
- analyze experimental measurements and extract quantitative results for physical parameters (eg momentum and heat transfer); and
- draw conclusions on the influence of various factors (such as topography, roughness, synoptic condition, etc.) in the evolution of atmospheric parameters

- compose concepts and laws that lead to the solution of complex processes such as those existing in the turbulent atmospheric boundary layer.
- combine equations in solving complex problems in atmospheric physics.
- compare and evaluate the results of the problems.

General Competences

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

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

The course aims at the following general competences

Decision-making
Working independently
Respect for the natural environment
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Introduction - The atmospheric boundary layer over flat uniform terrain
- ABL structure and depth. ABL formation under different atmospheric stability
- Conservation and momentum, heat and humidity transfer for laminar and turbulent ABL.
- Turbulent kinetic energy - Stability criteria
- Turbulent flows - Mean and turbulent parts.
- Turbulence Closure theories - Similarity theory - Wind profile evolution
- Flow over complex topography (changing terrain, canopies, hills)
- Local winds (e.g. Thermally driven, up and down-slope winds)
- Marine Atmospheric Boundary Layer

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures/ Exercises</td><td>52</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>95</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- Notes by M Tombrou mainly based on Chapter 18 of Meteorology for Scientists and Engineers, by Roland Stull
- Notes from C. Chelmis and G. Papaioannou
- Meteorology for Scientists and Engineers, 3rd Edition, 2015 by Roland Stull (http://www.eos.ubc.ca/books/Practical_Meteorology/ ISBN-13: 978-0-88865-178-5)
- Atmospheric Boundary Layer Flows Their Structure and Measurement J. C. KAIMAL J. J. FINNICAN, 1994, New York Oxford, OXFORD UNIVERSITY PRESS

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	**Y3306**	**SEMESTER**	**8**	
COURSE TITLE	**AIR QUALITY**			

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background and Specialised Knowledge.
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the Greek language for Erasmus students
COURSE WEBSITE (URL)	eclass: https://eclass.uoa.gr/courses/PHYS220**/**

(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 provides the student with an understanding of the mechanisms associated with Atmospheric Environment in terms of its quality. Upon completion of the course the student will be able to:

• recognize the problems of air pollution and formulate a research plan for the assessment of the prevailing situation, taking into account natural, chemical and dynamic mechanisms,
• Identify sources and sinks of pollutants released into the atmosphere either due to anthropogenic activities or due to natural processes,
• classify pollutants (primary pollutants, primary and secondary), sources and sinks of pollution,
• understand the physical and chemical processes that occur in the atmosphere,
• recognize the cleaning mechanisms of the atmosphere,
• describe the thermodynamic processes in the atmosphere that determine the stability and instability of the atmosphere and therefore the upward or downward movement of a polluted air mass,

• describe the photochemical cycle and know the specific parameters that affect it,
• define and explain the structure of the atmospheric boundary layer, its spatial and temporal evolution and the turbulent diffusion processes of the pollutants,
• examine diffusion problems based on simplified dispersion models (GAUSS model) and equations,
• calculate the various categories of motion in the atmosphere, and in particular medium-scale movements (sea breezes, anchorages - catwalks, valley-wind winds) and interpret their contribution to diffusion - dispersion of pollutants,
• describe measurements of physical parameters and atmospheric pollutants,
• know the mechanisms and parameters that define and define the urban microclimate,
• understand the urban heat island phenomenon and calculate energy flows,
• explain, based on the above, the links between air quality and the urban microclimate.

General Competences

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

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

The course aims at the following general competences:

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Decision-making
Working independently
Respect for the natural environment
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Introduction to the structure and composition of the atmosphere, atmospheric boundary layer.
- Introduction to tropospheric chemistry, anthropogenic and natural sources of air pollution, tropospheric photochemistry and stratospheric chemistry.
- Estimation of air pollution – theory of air diffusion and dispersion – analytic solutions: Gauss equat emissions.
- Atmospheric stability – instability.
- Introduction to air pollutants diffusion/dispersion model.
- Methodology for the measurement of air pollutants.
- Mechanisms for dry and wet deposition of air pollutants.
- Air quality in urban areas.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology), Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below

Activity	***Semester workload***
Lectures	26
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	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 examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exams in Greek Open-ended questions, Problem solving – Examinations on the basis of four problems of equivalent weight Solved problems and problems from previous examination periods uploaded to e-class platform

(5) ATTACHED BIBLIOGRAPHY

Recommended bibliography:

1. Environmental Physics, P. Kassomenos, KLEIDARITHMOS Editions, 2017.
2. Air Pollution, A. Triantafyllou, THALIS Editions, 2017.

Relevant scientific journals: ATMOSPHERE, ATMOSPHERIC ENVIRONMENT, ATMOSPHERIC POLLUTION RESEARCH, OPEN JOURNAL OF AIR POLLUTION

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	Y3400		SEMESTER	7
COURSE TITLE	ADVANCED NUCLEAR PHYSICS 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
Laboratory practice	3	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General Background and Skills Development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS134/

(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 advanced laboratory course includes specialized experiments of Nuclear and Particle Physics, which highlight the basic instrumentation and methodology required by modern experimental techniques in this field. With the successful attendance and completion of the course, the student is in position to: • Understand the required instrumentation, its operation and the methodology used to correctly perform an experiment. • Recognize the significance of the measured quantities for the confirmation of a physical principle. • Successfully handle the required instruments of the experimental device. • Process the experimental data correctly. • Express the typical statistical and systematic uncertainties of the measurement. • Organize systematically the data obtained from the experiment. • Graphically plot the measured data and the derived results. • Critically evaluate and confirm the physical principle of the experiment.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Working independently Team work Working in an interdisciplinary environment Project planning and management Respect for the natural environment Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Planning New Technology skills Creativity	

Determination
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Nuclear Cosmic Radiation Component Measurement
- γ-γ Angular Correlation
- Study of Compton Scattering
- Study of the Environmental Radioactivity
- Real Event Analysis from LHC Measurements
- Optimization of the Event Selection Criteria for New Physics with the ATLAS Experiment
- Measurement of Muonic Component of the Cosmic Radiation
- CAMAC Data Acquisition

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of video Projectors, eclass platform, instructors websites
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*	(see table below)
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Oral examination

Activity	*Semester workload*
Individual Study/ Study and Analysis of bibliography / Preparation	60
Laboratory practice	15
Course Total	**75**

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography*

- *Advanced Nuclear Laboratory Guide*, Collective Work, Edited by E. Stiliaris, Department of Physics, National and Kapodistrian University of Athens (2018)

- *Related academic journals:*

- American Journal of Physics
- Nuclear Instruments and Methods (A and B)
- Physics Education
- The Physics Teacher

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3402**	**SEMESTER**	**7**
COURSE TITLE	Elementary Particles I		
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**	
Lectures (theory and exercises)	4	6	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).			
COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background and Specialised Knowledge		
PREREQUISITE COURSES:	No		
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek		
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students		
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS148/		

(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 provides the student with basic knowledge on the properties and interactions of elementary particles. Upon the completion of the course, the student is able to:

- Know the elementary particles that compose the natural world, their properties (quantum numbers, masses) and interactions.
- Understand the theoretical basis of the classification of elementary particles through fundamental symmetries.
- Be familiar with the experimental processes for the detection and study of the properties of elementary particles (accelerators, detectors).
- Know basic elements of relativistic quantum mechanics (Klein-Gordon and Dirac equations) and their predictions for the properties of the particles that they describe (spin, antiparticles, interaction with the electromagnetic field).
- Handle the formalism for the calculation of production probabilities and distributions of particles in collision experiments (differential cross section).
- Calculate the cross section for simple processes of electromagnetic scattering.
- Know the main properties of the weak interaction (parity violation), as well as the experiments through which they have been determined.
- Understand the basic elements of the theory of the weak interaction and its carriers, as well as the phenomenological consequences for particle production, scattering and decay.

General Competences

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

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

The course aims at the following general competences

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Decision-making
- Working independently
- Analytical and synthetic thinking
- Critical thinking
- Problem solving

(3) SYLLABUS

- Introduction: Natural units, summary of elementary particles and interactions.
- Kinematics and measurements: Particle accelerators, particle detectors.
- Symmetries in particle physics: Groups SU(2) of spin and isospin, SU(3) of flavor and color. Symmetries C και P. Representations of SU(3), classification of mesons and baryons, magnetic moments of baryons.
- Relativistic quantum mechanics and antiparticles: Klein-Gordon equation, Dirac equation, free-particle solutions, antiparticles, massless fermions.
- Electromagnetic scattering: Non-relativistic scattering theory, Fermi' s golden rule. Relativistic scattering of spinless electron in electromagnetic field, electron-muon scattering, Feynman diagrams, scattering amplitude, cross section. Electron with spin in electromagnetic field, Møller scattering.
- Weak interactions: Fermi' s theory of β-decay, the Wu experiment, parity violation. Unification of electromagnetic and weak interactions, W and Z bosons. Muon and pion decay. Quark mxing, Cabibbo angle, CKM matrix. Neutrino mixing and oscillations.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVRY *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*	**Yes** Communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors eclass platform
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	<table><tr><th>*Activity*</th><th>*Semester workload*</th></tr><tr><td>Lectures</td><td>36</td></tr><tr><td>Exercises</td><td>16</td></tr><tr><td>Individual study/ problem solving/ analysis of bibliography</td><td>98</td></tr><tr><td>**Course Total**</td><td>**150**</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final written exam in Greek

(5) ATTACHED BIBLIOGRAPHY

D. Perkins, Introduction to High Energy Physics, Greek translation
A. Bettini, Introduction to Elementary Particle Physics, Greek translation
F. Halzen and A. Martin : Quarks and Leptons, John Wiley & Sons
Notes by the instructors

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3403**	**SEMESTER**	**7**
COURSE TITLE	**Nuclear Physics I**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	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, Specialized Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS136/

(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 invests on building upon the foundation of knowledge from the introductory course in Nuclear and Particle Physics, so that it would provide students with detailed knowledge of the fundamental symmetries involved in nuclear systems, while investigating the essential characteristics of nuclear reactions.

With the successful attendance and completion of the course, the student is in position to:

- Understand the fundamental interactions among nucleons, shaping the characteristics of nuclear matter.
- Determine the stability or disintegration of nuclear matter based on conservation principles and fundamental symmetries.
- Know the basic characteristics of nuclear structure and the radiation associated to its change.
- Understand the basic mechanisms behind reactions between nuclear isotopes

- Distinguish between microscopic and macroscopic degrees of freedom in nuclear matter
- Assess if a process is conserved or not based on fundamental symmetries and conservation laws.
- Calculate the stability of nuclei against potential decays based on theoretical models
- Apply the properties of the strong and weak nuclear interactions to explain stellar nucleosynthesis, as well as predict the isotopic behavior in technological applications.

- Explain fundamental subatomic phenomena in basic and applied level
- Evaluate theoretical models in comparison with experimental data
- Organize the approach to questions and problems in a methodical and organized manner

General Competences

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

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

The course aims at the following general competences

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
Respect for the natural environment
Criticism and self-criticism
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility
Creativity
Determination
Communication skills
Information management
Self control skills
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Nucleons and their interactions.
- Nucleon-nucleon strong interaction.
- Many-body quantum theory, models of nuclear structure.
- Experimental methodology and instrumentation in nuclear physics.
- Nuclear decays (α-, β-, γ-decay).
- Research fronts in contemporary nuclear physics, nuclear astrophysics.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of video Projectors, specialized instrumentation (eg radiation detectors)
eclass platform, instructors websites, use of online databases</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures. exercises</td><td>65</td></tr>
<tr><td>Seminars</td><td>15</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>65</td></tr>
<tr><td>Educational Visits</td><td>5</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving
Oral examination
Written term project</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- *W.N. Gottingham & Greenwood (in translation), Introduction to Nuclear Physics, G & K. Dardanos Publishers, Athens 2002*

- Related academic journals:

- *Nature*
- *Nature Physics*
- *Scientific Reports*
- *Science*
- *Physical Review Letters*
- *Physical Review C*
- *Journal of Instrumentation*
- *Acta Physica Polonica A*
- *Nuclear Instruments and Methods in Physics Research A*
- *Nuclear Instruments and Methods in Physics Research B*
- *European Physics Journal A*
- *Journal of Physics G*
- *Physics Letters B*
- *Nuclear Physics A*
- *Nuclear Physics B*
- *Nuclear Science and Techniques*
- *Canadian Journal of Physics*
- *International Journal of Atomic and Nuclear Physics*
- *arXiv.org Preprints*
- *Procedia*
- *IAEA Technical Reports*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y3404	SEMESTER	6
COURSE TITLE	ELECTROMAGNETISM II		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	*General Background*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS127/

(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 attendance and completion of the course, the student is able –in combination with the knowledge acquired by the Physics III and Electromagnetism I courses –to understand using numerous examples and applications, the principles of the fundamental electromagnetic interaction.
The course aims to:
Provide the student with the necessary mathematical skills in order to solve complex problems of electrodynamics resulting from the time dependent sources (moving charges and currents).
Usage of the above techniques to understand related dynamic phenomena of the production and propagation of electromagnetic waves.

General Competences

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

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

The course aims at the following general competences:

Search for, analysis and synthesis of data and description of phenomena using the fundamental equations of electrodynamics (Maxwell equations)
Working independently
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Time management
Creativity
Self control skills
Meeting Deadlines and Keeping Schedules
Problem solving

(3) SYLLABUS

- Applications of Maxwell’s equations, electromagnetic potentials and Coulomb and Lorenz gauges.
- Maxwell's stress tensor, energy-momentum conservation.
- Electromagnetic waves in dielectrics and conductors, dispersion.
- Waveguides, resonant cavities and optical fibers.
- Electromagnetic radiation, electric and magnetic dipole radiation (Lienard-Wiechert potentials, fields from moving charges).
- Radiation reaction.

l

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology),
eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>26</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Seminars</td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>92</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Exams</td><td>6</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
<tr><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final and intermediate written exams in Greek Oral examination, when necessary.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

Introduction to Electrodynamics, D. Griffiths, translated in Greek (2004) Ίδρυμα Τεχνολογίας και Έρευνας-Πανεπιστημιακές εκδόσεις Κρήτης

Κλασσική ηλεκτροδυναμική, Ι. Βέργαδος, ΑΡΗΣ ΣΥΜΕΩΝ

G. L. Pollack, D. R. Stump, Pearson (2005)

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3406**	**SEMESTER**	**6**
COURSE TITLE	**Atomic and Molecular 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**
Lectures (theory and exercises)	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background - Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS159/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The course is the first systematic introduction to the fundamental aspects of Atomic and Molecular Physics. It provides the students with the knowledge of the essential properties of atoms and molecules, as well as the fundamental symmetries involved in the interactions that form these building blocks of all universe.

With the successful attendance and completion of the course, the student is in position to:

- Describe the hydrogen atom and the interaction with an external magnetic field
- Understand the multi-electron atom, Helium spectrum, Hartree theory, interaction with an external field, multiple excitation, hyperfine structure and laser.
- Determine the fundamental symmetries that shape simple and complex molecular structure.
- Consolidate the application of conservation laws in atomic and molecular systems.
- Learn the principles of molecular spectroscopy.

- Explain the existence of atoms based on quantum mechanics
- Examine atomic spectra under interactions with external magnetic fields
- Explain the existence of molecules based on quantum mechanics.
- Determine molecular spectra based on fundamental symmetries and approximations.
- Apply properties of molecular systems to predict the dynamic interaction of molecules.

- Perform quantum mechanical calculations corresponding to atomic processes.
- Predict atomic spectra based on principles of spectroscopy.
- Explain fundamental atomic and molecular phenomena in basic and applied level
- Predict molecular spectra based on experimental data and principles of spectroscopy.
- Organize the approach to questions and problems in a methodical and organized manner.

General Competences

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

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

Project planning and management

Respect for difference and multiculturalism

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

The course aims at the following general competences

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

Respect for the natural environment

Criticism and self-criticism

Production of free, creative and inductive thinking

Analytical and synthetic thinking

Critical thinking

Time management

Planning

Taking initiative/responsibility

Creativity

Determination

Communication skills

Information management

Self control skills

Meeting Deadlines and Keeping Schedules

Flexibility / Adaptability

Problem solving

(3) SYLLABUS

- The hydrogen atom, the spin of electron and the interaction with an external magnetic field, coupling with orbital angular momentum, spectra, fine structure.
- Multi-electron atom, helium spectrum, Pauli's principle, Hartree theory, L-S coupling and J-J coupling, magnetic moments.
- Spectra of multi-electron atoms, interaction with an external field, multiple excitations, hyperfine structure, laser.
- Fundamental principles of molecular physics, Born-Oppenheimer approximation and two-atom molecules.
- The linear combination of atomic orbitals (LCAO), energy level diagram and molecular spectra, symmetries in molecules.
- Experimental methods in molecular spectroscopy.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)

Computer-aided lectures, use of video Projectors,

eclass platform, instructors websites, use of online databases</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.

Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures/exercises</td><td>52</td></tr>
<tr><td>Seminars</td><td>15</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>78</td></tr>
<tr><td>Educational Visits</td><td>5</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek

Open-ended questions

Mid-term exams

Problem solving

Oral examination</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- *Notes "Introduction to Atomic and Molecular Physics" (M. Kakoulidou, E. Mavromichalaki, E. Rozaki-Mavrouli),*

- Related academic journals:

- *Nature*
- *Nature Physics*
- *Nature Chemistry*
- *Scientific Reports*
- *Science*
- *Physical Review Letters*
- *Physical Review A*
- *Journal of Physical Chemistry*
- *Advances in Atomic, Molecular and Optical Physics*
- *Advances in Atomic and Molecular Physics*
- *Spectrochimica Acta Part B: Atomic Spectroscopy*
- *Atomic Data and Nuclear Data Tables*
- *Optics & Laser Technology*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3500**	**SEMESTER**	**8**
COURSE TITLE	**Solid State Physics 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**
Laboratory practice	3	3
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background and skills development
PREREQUISITE COURSES:	No (recommended Introduction to Solid state Physics, Solid State Physics I)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	http://solidlab.phys.uoa.gr/proptyxiako-ergasthrio-katey8ynshs.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*

This course is a Laboratory practice, covering six different unities related to Solid State Phenomena. Through the laboratory practice and the corresponding theoretical description the student acquires consolidation, deeper understanding as well as enrichment of knowledge on solid state physics

With the completion of the course the student is able to

- Carry out measurement of several properties like electrical and thermal conductivity, temperature, frequency, capacity etc.
- Assemble circuits and simple apparatuses and establish appropriate conditions for taking experimental data
- Acquire knowledge of basic elements of digital collection of experimental data (connection of apparatus to PC)

- Calculate parameters and understand their reliability as related to the experimental conditions
- Recognize possible deviations from theoretical description and determine their origin
- Explain basic ideas and microscopic mechanisms composing the investigated phenomena

- Presents and analyses his experimental data with the help of appropriate software taking into account the corresponding experimental errors
- Presents with clarity in his written report, which is to be delivered weekly, the experimental apparatus, the data, their properly commented analysis as well as the conclusions reached

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Team work
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Time management
Meeting Deadlines and Keeping Schedules
Problem solving

(3) SYLLABUS

- Electrons in a periodic potential: Computer aided Solution of the Kronig-Penney model. Electron energy levels, dispersion relation, energy bands and energy gaps. Metals, semiconductors, insulators. Velocity and effective mass of electrons in a crystalline body
- High-temperature superconductors: Measurement of electrical resistance of a high Tc superconductor in the region 80-300K. Observation of Meissner effect, magnetic properties of Type I and type II superconductors.
- The p-n junction: I-V characteristic and coefficient of ideality of the junction. Measurement of the capacity of the junction, voltage barrier, determination of the distribution of the dopant.>
- Linear lattice vibrations: forced oscillation of a system of masses. eigenfrequency, normal oscillation modes, phonons, optical and acoustical branches
- Relationship between electrical and thermal conductivity: Measurement of the electrical and thermal conductivity of metals (Cu, Al) at room temperature. Wiedeman Franz law.
- Annealing of colour centers in glass: Rate of disappearance of colour centres at constant Temperature. Relaxation time and its dependence on the annealing temperature

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Computer-aided lectures, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>25</td></tr>
<tr><td>Laboratory practice</td><td>21</td></tr>
<tr><td>Writing reports/ essays</td><td>29</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>75</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Oral examination
Laboratory reports</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography laboratory Guide «Laboratory exercises(experiments) on solid State Physics»

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3501**	**SEMESTER**	**7**
COURSE TITLE	Solid State Physics I		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special Background and Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	ιστοσελίδα eclass: https://eclass.uoa.gr/courses/PHYS190/

(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 students acquire the necessary knowledge for the properties of metals and semiconductors and transport phenomena in these materials. With the completion of the course the student is able to: • Understand the transport phenomena in metals and semiconductors under the influence of an electric field, a temperature gradient, and a carrier concentration gradient or under the influence of a magnetic field. • Understand the historical evolution of the models which were put forward in order to explain the transport phenomena approaching in a more realistic way the experimental evidence. • Recognize the differences in the properties of metals and semiconductors in accordance with the periodicity of their structure and their energy bands. • Understand the meanings of effective mass, chemical potential or Fermi energy, carrier mobility in metals and semiconductors as well as their effects in the conductivity of these materials at different temperatures. • Recognize the differences in the electrical conductivity of metals and semiconductors originating from the selection of the appropriate distribution function which describes the occupancy of the energy sates by the carriers contributing to the transport phenomena. • Combine his/her knowledge in Solid State Physics, Electromagnetism, Quantum Mechanics and Statistical Physics in order to understand transport phenomena in metals and semiconductors.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences • Search for, analysis and synthesis of data and information, with the use of the necessary technology • Decision-making • Working independently • Analytical and synthetic thinking • Critical thinking • Problem solving

(3) SYLLABUS

- Transport phenomena in metals, electrical and thermal conductivity (Drude, Lorenz, and Sommerfeld models), Boltzmann transport equation, temperature dependence of electrical conductivity.
- Energy bands, motion of electrons in a periodic potential, conductors, insulators and semiconductors, Bloch's theorem, the Kronig-Penney model.
- Semiconductor models, density of states in real materials, Fermi-Dirac statistics, equilibrium carrier distribution, doping, Fermi level, transport phenomena in semiconductors, drift, Hall effect, diffusion, band bending.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>32</td></tr>
<tr><td>Exercises</td><td>20</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>95</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography:*

Φυσική Ημιαγωγών, Γ.Π. Τριμπέρης, LIBERAL BOOKS ΜΟΝΟΠΡΟΣΩΠΗ ΕΠΕ, 2013

Φυσική Στερεάς Κατάστασης – Τόμος I, Ε. Ν. Οικονόμου, ΙΤΕ ΠΑΝ/ΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ, 2010

Φυσική Στερεάς Κατάστασης, Ibach& H. Luth, ΕΚΔΟΣΕΙΣ , ΠΕΛΑΓΙΑ ΖΗΤΗ, 2011

Φυσική Στερεάς Κατάστασης, N. Ashcroft, N.D. Mermin, ΕΚΔΟΣΕΙΣ Γ.Π. ΠΝΕΥΜΑΤΙΚΟΣ, 2012

- *Related academic journals:* Physics Today, Scientific American

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3502**	**SEMESTER**	**8**
COURSE TITLE	**SOLID STATE PHYSICS II**		

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

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS205/

(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 student acquires the necessary knowledge for the understanding of the magnetic properties of matter (diamagnetism, ferromagnetism, antiferromagnetism), superconductivity, dielectric and optical properties of solids, mainly on the basis of microscopic principles and quantum mechanics. With the completion of the course the student is able to: Describe the phenomena of diamagnetism, ferromagnetism, antiferromagnetism, superconductivity, dielectric phenomena, and ferroelectricity. Recognise the importance of strong correlations with respect to these phenomena. Trace back the aforementioned phenomena to first principles of many-body quantum mechanics. Calculate critical phase-transition temperatures in magnetic, superconducting and ferroelectric materials. Explain the basic notions, principles and laws related to strong correlations. Solve many-body problems with approximate methods. Compose models that describe materials with strong correlations. Evaluate the approximate solutions of models.

General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Working independently Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management Creativity Meeting Deadlines and Keeping Schedules Problem solving	

(3) SYLLABUS

- Magnetism, diamagnetism and paramagnetism, origin of magnetic interactions, types of magnetic ordering, magnetic resonance.
- Superconductivity, general characteristics of superconductors, microscopic theory of superconductivity, the Josephson effect.
- Dielectric and optical properties of solids, fundamental properties of dielectrics, sources of polarizability, ferroelectricity.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>26</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>98</td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek

Open-ended questions, Problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

C. Kittel, «Εισαγωγή στη Φυσική Στερεάς Κατάστασης», ΕΚΔΟΣΕΙΣ Α.Γ. ΠΝΕΥΜΑΤΙΚΟΣ, Αθήνα 1979. Code 6847
(C. Kittel, "Introduction to Solid State Physics", translated to greek, Pnevmatikos Editions, Athens 1979)
Ε. Ν. Οικονόμου, «Φυσική Στερεάς Κατάστασης, Τόμος ΙΙ», ΙΤΕ ΠΑΝ/ΚΕΣ ΕΚΔ. ΚΡΗΤΗΣ, Ηράκλειο 2003. Κωδ. «Εύδοξου» 299
(E.N. Economou, "Solid State Physics, Vol. II", Crete University Editions, Heracleon 2003)
H. Ibach & H. Lüth, «Φυσική Στερεάς Κατάστασης», ΕΚΔΟΣΕΙΣ ΠΕΛΑΓΙΑ ΖΗΤΗ, Θεσσαλονίκη 2011. Κωδ. «Εύδοξου» 12583778
(H. Ibach & H. Lüth, "Solid State Physics", translated to greek, Pelagia Ziti Editions, Thessaloniki 2011)
N. W. Ashcroft & N. D. Mermin, «Φυσική Στερεάς Κατάστασης», ΕΚΔΟΣΕΙΣ Α.Γ. ΠΝΕΥΜΑΤΙΚΟΣ, Αθήνα 2012. Κωδ. «Εύδοξου» 22768829
(H. Ibach & H. Lüth, "Solid State Physics", translated to greek, Pnevmatikos Editions, Athens 2012)

- Related academic journals:

Physical Review B, Physical Review Letters, Journal of Magnetism and Magnetic Materials, Journal of Superconductivity.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**Y3503**	**SEMESTER**	**6**
COURSE TITLE	**Quantum Optics and Lasers**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	4	6
Laboratory practice	* see unit (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*	Special Background and Specialised Knowledge. (Statistically, around 1/2 of students who take the exam come from the Direction of Solid State Physics, 1/3 from the Direction of Nuclear Physics and Elementary Particles and the rest from the other three Directions of the NKUA Department of Physics.)
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	e-class website: https://eclass.uoa.gr/courses/PHYS107

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The aim of this course is to introduce students to -- and deepen their knowledge about -- the quantum aspect of the interaction of electromagnetic (EM) radiation - mainly near the visible regime - with matter, which is considered as a set of two-level or multi-level systems, as well as obtain a first contact with LASERs.

By successfully attending and completing the course, the student should:

Become familiar with the first steps of quantum optics and understand how black body radiation and the experimental - theoretical convolution led to quantization. Compare the laws of Planck, Rayleigh-Jeans, Wien, and explain how the Stefan-Boltzmann law arises. Analyze EM waves with emphasis on boundary conditions and normal modes within a cavity (rectangular parallelepiped and cylindrical).

Familiarize with the concepts of discrete spectrum, two-level system (2LS), multi-level system (mLS) and their various realizations in atoms, quantum dots, color centers. Understand the stimulated or spontaneous absorption and emission processes of a photon in the 2LS.

Analyze the interaction of EM radiation - 2LS or mLS semi-classically, that is, treating the 2LS or mLS as a system of quantum states, while EM waves are treated classically within the dipole approximation. Become familiar with time-dependent perturbation theory. Understand concepts such as Rabi frequency, transfer rate, rotating wave approximation, and how the allowed transitions and the corresponding selection rules arise.

Analyze the interaction of EM radiation - 2LS or mLS quantum mechanically, that is, addressing both 2LS or mLS and the EM waves quantum mechanically. Understand quantization of EM field and concepts such as spinors, commutators, anticommutators, transition dipole moment. Study in this context absorption and emission of photons. Compare the semi-classical with the full quantum mechanical approach.

Become familiar with MATLAB by plotting equations describing the time-dependent occupation probability of states in the semi-classical and in the quantum mechanical approach and the photon population in the quantum mechanical approach.

Understand the principles of LASER operation. Analyze and solve rate equations with two lasing and two auxiliary levels. Be introduced into concepts such as level lifetime, pumping, critical pumping, population inversion. Calculate the population of levels and the radiation density in the cavity by analyzing the rate equations analytically in the stationary state and numerically as a function of time. Also, in this context, be introduced into MATLAB. Analyze the longitudinal and transverse EM field modes in a cavity (rectangular parallelepiped and cylindrical). Become familiar with various types of LASERs.

If time permits, be introduced to topics such as density matrix, Fresnel equations, Brewster angle, total internal reflection, polarized beam emission.

It is implied, anyway, that all these are accompanied with the solution of relevant problems.

General Competences

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

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

With successful completion and examination of the course, the aim is that the student acquires the following general competences and skills:

Search for, analysis and synthesis of data and information. Working independently. Criticism and self-criticism. Production of free, creative and inductive thinking. Analytical and synthetic thinking. Critical thinking. New Technology skills. Learning MATLAB programming language. Problem solving. Meeting Deadlines and Keeping Schedules (5 sets of problems and 3 MATLAB exercises are given to the students with deadlines).

(3) SYLLABUS

Synoptically

- Black body. Planck, Rayleigh-Jeans, Wien, Stefan-Boltzmann laws.

- Electromagnetic (EM) waves: boundary conditions, normal modes in a cavity.

- Discrete spectrum. Two-level system (2LS) or multi-level system (mLS): atom, quantum dot, color center. Stimulated - spontaneous absorption and emission processes.

- EM radiation - 2LS or mLS interaction, semi-classically. Dipole approximation. Time-dependent perturbation theory. Rabi frequency. Rotating wave approximation. Allowed transitions.

- EM radiation - 2LS or mLS interaction, quantum mechanically. EM field quantization. Spinors. Commutators. Anticommutators. Transition dipole moment. Photon absorption - emission. Density matrix.

- LASER: pumping, population inversion, rate equations. Longitudinal, transverse EM modes. LASER types.

Course Description

We focus on quantum optics, while we describe the LASER operation principles without extending to technical details. The modules taught are mainly:

Introduction to the quantum nature of light, i.e., black body, Planck, Rayleigh-Jeans, Wien, Stefan-Boltzmann laws, EM waves: boundary conditions, normal modes in a cavity. Infinitesimal number of EM wave normal modes per infinitesimal frequency interval.

Einstein mechanisms of interaction between EM radiation - matter (2LS). Stimulated and spontaneous absorption and emission processes. Derivation of Planck's law from the absorption and emission processes and Boltzmann statistics. Relation between Einstein coefficients A and B. Discrete spectrum: atoms and molecules, color centers, artificial atoms and molecules. Color centers. Quantum dots.

Semi-classical approach to the interaction between EM radiation - matter (2LS or mLS). EM field: classically, 2LS or mLS, e.g. atom or quantum dot: quantum mechanically. Unperturbed system (that is without EM field). Perturbed system (that is subjected to EM field). Time-dependent perturbation theory. Dipole moment. Equations describing the time evolution of a 2LS or mLS and their solution. Rabi frequency. Rotating Wave Approximation. Calculation of Einstein coefficients. Hydrogen atom. Calculation of the dipole moment matrix elements. Allowed and forbidden transitions. Selection rules.

Quantum mechanical approach to the interaction between EM radiation - matter (2LS or mLS). EM field quantization. EM field Hamiltonian with photon annihilation and creation operators. 2LS or mLS Hamiltonian with spinors. 2LS or mLS - EM field interaction Hamiltonian. Boson commutation and fermion anticommutation relations. Expected values of quantities for the Rabi and Jaynes-Cummings Hamiltonians. Photon absorption and emission.

Basic LASER operation principles. Pumping mechanisms. Rate equations with two lasing and two auxiliary levels. Level lifetime. Pumping. Relative probabilities. Radiation loss at mirrors. Rate equations for the lasing levels' populations and the radiation density in the cavity. Level populations and radiation density at the stationary case. Critical pumping. Population inversion. Various types of LASERs. Longitudinal and transverse EM field modes in a cavity (rectangular parallelepiped and

cylindrical). Other subjects: Fresnel equations. Brewster angle. Total internal reflection. Polarized beam emission. Density matrix. Issues relative to the properties and the operation of LASERs. The course is partially renewed each year. Keywords: electromagnetic (EM), photon, quantum of light, quantum optics, two-level system (2LS), multi-level system (mLS), EM field quantization, density matrix, electric transition dipole moment, Rabi frequency, EM radiation - matter interaction, commutators, anticommutators, bosons, fermions, stimulated and spontaneous Einstein mechanisms, semi-classical approximation, LASER, pumping, population inversion, EM field Hamiltonian with photon creation and annihilation operators, two-level and multi-level Hamiltonian with spinors, two-level and multi-level - EM field interaction Hamiltonian, boson commutation and fermion anticommutation relations, spinors, Rabi Hamiltonian, Jaynes-Cummings Hamiltonian, photon absorption, photon emission, quantum dots, color centers.

(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*	Yes Lessons are mainly taught on the greenboard, with encouragement of questions, observations and objections by the students. This is a constructive process. A projector is rarely used when it is necessary to display an image or a video. There is e-mail communication with students. There is a regularly renewed e-class website: https://eclass.uoa.gr/courses/PHYS107/ Among other things, all examination papers of older examinations can be found, solved, there. Video lectures from the year 2014 can be found at the website: https://delos.uoa.gr/ The e-book Quantum Optics and LASERS, open access for everybody, can be found at the Kallipos repository: Κ. Σιμσερίδης [C. Simserides], 2015. Κβαντική οπτική και LASERs [Quantum optics and LASERs]. Αθήνα [Athens]: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών [HEALLINK]. Γλώσσα [Language]: Ελληνικά [Greek]. Pages 324. URI: http://hdl.handle.net/11419/2108 ISBN: 978-960-603-073-4 Eudoxus ID: 320166 * There are 3 exercises, which must be solved by the students, by means of numerical calculations, in MATLAB. So, for 1 hour, I explain, in groups, in my office, what students have to do, in front of computers. Last year (2017-18), for the first time, for 1 hour, we visited

	a research laboratory of our Department where optical measurements are performed, with the help of a LASER, on semiconductor heterostructures and explained what was happening.
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*	(see table below)

Activity	***Semester workload***
Lectures	42 hours
Exercises	10 hours
Individual Study/ Study and Analysis of bibliography / Preparation	90 hours
Laboratory practice *	Use of MATLAB. Numerical solution of 3 exercises. 8 hours
Writing reports/ essays	After completion of each chapter, in total 5 sets of exercises, which count altogether for 1 in 10 units in the final grade of the course, are given to all those students who desire such an option.
Educational Visits	Visit to a research semiconductor laboratory in our Department, where measurements are performed with the help of a LASER.
Course Total	**150 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.*	Final written exams in Greek with open-ended questions and problem solving. Writing essays: After completion of each chapter, in total 5 sets of exercises, which count altogether for 1 in 10 units in the final grade of the course, are given to all those students who desire such an option. Also, by use of MATLAB, numerical solution of 3 exercises.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography: (title, author, publisher, year, place, Eudoxus code)

1. Κβαντική Οπτική και Lasers [Quantum Optics and Lasers], Κ. Σιμσερίδης [C. Simserides], Kallipos, 2015, Athens, 320166 (e-book)

2. Κβαντική Οπτική [Quantum Optics], M. Fox, ITE Πανεπιστημιακές Εκδόσεις Κρήτης [Crete University Press], 2014, Ηράκλειο Κρήτης [Heraklion Crete], 32998376

3. Εισαγωγή στη Κβαντική Οπτική και Lasers [Introduction to Quantum Optics and Lasers], Σ. Βες [S. Ves], Εκδόσεις Σ. Γιαχούδης & ΣΙΑ Ο.Ε, 1999, Θεσσαλονίκη [Thessaloniki], 8762

4. Principles of Lasers (electronic resource), O. Svelto, HEAL-LINK, 2010, 73250879 (e-book)

5. Αρχές των Lasers [Principles of Lasers], O. Svelto, Εκδόσεις Σ. Αθανασόπουλος & ΣΙΑ Ο.Ε., 1986, Αθήνα [Athens], 45477

6. Laser, Π. Περσεφόνης [P. Persefonis], Εκδόσεις Π. Δενερτζής, 2010, Αθήνα [Athens], 27120

- Related academic journals: There are too many to cite here because Quantum Optics and LASERs are today at the cutting edge of science, in optics as well as in condensed matter physics with numerous interdisciplinary applications.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E0391**	SEMESTER	6
COURSE TITLE	Statistical Physics II		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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 και Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS260/

(2) LEARNING OUTCOMES

Learning outcomes
Learning outcomes *The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.* *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The aim of the course is the introduction of the physics of phase transitions for interacting particle systems. After an introduction to the thermodynamics of phase-transitions, two basic mean-field theories (Weiss and Bragg-Williams) are analyzed, in which the crucial role of interactions is showcased. These methods are applied to several systems. Subsequently, the Landau phenomenological theory for phase changes is developed. This method highlights the importance of symmetries and their breaking, the class parameter and the concept of universality. Finally, the significance of fluctuations in phase transitions is analyzed, as well as and their role in invalidating the predictions of mean-field theory. In this context, the theory of renormalization is introduced, with simple examples, such as the Ising model of one and two dimensions With the completion of the course the student is able to Describe phase transition phenomena in the context of mean-field theory of interacting systems. Identify physical laws underlying phase transitions in various condensed matter systems. Explain the role of symmetry and symmetry breaking at phase transitions. Find the order parameter of a transition and construct the Landau free energy expansion. Comprehend the notion of fluctuations and the conditions under which they invalidate mean-field theory. Understand to notion of renormalization and how it improve the understanding of phase transitions. To evaluate physical quantities related with critical phenomena in different physical systems. To calculate critical exponents in the context of mean-field theory. To calculate the structure of domain walls and surface energy. To calculate corrections in critical exponents using Kadanoff decimation renormalization. Combine concepts and physical laws of correlations to interpret the critical behavior of condense matter. Combine fundamental physical laws and apply methodologies in order to solve problems related to phase transitions. Comprehension of the dynamics of a phase transition.

General Competences	
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…* *…….*

By successfully attending and completing the course the student will acquire the following skills:

- Ability to search, analyze and compose data and information, using the appropriate technological tools.
- Ability to work autonomously.
- Train free, creative and inductive thinking.
- Train analytical and synthetic thinking.
- Ability to solve problems.

(3) SYLLABUS

Equilibrium and thermodynamic potentials, equilibrium of homogeneous systems, phase equilibrium
Van der Waals equation, VdW gas properties, thermodynamic phase transition, other phases in the VdW standard, critical behavior, mean field theory approximation, molecular field parameters, critical behavior.
Ferromagnetism, exchange interaction, Heisenberg model, Ising model, spin waves and magnons, Weiss theory, critical behavior
Unified view of critical behavior in fluid and magnetic materials.
Bragg-Williams approximation. Application to ferromagnetic materials, alloys, solutions, melting of solids, crystals with gaps or impurities, macromolecules, adsorption of surface molecules, etc.
Theory of excluded volume in macromolecules, critical behavior, analogies with ferromagnetism.
Symmetry, order parameter concept, effective Hamiltonian, construction of the energy expansion, Landau functional, assumptions.
Second order phase transitions, correlation length, critical exponents, scaling laws. Response functions: a) heat capacity. Landau expansion of VdW gas. Ferroelectricity.
First order phase transitions, role of symmetry, clarification for critical exhibitors, heat capacity.
Orientation transition. Transition I-N. One-dimensional translational symmetry, crystal. System with external macroscopic field effect. Response functions: b) susceptibility. Order change of a phase transition. Systems with two order parameters. Coupling of order parameters. Piezoelectricity, anti-ferroelectricity.
Virial method, cluster method, thermodynamic interfaces, nucleation.
Variations: Heterogeneity near phase changes, Gradient expansion and Ornstein-Zernike approach, Ginsburg Criterion
Renormalization: Ising Model in 1D, Ising in 1D Model Solution Ising in 2D Model with Kadanoff Renormalization
Percolation: Bond-Site models, Significant Quantities and Order Parameters, Phase Transitions in 1 Dimension, Phase Transitions in Bethe Lattices

(1) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>85</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>150</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(2) ATTACHED BIBLIOGRAPHY

- Suggested bibliography
STATISTICAL PHYSICS, F. Mandl
STATISTICAL PHYSICS AND THERMODYNAMICS , E. N. EconomouE.N. Οικονόμου
Lecture Notes «STATISTICAL PHYSICS», I. Hadjiagapiou"

- Related academic journals:

K.Huang, Statisical Mechanics, Wiley (1987)
M. Toda, R. Kubo, N. Saito, Statistical Physics I, Springer, 1998
Principles of condensed matter physics P.M. Chaikin, T.C. Lubensky, Cambridge University Press 1995.
R.K. Pathria, Statistical Mechanics, Butterworth-Heinemann, 1996
J. P. Sethna, Statistical Mechanics, Oxford University Press, 2010
M. Kardar, Statisical Physics of Particles, Cambridge University Press,
M. Kardar, Statisical Physics of Fields, Cambridge University Press,

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E0392**	**SEMESTER**	**6**
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**
Lectures (theory and exercises)	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 - Specialised Knowledge
PREREQUISITE COURSES:	No (recommended Mechanics I)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS210/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

This course aims to introduce the student to basic concepts of Fluid Dynamics. It also gives him the opportunity to go beyond a qualitative presentation in the quantitative use of the basic theoretical tools for the further modeling of the relevant physical phenomena.

At the end of the course, each student will be able to:
1. Understand how the basic equations of Classical Mechanics lead to the Navier-Stokes equations and the basic conservation laws.
2. Use the Bernoulli integral to describe simple fluids, compressed or uncompressed.
3. Know the most basic waves and fluid instabilities.
4. Recognize the role of viscosity and describe the dynamics in the limit of large / small Reynolds numbers.
5. Apply the above to a variety of geophysical fluids in the atmosphere and the ocean, analyze and quantitatively quantify the results, recognizing the particular role of Earth rotation, stratification and turbulence.

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Decision-making
Working independently
Analytical and synthetic thinking
Critical thinking
Time management
Creativity
Meeting Deadlines and Keeping Schedules
Problem solving

(3) SYLLABUS

- Introduction, kinematics and conservation laws, Euler and Navier-Stokes equations.
- Bernoulli equation, hydrostatics, gravity waves.
- Instability: General theory, Rayleigh-Taylor and Kelvin-Helmholtz instabilities.
- Introduction to turbulence, turbulent flows and the turbulent kinetic energy.
- Geophysical fluid dynamics: Coordinate systems and the effect of the Earth's rotation, scaling, vorticity conservation.
- Rotation effects in geophysical flows: Geostrophic balance, Ekman dynamics, barotropic waves in the presence of rotation, stratification effects in geophysical flows: Stratified geostrophic dynamics, internal waves
- Supersonic flow and shock waves, computational fluid dynamics.

(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*	**Yes** Electronic communication with the students using ICT
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*	see table below
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 in Greek

Activity	***Semester workload***
Lectures./ exercises	65
Individual Study/ Study and Analysis of bibliography / Preparation	82
Exams	*3*
Course Total	***150***

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography (given through the EYDOXUS platform):

- *Σημειώσεις διδασκόντων https://eclass.uoa.gr/modules/document/?course=PHYS210*

- Other:

- *Fluid Mechanics, Kundu, Cohen, Dowling*
- *Intoduction to Geophysical Fluid Dynamics, Cushman-Roisin, Beckers*
- *An introduction to fluid dynamics, Batchelor*
- *Fluid Mechanics, Landau, Lifshitz*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3103**	SEMESTER	8
COURSE TITLE	Non linear dynamical systems		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (in Greek language for Erasmus students)
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS289/*

(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 provides a rigorous, systematic and an in-depth study of the theory of dynamical systems with applications from the fields of physics, biology, chemistry, climatology and economics.

With the completion of the course the student is able to:

- Determine the qualitative behavior of one dimensional and two-dimensional systems and determine the stability of their equilibria or of their periodic orbits.
- Determine the evolution of linear dynamical systems.
- Provide numerical solutions of the dynamical systems.
- Provide approximate solutions with the use of perturbation techniques.
- Characterize the nature of the attractor that emerges at bifurcation points.
- Use the method of characteristics in order to solve kinematic wave equations.
- Determine the sensitivity of a chaotic system by calculating the Lyapunov exponent of its trajectories.

General Competences

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

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

The course aims at the following general competences

Team Work
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Dynamical systems as flows in phase space and as maps. Equilibria and their stability. Bifurcations in one dimensional dynamical systems.
- Two dimensional dynamical systems. Linear dynamics in two dimensions. Poincare-Bendixson theorem. Limit cycles. Hopf bifurcations. Stability of limit cycles. Parametric instability.
- Non linear oscillations. Perturbation methods. Method of multiple scales.
- Introduction to chaotic systems. Lorenz system. Lyapunov exponents.
- Non linear one dimensional wave equations. Shock waves. Traffic flow. Burger’s equation.
- Non linear waves. Boussinesq equations and introduction to soliton theory.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Computer-aided lectures, use of Overhead Projectors, Electronic communication with the students using ICT, (Information and Communications Technology),
eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>26 hrs</td></tr>
<tr><td>Exercises</td><td>26 hrs</td></tr>
<tr><td>Individual Study/Study and Analysis of bibliography / Preparation</td><td>73 hrs</td></tr>
<tr><td></td><td></td></tr>
<tr><td>CourseTotal</td><td>125</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek

Oral examination (when appropriate)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography:

1. Strogatz, S. - Nonlinear Dynamics and Chaos,CRC Press, 2018, Boca Raton, FL, U.S.A.

2.Ablowitz, M.- Nonlinear Dispersive Waves, Cambridge University Press, 2012, Cambridge, U.K.

3. Arnold, V. Ordinary Differential Equations, MIT Press, 1978, Cambridge, MA, U.S.A.

- Related academic journals:-

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3106**	**SEMESTER**	**6**
COURSE TITLE	**High Energy Astrophysics**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No (recommended Special Theory of Relativity)
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS209/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

This course aims to introduce the student to High Energy Astrophysics mechanisms, i.e .,the processes of the more energetic phenomena of the universe which are mainly associated with compact astrophysical objects. Since they can not be reproduced in the laboratory, the observations with space or ground-based telescopes offer the opportunity to understand nature in its most extreme states. At the same time, the student is given the opportunity to go beyond a qualitative presentation in the quantitative use of basic theoretical tools for the further modeling of the relevant physical phenomena.

At the end of the course, each student will be able to:

1. Know the various high-energy sources that have been observed and what is the modern view of the scientific community on their characteristics and how they are formed.
2. Understand the various mechanisms producing non-thermal radiation as well as the interaction of matter with radiation.
3. Combine the knowledge gained in basic courses (such as Mechanics I and Electromagnetism I) to explain already explored particle acceleration mechanisms to very high energies.
4. Have the necessary tools to understand new mechanisms that may be proposed in the near future in this rapidly evolving research field of Astrophysics.
5. Similarly for the acceleration of relativistic plasma outflows from the environment of compact objects, the role of the magnetic field in them, and the physics of accretion disks which feed with energy most of these phenomena.

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Decision-making
Working independently
Analytical and synthetic thinking
Critical thinking
Time management
Creativity
Meeting Deadlines and Keeping Schedules
Problem solving

(3) SYLLABUS

- Astrophysical high energy sources: Observations and physical processes.
- Inverse Compton scattering and applications.
- Synchrotron radiation and applications.
- Particle acceleration to high energies: Fermi mechanisms and acceleration in potential differences.
- Magnetohydrodynamic acceleration of relativistic astrophysical flows.
- Astrophysical accretion disks.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures/ exercises</td><td>52</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>70</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (given through the EYDOXUS platform):

• Μαστιχιάδης, Α., Βλαχάκης, Ν., 2015. Αστροφυσική υψηλών ενεργειών. [ηλεκτρ. βιβλ.] Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Διαθέσιμο στο: http://hdl.handle.net/11419/3100

- Other:

• Rybicki & Lightman, Radiative Processes in Astrophysics, John Wiley & Sons

• Longair, High Energy Astrophysics, Cambridge University Press

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	E3108	SEMESTER	7	
COURSE TITLE	SOLAR 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
Lectures (theory and exercises)			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*	*Specialized Knowledge*			
PREREQUISITE COURSES:	No			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes,in the English language for Erasmus students			
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS224/			

(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 student acquires the necessary knowledge for the Solar Physics With the completion of the course the student is able to He deeply understands the phenomena that occur in the interior and the atmosphere of the Sun, the interplanetary space and the solar wind. Particularly, he knows in detail the solar eruptive phenomena (flares and coronal mass ejections). Understand the natural processes that lead to these natural phenomena. Be able to apply the magnetohydrodynamic theory of solar plasma to understand the observed morphologies and phenomena. Be able to combine the various methods of solar plasma with observational data in order to interpret them. *Consequently the students acquire skill and ability* *To evaluate physical parameters and examine solar phenomena* *To combine the MHD theory of solar plasma with the observational data*

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Decision-making Working independently Production of new research ideas Respect for the natural environment Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management Planning New Technology skills Information management Meeting Deadlines and Keeping Schedules Problem solving	

(3) SYLLABUS

- Sun: Basic characteristics.
- Solar interior: Core, radiation zone, convection zone.
- Solar atmosphere: Photosphere, chromosphere, transition region, corona.
- Quiet Sun: Granulation, supergranulation, limb darkering, chromospheric network, spicules, streamers, polar plumes, coronal condensations, coronal holes.
- Coronal heating.
- Solar magmetic field: Babcock theory, motion of particles in the solar magnetic field, magnetic loops, magnetic traps, magnetic mirrors.
- Solar plasma and magnetic field: MHD and magneto-hydrostatic approximation, reconnection of magnetic lines, current sheets.
- Active Sun: Active regions, faculae-plage, magnetic elements, pores, sunspots, filaments-prominences, flares, coronal mass ejections.
- Solar cycle and periodicities.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students usingICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>26</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Individual Study/Study and Analysis of bibliography / Preparation</td><td>60</td></tr>
<tr><td>Writing reports/ essays</td><td>8</td></tr>
<tr><td>Presentations</td><td>2</td></tr>
<tr><td>Examinations</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td>CourseTotal</td><td>125</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Writing essays (optionally)
Essay presentation (optionally)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography:

In the Sun trails: Introduction to Solar Physics, P. Preka-Papadema, E. Danezis, E. Theodosiou, D.Kargiolaki, Diavlos Publications, 2009, Athens, Greece, (IN GREEK)

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3109	SEMESTER	7
COURSE TITLE	Space 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
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS212/

(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 covers the fundamentals of the dynamics and evolution of space plasma environments, the physical processes that link the Sun to planetary magnetospheres, and the geospace phenomena resulting from the variable coupling of the solar wind with the terrestrial magnetosphere. With the completion of the course the student should be able to: - Define what a plasma is and describe the basic properties and dynamics of some important plasmas in the solar system. - Describe the key elements of the Sun-Earth interaction and of the geospace particle and electromagnetic environment. - Recognise the effects of distinct solar and interplanetary disturbances on magnetospheric dynamics. - Explain the basic concepts and principles of charged particle motion and wave-particle interaction - Calculate various key physical parameters of space particles and fields using the appropriate mathematical formulas. - Differentiate between distinct collective processes of energy conversion, involved in the transfer of magnetic energy of the Sun and kinetic energy of the solar wind to kinetic energy of geospace plasma. - Combine relevant formulas to solve complex problems involving wave-particle interactions. - Evaluate the results of problem solutions in the framework of the theoretical predictions.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Analysis and synthesis of data and information Decision-making Working independently Team work Project planning and management Analytical and synthetic thinking Critical thinking Taking initiative/responsibility New Technology skills Learning word/excel/ppt/ origin/spss Communication skills Information management	

Meeting Deadlines and Keeping Schedules Flexibility / Adaptability Problem solving

(3) SYLLABUS

- Planetary magnetism, solar-terrestrial coupling, basic plasma properties, space plasma, charged particle motion in electric and magnetic fields, adiabatic invariants of motion, plasma waves.
- Solar wind: Parker theory, magnetic field, shock waves, CIR, ICMEs, fast and slow solar wind. Interplanetary space.
- Heliosphere: structure, variability, cosmic rays.
- Earth magnetosphere: geomagnetic field, topology, plasma populations, sources and losses of plasma, open and closed magnetosphere models, magnetospheric disturbances, aurora.
- Explosive phenomena in geospace: geomagnetic storms, magnetospheric substorms.
- Energetic particles in geospace: ring current, Van Allen radiation belts, acceleration and loss mechanisms, wave-particle interactions.
- Outer planets: magnetosphere and satellites of Jupiter, magnetosphere of Saturn, rings and satellites of Saturn, magnetospheres of Uranus and Neptune.
- Inner planets: magnetic field of Mars, ionosphere of Venus, magnetosphere of Mercury.
- Comets and small bodies in the heliosphere.
- Principles of design and implementation of space missions, space instrumentation, analysis of spacecraft measurements.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Yes
Electronic communication with the students using ICT (Information and Communications Technology), Computer-aided lectures, use of Overhead Projectors, Use of email, e-class platform, doodle, OneDrive, Kahoot! platform.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>38</td></tr>
<tr><td>Exercises</td><td>10</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>53</td></tr>
<tr><td>Writing reports/essays</td><td>20</td></tr>
<tr><td>Interactive Teaching</td><td>4</td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving
Writing essays

Yes. They are announced during the first lectures and are available in the folder “Documents” of the course on the e-class platform.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

Space Physics - An introduction to plasmas and particles in the heliosphere and magnetospheres: May-Britt Kallenrode, Springer, 2004

Space Weather - Physics and Effects: Volker Bothmer and Ioannis A. Daglis, Springer, 2007

Introduction to Space Physics: Margaret G. Kivelson and Chistopher T. Russell, Cambridge University Press, 1995

Space Storms and Space Weather Hazards: Ioannis A. Daglis, Springer, 2001

Waves, particles and storms in geospace: Georgios Balasis, Ioannis A. Daglis, Ian R. Mann, Oxford University Press, 2016

- Related academic journals:

Annales Geophysicae

Journal of Geophysical Research: Space Physics

Geophysical Research Letters

Space Weather

Planetary and Space Science

Space Science Reviews

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3110	SEMESTER	8
COURSE TITLE	STELLAR SYSTEMS AND GALAXIES		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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, Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS252

(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 students acquire the necessary knowledge regarding interstellar medium, variable stars, double stars, cataclysmic variables, and X-ray binaries. It also includes the formation, evolution, and structure of galaxies and the Milky Way. In addition, students familiarize themselves with the concept of dark matter and specifically with the modern theories for its distribution and nature as well as with the observational evidence for its existence. Finally there is a section on Active Galactic Nuclei. With the completion of the course the student is able to Understand the physics of Interstellar Medium Know concepts such as rotation curves of spiral galaxies and decomposition of rotation curves. Describe the fundamental structure of galaxies, including that of the Milky Way. Know the laws that describe the distribution of luminous and dark matter in galaxies as well as the modern theories regarding the nature of dark matter, Understand the concept of accretion onto compact objects. Describe the basic properties of galaxies and their structure. Compute the mass distribution, rotation curve, and potential of galaxies. Apply Kepler's laws to deduce stellar masses Describe basic concepts regarding galaxies and their structure. Compare the luminous and dark matter content of a stellar system.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management	

Planning
Taking initiative/responsibility
New Technology skills
Learning word/excel/ppt/ origin/spss
Creativity
Determination
Communication skills
Information management
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Variable stars.
- Binary stars: Formation and evolution.
- Interstellar medium: Regions of molecular, atomic and ionized hydrogen.
- Mass accretion: Compact X-ray systems
- Star clusters: Dynamical evolution, HR diagram.
- Our galaxy: Spiral structure and rotation.
- Galaxies: Formation and evolution, active galactic nuclei and quasars.
- Local Group of Galaxies.
- Dark Matter (Distribution and Nature).
- Rotation Curves of Spiral Galaxies.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below
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 in Greek Open-ended questions, Problem solving

Activity	*Semester workload*
Lectures/ exercises	52
Individual Study/ Study and Analysis of bibliography / Preparation	73
Course Total	125

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

1) Αστροφυσική, τόμος Β’, Δομή και εξέλιξη του σύμπαντος: Γαλαξίες, Ηλιακό σύστημα, F. Shu, ΙΤΕ ΠΑΝ/ΚΕΣ ΕΚΔΟΣΕΙΣ ΚΡΗΤΗΣ, 2009, ΗΡΑΚΛΕΙΟ ΚΡΗΤΗΣ

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3111	SEMESTER	7
COURSE TITLE	GENERAL RELATIVITY AND COSMOLOGY		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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, Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	ιστοσελίδα eclass: https://eclass.uoa.gr/courses/PHYS262/ https://eclass.uoa.gr/modules/auth/opencourses.php?fc=64

(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 student acquires the necessary knowledge for the understanding of several physical quantities related to the subject og General Relativity and Cosmology both at the mathematical and the physical level. With the completion of the course the student is able To understand Riemann geometry and the covariance of Einstein's dynamical equations. Understanding and application of symmetries in the problem of solving the above equations. To handle the basic physical objects of the theory. To compose concepts and laws in a way which simplifies the solutions of complicated physical systems. To combine and find integrability conditions for a given set of equations. To evaluate the results of the solutions to specific 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…* *…….*
The course aims at the following general competences Decision-making Working independently Team work Production of new research ideas Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking New Technology skills Learning Mathematica programming language Creativity Determination Problem solving	

(3) SYLLABUS

- Tensors in linear spaces, manifolds, tensors in manifolds.
- Differentiation, torsion and curvature, covariant derivative, Lie derivative, Christoffel connection, Riemann curvature tensor, symmetries of geometrical objects.
- Einstein equation, energy-momentum tensor, weak gravitational fields.
- Symmetries (Killing fields), homogeneous spaces, spatial homogeneous space-times, Bianchi models.
- Spherical symmetric metric, Schwarzchild solution and its physical interpretation, observations, tests of general theory of relativity.
- Cosmology, the cosmological principle and the typical cosmological model.
- Friedmann-Robertson-Walker model, solutions, different eras in the universe evolution.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td colspan="2">Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td colspan="2">Yes
Electronic communication with the students using ICT (Information and Communications Technology)
Teaching support with computer and videoprojector
eclass platform</td></tr>
<tr><td rowspan="5">TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>Activity</td><td>Semester workload</td></tr>
<tr><td>Lectures/ exercises</td><td>52</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>73</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td colspan="2">Final written exams in Greek</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- *Suggested bibliography : Lecture notes*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	**E3201**	SEMESTER	8	
COURSE TITLE	Optoelectronics and Optical Communications			

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	*Specialised Knowledge*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS240/

(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 student acquires the necessary knowledge for the understanding of the operation of optoelectronic devices and optical communications systems and their structural elements including optical signal propagation in optical fibres as well as devices light sources, detectors and amplifiers.

With the completion of the course the student is able to:

A. Describe the generic operation of optoelectronic devices. Define their suitability to support more complex systems with emphasis on optical communications systems and combine these appropriately to achieve the required system operation and performance.

B. Explain the principle of operation of different optoelectronic devices and evaluate their suitability for different systems with emphasis on optical communications. Examine the efficiency of these systems and classify these according to their performance for a range of operation parameters.

C. Combine functions and construction elements, in order to design optoelectronic systems with given specifications. Develop relevant mathematical models to evaluate these systems. Compare different systems and propose optimal solutions regarding their operation and performance.

General Competences

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

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

The course aims at the following general competences

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Adapting to new situations
- Decision-making
- Working independently
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Production of free, creative and inductive thinking
- Analytical and synthetic thinking
- Critical thinking
- Time management
- Planning
- Information management
- Meeting Deadlines and Keeping Schedules
- Flexibility / Adaptability
- Problem solving

(3) SYLLABUS

- Waveguiding in optical fibres: geometrical and electromagnetic wave analysis
- Dispersion in optical fibres
- Optical Fibre Amplifiers
- Structure and characteristics of Light Emitting Diodes (LEDs) LED, semiconductor lasers and semiconductor optical amplifiers.
- Light detectors, typical photodiode structures, phototransistors, MSM and photovoltaic elements.
- Modern optical communication systems and networks

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures exercises</td><td>52</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>73</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Oral examination during the lectures</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *Optoelectronics: An introduction, John Wilson, John Hawkes (translation: Α. Σεραφετινίδης, Μ.Ι. Μακροπούλου, Α. Παπαγιάννης), ΕΚΔΟΣΕΙΣ Ε.Μ.Π, 2007, Αθήνα, Κωδικός Εύδοξου 20206*
- *Optoelectronics, New Improved, Singh Jasprit (μετάφραση: Μ. Δρακάκη), ΕΚΔΟΣΕΙΣ Α. ΤΖΙΟΛΑ & ΥΙΟΙ Ο.Ε., 2007, Αθήνα, Κωδικός Εύδοξου 50655998*

- Related academic journals:

Optics Letters, OSA
Optics Express, OSA
IEEE Photonics Technology Letters
IEEE Journal of Lightwave Technology
IEEE Journal of Optical Communications and Networking
IEEE Journal on Selected Areas in Communications
IET Optoelectronics
Optoelectronics Letters, Springer
Optics Communications Journal - Elsevier
Photonic Network Communications, Springer

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3202**	**SEMESTER**	**8**
COURSE TITLE	Automatic Control Systems		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	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*	*Specialised knowledge*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS241/

(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 Physical Education, and especially in the case of electronics, automated control courses can help to change the view of the physical system itself.
The concept of feedback is critical and meaningful in order to understand the way in which a natural system changes. It can help broaden the theoretical background of a theoretical physics while it is a necessary knowledge for an experimental physicist.
At the same time, automatic control systems are essential, basic knowledge for the specialization of electronics, as a large part of elementary electronic devices, telecommunication devices, etc., are based on feedback systems.
Modeling with automatic control methodologies, such as Laplace transformation techniques and determining the corresponding transfer functions, is the first step in describing and studying systems. Then the analysis with the state space equations (in the time domain and in the frequency domain) leads to the proper design of the appropriate automatic controllers for example to accelerate / slow down the evolution of the systems, as well as to determine and control their physical limits.
All of the above highlights a number of important tools for the design and execution of experimental processes as well as theoretical studies. In particular, closed loop and feedback systems play a catalytic role in complex systems encountered in electronic applications, such as analog and digital circuits and devices, in astronomy, such as adaptive optics, in Nuclear Physics, such as magnetic fusion restriction, in specific modes of operation of laboratory instruments (Atomic Force Microscopy), but also in neighboring disciplines such as Biology.
Furthermore, understanding the theory of linear control systems is important for approaching situations requiring automatic control tools and methodologies in physics science, such as quantum control (e.g. coherent control).
The course also includes a presentation of modern methodologies for the design of automatic control systems using computational platforms (MATLAB).

Individual objectives of the course - expected learning outcomes:
After completing the course the students are expected to:
1. Understand the basic features of the feedback concept and how it affects a linear dynamic system.
2. Describe the basic parts of a linear system using flow charts and the corresponding terminology.
3. Lay out the appropriate differential equations for a continuous time system.
4. Use methodologies and corresponding mathematical techniques for modeling the above systems (Laplace transforms and inverse transformations).
5. Form the transfer functions, feedback and error functions in electrical, mechanical and electronic systems.
6. Use and apply conversion from the time domain to the frequency domain and vice versa.
7. Draw up the exponential array of the system.
8. Solve a time invariant linear system (LTI) in the time and frequency domains.
9. To conclude about the stability of a system with single input and single output (SISO).
10. Design and interpret Nyquist diagrams.
11. Analyze Multi-Input / Output Systems (MIMO).
12. Design and interpret Bode diagrams.
13. Plan ahead and phase delay controllers.
14. Lay out the appropriate state space equations for a discrete time system.
15. Use methodologies and corresponding mathematical techniques for modeling the above systems (z transforms and inverse transformations).
16. Conclude on the stability of a discrete time system.

General Competences

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

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

The course aims at the following general competences

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
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility
New Technology skills
Learning C / Matlab programming language ...
Creativity
Determination
Information management
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- *Basic concepts, Laplace and inverse Laplace transform, applications.*
- *Transfer function (of complex frequency), feedback, steady state errors.*
- *State equations (electrical, mechanical, electronic systems).*
- *Matrices, matrix exponential, solution of LTI systems in frequency and time domain.*
- *Stability (SISO open and closed loop systems, MIMO systems)*
- *Bode plots, phase lag and lead networks and design.*
- *Discrete time systems, Z-transform, inverse Z, stability.*

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>52</td></tr>
<tr><td>Exercises</td><td>13</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>60</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

Suggested bibliography

- *Ogata, K., Modern Control Engineering, 2009 (Εύδοξος: 12346979).*
- *Dorf R.C., Bishop R.H., Modern Control Systems, 2003, (Εύδοξος: 59396181)*
- *Krikelis, N.I., Introduction to Automatic Control, 2002 (Εύδοξος: 45290).*

- Related academic journals:

- *IEEE Robotics & Automation Magazine*
- *IEEE Spectrum: Technology, Engineering, and Science News*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	E3203		SEMESTER	8
COURSE TITLE	**Microelectronics**			

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	eclass: https://eclass.uoa.gr/courses/PHYS239/

(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 student acquires the necessary knowledge for the understanding of the structure and the functionalities of fundamental microelectronic devices as well as the fabrication processes required for their realisation With the completion of the course the student is able to: A. Determine the fabrication steps required for the realisation of a microelectronic device. Moreover to describe the function of the fundamental microelectronic devices (pn diodes, MOSFET, CMOS) B. To identify the differences between alternative technological approaches and to estimate the performance of the corresponding realisations. To explain the operation of fundamental microelectronic devices taking into account their structural properties C. To combine the functions with basic structural elements in order to design microelectronic circuits with the desired specifications. To determine the optimal realisation techniques comparing the available technologies

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences • Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Respect for the natural environment • Production of free, creative and inductive thinking • Analytical and synthetic thinking • Critical thinking • Time management • New Technology skills • Information management • Meeting Deadlines and Keeping Schedules • Flexibility / Adaptability • Problem solving	

(3) SYLLABUS

- Development and fields of application in the realization of integrated circuits of silicon or compound semiconductors.
- Processes (crystal development, epitaxy, oxidation, doping via diffusion or ion implantation, metallization, lithography and subtractive processes).
- Structure of basic devices and physical design of integrated circuits.
- Application in the realization of logic gates and CMOS memory circuits.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures /Exercises</td><td>52</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>65</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Educational Visits</td><td>5 hr</td></tr>
<tr><td>Exams</td><td>3 hr</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125 hr</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Oral examination during the lectures</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- *Σχεδίαση Ολοκληρωμάτων CMOS VLSI ,Weste Neil H., Eshraghian Karman,(μετάφραση: Δημήτριος Σούντρης Κ. Πεκμεστζής), ΕΚΔΟΣΕΙΣ Α.ΠΑΠΑΣΩΤΗΡΙΟΥ & ΣΙΑ, 2010, Αθηνα,,Κωδικός Ευδοξου:9779*
- *Σημειώσεις «Εισαγωγή στη Μικροηλεκτρονική*

- Related academic journals

- *IEEE Journal of Quantum Electronics*
- *Physical Review*
- *Physical Review Letters*
- *Physica Status Solidi*
- *Journal of Applied Physics*
- *Applied Physics Letters*
- *J. Electrochem. Soc.*
- *International Journal of Nanotechnology,*
- *Microelectronic Engineering,*
- *Superlattices and Microstructures*
- *Semiconductor Science & Technology*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3204**	SEMESTER	7
COURSE TITLE	Introduction to Telecommunications Systems		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises) and Laboratory practice	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS257/

(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 student acquires the necessary knowledge for the understanding of the operation of analogue and digital telecommunications systems and the functions they comprise including modulation, digitisation and signal transmission over a communication channel. With the completion of the course the student is able to: **A.** Describe the generic operation of telecommunications systems. Define the generic functions of telecommunications systems and their structural elements and combine these appropriately to achieve the required system operation and performance. **B.** Explain the principle of operation of different telecommunications systems and evaluate their suitability for a variety of applications. Examine the efficiency of these systems and classify these according to their performance for a range of operation parameters. **C.** Combine functions and construction elements, in order to design telecommunications systems with given specifications. Develop relevant mathematical models to evaluate these systems. Compare different systems and propose optimal solutions regarding their operation and performance.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences • 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 • Showing social, professional and ethical responsibility and sensitivity to gender issues • Production of free, creative and inductive thinking • Analytical and synthetic thinking • Critical thinking • Time management • Planning • New Technology skills • Information management	

- Meeting Deadlines and Keeping Schedules
- Flexibility / Adaptability
- Problem solving

(3) SYLLABUS

- Description of telecommunications systems
- Analogue modulation
- Sampling and pulse modulation
- Pulse code modulation (PCM) systems
- Digital Modulation
- Propagation channel characteristics
- Laboratory experiments

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures/ exercises</td><td>9 weeks X 4 hrs/week=36 hrs
4 weeks X 2 hrs/week=8 hrs</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>57 hrs</td></tr>
<tr><td>Laboratory practice</td><td>4 week X 2 hrs/week=8 hrs</td></tr>
<tr><td>Writing reports/ essays</td><td>16 hrs</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek.
Oral examination during lectures and laboratory sessions.
Laboratory reports.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- *Communications Systems, 5η edition, S. Haykin & M. Moher, Εκδόσεις Παπασωτηρίου και ΣΙΑ ΙΚΕ, 2010, Αθήνα, Κωδικός Εύδοξου 9778*
- *Introduction to Telecommunications, Αθανάσιος Κανάτας, Εκδόσεις Τζιόλα, 2017, Αθήνα, Κωδικός Εύδοξου 68473981*

- Related academic journals:

IEEE Journal of Communications and Networks
IEEE Communications Letters
IEEE Communications Magazine
IEEE Transactions on Communications
IEEE Transactions on Information Theory
IEEE Journal on Selected Areas in Communications
IEEE Wireless Communications Letters
IEEE Wireless Communications
IEEE Transactions on Wireless Communications
IEEE Journal of Optical Communications and Networking

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3207	SEMESTER	8
COURSE TITLE	Computer Systems		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/modules/auth/opencourses.php?fc=64

(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 student acquires the necessary knowledge for the understanding of computer operating systems with respect to their architecture and organization as well as their efficient programming for utilizing computers in physics experiments or solving physics problems. With the completion of the course the student is able to Describe the basic architecture and organization of computer operating systems. Describe computing efficiency, algorithmic time complexity and parallelism of processes and threads. Explain the basic concepts of operating systems. Examine the various parameters that lead to improving the use of computers and digital computing boards in physics experiments and in computing techniques for problems in physics. Combine processes/threads and device drivers for the monitoring and data acquisition in physics experiments. Improve the efficiency of computing techniques for solving problems in physics. Evaluate the results of the computer solutions in physics 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…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Working independently Team work Project planning and management Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management Planning Taking initiative/responsibility New Technology skills Learning C / Matlab programming language ... Learning word/excel/ppt/ origin/spss Creativity Determination

Communication skills
Information management
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Types of operating systems, their structure, processes and system calls, processes and threads, process communication, semaphores, mutex, monitors, low level scheduling.
- Memory management, segments, virtual memory and paging, page replacement techniques, page size, thrashing and implementation issues.
- Directories, input/output, device handlers, and I/O software design principles.
- Deadlocks: Recovery and avoidance, security and cryptography principles, multiprocessor systems.
- Implementation in C and C++ code of relative example applications.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below

Activity	*Semester workload*
Lectures/ exercises	52
Individual Study/ Study and Analysis of bibliography / Preparation	48
Writing reports/ essays	25
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.*	Final written exams in Greek Mid-term written examination Writing essays

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
1. Modern Operating Systems, ANDREW S. TANENBAUM, KLEIDARITHMOS PUBLICATIONS LTD, 2009, Athens, Code: 13884
2. Operating Systems, Silberschatz Abraham, Galvin Peter B. ,Gagne Greg, PARIKOY PUBLICATIONS, 2009, Αθήνα, Code: 14841

- Related academic journals:

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3302	SEMESTER	7
COURSE TITLE	Physical Oceanography		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	eclass: https://eclass.uoa.gr/courses/PHYS130/

(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 student acquires the necessary knowledge for the understanding quantities related to ocean dynamics

With the completion of the course the student is able to

- Describe the physical properties of seawater, observational methods of the ocean dynamics and characteristics and the dominant pattern of oceanic circulation.
- Describe the laws of ocean dynamics.
- Calculate various physical oceanic parameters such as wind-driven circulation, thermohaline circulation and ocean waves of various scales (surface and internal).

After completion of the course. The student can:

- Compose concepts and physical laws that lead to the problem solving of ocean systems.
- Estimate various variables of the oceanic circulation and ocean waves.
- Combine physical laws that describe the ocean dynamics.

General Competences

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

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Respect for the natural environment
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Seawater properties, surface and vertical distribution of physical oceanography parameters in the world ocean.
- Conservation laws in physical oceanography.
- Currents without friction, shallow water equations and the conservation of vorticity in the ocean.
- Currents with friction: Wind-driven circulation, the Ekman surface layer and the westward intensification of ocean circulation.
- Thermohaline circulation.
- Surface gravity waves, internal waves, tides and ocean waves in the presence of rotation.
- Equatorial ocean dynamics

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures. exercises</td><td>52</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>73</td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Ωκεανογραφία, Εισαγωγή στο Θαλάσσιο Περιβάλλον, Α. Θεοδώρου, UNIBOOKS IKE, 2017, Αθήνα, 68369735

Ωκεανογραφία, Φ. Σακελλαριάδου, ΕΚΔΟΣΕΙΣ ΣΤΑΜΟΥΛΗ Α. Ε, 2007, 23058

- Related academic journals and textbooks:

S. Pond and G. L. Pickard, 1995, Introductory Dynamical Oceanography, 2nd edition, Butterworth-Heinemann, ISBN 0-7506-2496-5.

J. A. Knauss, 1997, Introduction to Physical Oceanography, 2nd edition, Prentice-Hall, ISBN 0-13-238155-9.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	E3305	SEMESTER	7	
COURSE TITLE	Synoptic Meteorology			
INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*			WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)			2	
Laboratory practice			2	
				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 Knowledge			
PREREQUISITE COURSES:	No			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes,in the English language for Erasmus students			
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS207/			

(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 student acquires the necessary knowledge to recognize, analyze and understand the weather charts and to study the vertical profile of weather systems in the troposphere in a way that they can be able to predict weather phenomena

With the completion of the course the student is able to

Describe the synoptic scale atmospheric circulation in the troposphere with the aid of weather charts.
Recognise the weather systems in the midlatitudes and define the associated weather phenomena

Explain the development, evolution and movement of weather systems.
Distinguish the weather phenomena and their duration
Appreciate the weather conditions in the following hours or days

Combine all data derived from the weather chart analysis
Compose the current meteorological situation
Organize the forecast of future meteorological situation

General Competences

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

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Team work
Working in an international environment
Project planning and management
Respect for the natural environment
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility

New Technology skills
Creativity
Determination
Communication skills
Information management
Self control skills
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problemsolving

(3) SYLLABUS

- Vertical structure of atmosphere,atmospheric pressure,air masses.
- Fronts and frontal surfaces,associated weather phenomena.
- Depressions and anticyclones,associated weather phenomena.
- Surface weather charts,isobaric charts,thickness charts.
- Temperature advection,vorticity and vorticity advection,vertical motion.
- General circulation of the troposphere,jet streams,Rossby waves,blocking systems.
- Combined analysis of surface and isobaric charts,system movement.

(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*	**Yes** Electronic communication with the students usingICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclassplatform
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*	(see table below)
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 in Greek using summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions Written exams for every lablratory course (once a week) using short-answer questions. Student presence is required in each lab class and replacement is demanded in case of justified absence

Activity	*Semester workload*
Lectures/ exercises	26 hours
Seminars	5 hours
Individual Study/Study and Analysis of bibliography / Preparation	63 hours
Laboratorypractice	26 hours
EducationalVisits	*5* hours
CourseTotal	***125*** hours

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography

- *Lessons of Meteorology and Climatology, A. Flocas, Ziti Publications 1997 (in greek)*
- *Introduction to Dynamic Meteorology A, Bartzokas, Parikos Publications, 2012 (in greek)*
- *Petterssen S.,m 1956: Weather Analysis and Forecasting, Mc Graw Hill*
- *Bluestein H., 1993: Synoptic and Dynamic Meteorology in Midlatitudes, Oxford University Press*

- Related academic journals:

- Meteorology and Atmospheric Physics
- Journal of Atmospheric Sciences
- Monthly Weather Review
- Quaterly Journal of Royal Meteorological Society

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	Y 3309	SEMESTER	8
COURSE TITLE	Climate – Climate Change		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	Specialised Knowledge.
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the Greek language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS238/

(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 provides the student with an understanding of the mechanisms associated with Climate and Climate Change. Upon completion of the course the student will be able to:

• understand the Planetary Energy budget and the mechanisms and processes that determine/ influence it,
• describe the general circulation of the atmosphere and link it to climate and climate change,
• define the hydrological cycle and calculate the water balance in the atmosphere,
• describe global climate and regional climate (Greece, the Mediterranean),
• understand and describe climatic classifications,
• define greenhouse gases and describe in particular their role in radiation balance and climate equilibrium.
• explain the role of suspended particles in the interaction of particles and radiation.
• describe the air-to-surface coupling mechanisms.
• comprehend natural climatic fluctuations of the atmosphere and the oceans.
• define and classify anthropogenic effects on the climate,

• describe climate simulation models with basic equations, initial and boundary conditions and feedback mechanisms,
• define a simple climate model, in terms of its structure and its basic components,
• describe the urban climate and explain the specific mechanisms that affect it,
• distinguish climate variability from climate change,
• interpret the effect of global climate variability on climate,
• understand climate projections in the future.

General Competences

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

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

The course aims at the following general competences:

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Decision-making
Working independently
Respect for the natural environment
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

- Planetary energy budget
- General atmospheric circulation
- Hydrological cycle.
- Greenhouse gases and their role in climate, aerosol particles and their impact to radiative transfer.
- Coupling processes of the atmosphere-oceans-land.
- Natural variations of the atmosphere and the oceans, forcing mechanisms.
- Climate simulation models, basic set of partial differential equations, initial and boundary conditio climate processes, feedback mechanisms.
- Global and regional climate, climate categorization.
- Climate variability and global climate (El Nino and Southern Oscillation – ENSO, North Atlantic Oscillation – NAO).

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology), Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	See table below

Activity	*Semester workload*
Lectures	26
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	73
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.*	Final written exams in Greek Open-ended questions, Problem solving – Examinations on the basis of four problems of equivalent weight. Solved problems and problems from previous examination periods uploaded to e-class platform.

(4) ATTACHED BIBLIOGRAPHY

Recommended bibliography:

1/ Atmosphere, C. Varotsos, ATHANASOPOULOS Editions, 2008.
2/ Special Chapters in Atmospheric Physics and Chemistry, ATHANASOPOULOS Editions, 2014.

Relevant scientific journals: CLIMATE, THEORETICAL AND APPLIED CLIMATOLOGY, CLIMATE CHANGE, NATURE - Climate

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3310	SEMESTER	8
COURSE TITLE	Renewable Energy Sources – Bioclimatic Design of Buildings		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS145/

(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 student acquires the necessary knowledge for the renewable energy sources and their application in the built environment. With the completion of the course the student is able to Describe the renewable energy sources. Define physical quantities related to the characteristic parameters of the renewable energy sources needed to calculate the provided and exploitable energy etc. Explain the basic concepts and principles of operation of the renewable systems. Calculate the efficiency of a systems as well as the provided and exploitable energy using the proper mathematical formulas. Compose concepts and physical laws that lead to the problem solving of the application of the renewable systems. Combine mathematical formulas in problems requesting the calculation of the efficiency of complex renewable systems. Evaluate the results of the physics 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…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Project planning and management Respect for the natural environment Analytical and synthetic thinking Critical thinking New Technology skills Information management Flexibility / Adaptability Problem solving	

(3) SYLLABUS

- Wind energy: Wind and characteristic parameters of wind, interaction of horizontal wind with the earth's surface, wind power equation, advantages-disadvantages.
- Solar energy: Solar radiation, active and passive solar systems, photovoltaics, applications.
- Biomass: Production, biomass sources and biomass conversion process, biomass products, advantages-disadvantages.
- Geothermal energy: Geothermal fields, applications of geothermal energy, environmental issues, advantages-disadvantages, applications.
- Hydroelectricity: Basic theory, characteristics of hydrothermal facilities, advantages-disadvantages, applications.
- Buildings: Bioclimatic design, active and passive systems, energy conservation, application of renewable systems in buildings.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	See table below
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 in Greek Open-ended questions, Problem solving Oral examination where appropriate

Activity	*Semester workload*
Lectures	26
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	70
Written Exams	3
Course Total	***125***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- Ήπιες και Ανανεώσιμες πηγές Ενέργειας-Σύγχρονες Τεχνολογίες, Η. Λειβαδά, Μ. Ασημακοπούλου ΕΚΔΟΣΕΙΣ Σ. ΑΘΑΝΑΣΟΠΟΥΛΟΣ & ΣΙΑ Ο.Ε
- Συμβατικές και ΅Ηπιες Μορφές Ενέργειας Κ. Μπαλαράς, Α. Αργυρίου, Φ. Καραγιάννης ΣΕΛΚΑ-4Μ ΕΠΕ

- Related academic journals:

Renewable and Sustainable Energy
Renewable Energy
Journal of Renewable Energy

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	E3405	SEMESTER	7	
COURSE TITLE	Mathematical 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
Lectures (theory and exercises)			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*	Specialised knowledge			
PREREQUISITE COURSES:	No			
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students			
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS230/			

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The first objective of the course is to develop skills related to solving physical problems of initial and boundary conditions using special functions and Green's functions.

The second objective of the course is to introduce group theory and its representations to develop skills for solving physical problems through their symmetries.

With the completion of the course the student is able to:

- Use special functions and characteristic polynomials (examples: Hypergeometric, Bessel, Legendre, Jacobi) as easy as using trigonometric functions.
- Calculate Green's functions of differential operators.
- Solve problems of initial and boundary conditions.
- Analyze finite groups in their structural characteristics.
- Determine irreducible representations of finite groups.
- Analyze reducible representations of finite groups in irreducible.
- Use irreducible representations to characterize energy eigenfunctions and provide selection rules for quantum systems.

By developing these skills, students will be able to:

- Solve complex problems in quantum mechanics, electromagnetism, and other areas of physics requiring the solution of differential equations with imposed initial and / or boundary conditions.
- Solve problems in atomic and molecular physics, solid state and High Energy Physics related to physical systems which possess discrete and continuous symmetries.
- To compose concepts and laws in mathematically self-consistent frameworks to solve complex physical problems.
- Evaluate his/her results.

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…*
	…….

By successfully attending and completing the course the student will acquire the following skills:

- Ability to search, analyze and compose data and information, using the appropriate technological tools.
- Ability to work autonomously.
- Train free, creative and inductive thinking.
- Train analytical and synthetic thinking.
- Ability to solve problems.

SYLLABUS

Special functions and Green's functions:

- Sturm-Liouville theory.
- Initial value problems.
- Inhomogeneous boundary conditions.
- Special functions and orthogonal polynomials. Eigenfunction expansion.
- General theory of Green functions
- Methods of computing Green functions
- Examples using Laplace and diffusion equations.

Elements of group theory:

- Basic definitions, abelian and non-abelian groups, finite and continuous groups.
- Subgroups, cyclic groups, generators.
- Cosets, Lagrange theorem, normal subgroups, factor groups, conjugacy clases.
- Reducible and irreducible representations, Schur's first and second lemma.
- Great orthogonality theorem.
- Character of a representation.
- Regular representation.
- Decomposition of reducible representations.
- Character tables.
- Applications in Quantum Mechanics.

(3) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, e-class platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>13</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>70</td></tr>
<tr><td>Writing reports/ essays</td><td>3</td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving
Mid-term written examination</td></tr>
</table>

(4) ATTACHED BIBLIOGRAPHY

- **Lectures on Mathematical Methods** (in Greek, on line), K. Sfetsos
- **Lectures Notes on Group Theory**, K. Sfetsos
- **Elements of Green's functions and propagation**, G. Barton, Oxford Science Publications
- **Mathematical Methods for Physicists**, G.B. Arfken & H.J. Weber
- **Mathematics of Classical and Quantum Physics**, F.W. Byron & R.W. Fuller, Dover

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3409	SEMESTER	8
COURSE TITLE	MEDICAL 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
Lectures (theory and exercises)	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*	Specialised Knowledge,
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS215/

(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*

Application of the basic principles of Physics and Technology and in particular of the Atomic & Nuclear Physics in Medical Imaging, Dosimetry and Radiotherapy. This course examines the basic application of ionizing radiation in medical diagnosis and treatment.

With the successful attendance and completion of the course, the student is in position to:

- Describe the basic characteristics of ionizing radiation.
- Understand the basic interactions of photons and charged particles with matter.
- Understand the basic principles underlying the imaging techniques of Nuclear Medicine.
- Identify the radiation risk and the protection procedures and methodology to be applied.

- Calculate all the physical quantities associated with the interaction of charged particles with matter (energy deposition, mean free path).
- Formulate the basic imaging principles governing projective and tomographic techniques for different types of radiation (X-rays, Single-Photon Emission Computed Tomography, Positron Emission and Magnetic Resonance Imaging).
- Calculate radiation dosimetry and explain the basic mechanisms for the application of ionizing beams to Radiotherapy.

- Design and analyze the operation of imaging devices in Nuclear Medicine.
- Compose and combine various tomographic techniques of medical physics.
- Critically evaluate radio-protection results and radio-therapy methods.

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Team work
Working in an interdisciplinary environment
Project planning and management
Respect for the natural environment
Production of free, creative and inductive thinking
Analytical and synthetic thinking

Critical thinking
Planning
New Technology skills
Creativity
Determination
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Radiation physics, production of ionizing and non-ionizing radiation, matter-radiation interaction.
- Biological effects of radiation, radiation protection, dosimetry.
- Medical imaging, diagnostic radiology, principles of computed tomography.
- Computed Tomography (CT), Single-Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET).
- Non-ionizing imaging techniques: Magnetic Resonance Imaging (MRI), ultrasound imaging.
- Radiotherapy, brachytherapy, heavy-ion radiotherapy.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of video Projectors, eclass platform, instructors websites</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures/ exercises)</td><td>52</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>52</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Writing reports/ essays</td><td>21</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Oral examination</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- ***ΙΑΤΡΙΚΗ ΦΥΣΙΚΗ*** (2η Έκδοση) Συλλογικό Έργο των Μελών του Εργαστηρίου της Ιατρικής Φυσικής, Επιμέλεια Ε. Γεωργίου, Εκδόσεις BROKEN HILL PUBLISHERS LTD (2013), Κωδικός Εύδοξου 32997826
- **Κ. Κάππας και Κ. Θεοδώρου: *Ακτινοβολίες και Ακτινοπροστασία***, Εκδόσεις BROKEN HILL PUBLISHERS LTD (2017), Κωδικός Εύδοξου 68373288

- Related academic journals:

- Annals of Nuclear Medicine
- Computers in Biology and Medicine
- IEEE Transactions on Image Processing
- IEEE Transactions on Nuclear Science
- IEEE Transactions on Radiation and Plasma Medical Sciences
- Journal of Instrumentation
- Medical Physics
- Nuclear Instruments and Methods in Physics Research (A & B)
- Physics in Medicine and Biology
- Radiation Physics
- The Journal of Nuclear Medicine

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3414	SEMESTER	8
COURSE TITLE	Special Subjects in Nuclear & Particle 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
Lectures (theory and exercises)	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*	Specialised knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS299/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The first objective of the course is to introduce the theory of Lie groups and their application in particle physics. Emphasis is given on SU(2), SU(3) and SU(N) groups and their representations.

The second objective of the course is to introduce the abelian and non-abelian gauge theories, the Higgs mechanism for spontaneous symmetry breaking and the formulation of the Standard Model .

With the completion of the course the student is able to:

- Understand the basic use of Lie groups in particle physics.
- Find representations of product states in a SU(N) Yang-Mills theory with N> 1.
- Use isospin symmetry to calculate transition amplitudes in hadronic decays.
- Understand the concept of local symmetry and the gauging of continuous symmetries.
- Use abelian gauge theoretical description to understand basic concepts of electromagnetism.
- Understand the basic mechanism for spontaneous symmetry breaking.
- Formulate from first principles the Standard Model of Particle Physics.

By developing these skills, students will be able to:

- Solve simple scattering problems in scattering of strong interacting matter.
- Find representations of composite systems consisting of elementary particles.
- Construct Lagrangians with prescribed symmetry properties.
- To construct theoretical models which describe spontaneously broken symmetries.
- Understand in depth the basic ingredients of models used in contemporary particle 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	*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…*
	…….

By successfully attending and completing the course the student will acquire the following skills:

- Ability to search, analyze and compose data and information, using the appropriate technological tools.
- Ability to work autonomously.
- Train free, creative and inductive thinking.
- Train analytical and synthetic thinking.
- Ability to solve problems.

3. SYLLABUS

Introduction to Lie groups in particle physics:

- SU(2) Lie group, isospin symmetry.
- SU(3) isospin symmetry.
- Applications of isospin symmetry in hadronic transitions and decays.
- Yang-Tableaus and representations of SU(N).

Introduction to gauge theories:

- Abelian and non-abelian gauge theories (examples). Applications in electromagnetism.
- Spontaneous breaking of gauge symmetry. Higgs mechanism. Application in the abelian (superconductivity in electromagnetism) and non-abelian case.
- Introduction to the phenomenology of the weak interaction.
- Weinberg-Salam Standard Model.
- GIM mechanism.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors,
e-class platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>13</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>72</td></tr>
<tr><td>Writing reports/ essays</td><td>1</td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exam in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- **Introduction to High Energy Physics**, D.H. Perkins, Cambridge University Press.
- **Lecture notes of the tutors** (in Greek)

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3415**	**SEMESTER**	**7**
COURSE TITLE	Astroparticle Physics and Cosmic Rays		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	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*	*Specialised Knowledge*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS219/

(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 student acquires the necessary knowledge for the understanding of several physical quantities related to Astroparticle Physics and Cosmic Rays.

With the completion of the course the student is able to

- Define what cosmic rays are, as well as nucleosynthesis, dark energy and dark matter and describe the basic properties of hadronic/ electromagnetic showers.
- Explain the basic methods of cosmic ray detection and recognize the basic detection experiments.
- Explain the recent experimental results and conclusions (hadronic showers, neutrinos, γ-rays, dark matter)

General Competences

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

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

The course aims at the following general competences

Analysis and synthesis of data and information
Decision-making
Working independently
Team work
Project planning and management
Analytical and synthetic thinking
Critical thinking
Taking initiative/responsibility
New Technology skills
Learning word/excel/ppt/ origin/spss
Communication skills
Information management
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Introduction: What is Astroparticle Physics. The Role of Elementary Particle Physics in the Understanding of the Universe.
- Cosmology - Early Universe:
- Expansion of the Universe. Hubble's Law. Thermodynamics of the early universe. Big Bang. Cosmic Background Radiation. Neutron - proton ratio. Primary nucleosynthesis.
- Microwave background measurements and effects on cosmology. Recent developments. Dark matter. Dark energy.
- Cosmic rays
- Primary cosmic rays- properties, neutrinos, γ-rays, Secondary cosmic rays, hadronic and electromagnetic showers, cosmic ray acceleration.
- Cosmic rays detection methods and devices
- Detection experiments, hadronic showers, neutrinos, γ-rays
- Recent experimental results: hadronic showers, neutrinos, γ-rays, dark matter.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVRY *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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below
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 in Greek

Activity	***Semester workload***
Lectures	26
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	73
Course Total	***125***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography
Κοσμική Ακτινοβολία , Ε. Χριστοπούλου-Μαυρομιχαλάκη, ΕΚΔΟΣΕΙΣ Μ. ΑΘΑΝΑΣΟΠΟΥΛΟΥ-Σ. ΑΘΑΝΑΣΟΠΟΥΛΟΥ Ο.Ε, 2009 , ΑΘΗΝΑ

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3416	SEMESTER	8
COURSE TITLE	Contemporary Quantum Mechanics & Applications		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	Specialised knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS253/

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
The first objective of the course is to introduce the concepts of density matrix, mixed states, multipartite systems, quantum entanglement, quantum information, qubits, quantum teleportation and quantum cryptography. The second objective of the course is to provide an introduction to classical and quantum open systems, decoherence, non-unitary evolution, Kraus operators and Lindblad equations. With the completion of the course the student: • Becomes familiar with time-dependent perturbation theory. • Becomes familiar with the use density matrix formalism to solve problems of multipartite quantum systems. • Understands the basic concepts concerning quantum correlations such as entanglement, discord, mutual information, etc . • Becomes familiar with the basic ingredients of quantum information theory. • Becomes familiar with the theoretical basis of the recent developments in quantum technology (teleportation, quantum cryptography, etc.). • Is able to solve problems of non-unitary evolution. • Becomes familiar with decoherence and its impact on quantum interference. By developing these skills, students will be able to: • Solve problems related to radiation-matter interaction. • Solve problems in open quantum systems and multipartite quantum systems. • Follow the recent developments in quantum information and technology. • Upgrade his conception of quantum mechanics. • Understand the role of environment in quantum mechanical applications.
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…* *…….*
By successfully attending and completing the course the student will acquire the following skills: • Ability to search, analyze and compose data and information, using the appropriate technological tools. • Ability to work autonomously. • Train free, creative and inductive thinking. • Train analytical and synthetic thinking. • Ability to solve problems.

(3) SYLLABUS

- Time-dependent perturbation theory, matter-radiation interaction, applications.
- Open quantum systems, density matrix.
- Quantum coherence-decoherence.
- Quantum entanglement, elements of measurement theory, EPR paradox, Bell inequalities.
- Elements of quantum information and quantum computers.
- Elements of quantum technology (quantum teleportation, quantum cryptography)
- Non-unitary evolution, Kraus operators.
- Quantum master equations, Lindblad equation.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>13</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>72</td></tr>
<tr><td>Writing reports/ essays</td><td>1</td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Lectures notes of the tutors (in greek)

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3511	SEMESTER	7
COURSE TITLE	PHYSICS OF MOLECULES AND NANOMATERIALS		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS235/

(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 offers to the student the necessary knowledge for the understanding of basic concepts of physics of molecules and nanomaterials with emphasis on fundamental aspects of molecular bonding and molecular spectra as well as the electronic structure of nanomaterials (graphene and carbon nanotubes). With the completion of the course the student is able to:

- Apply the adiabatic Born-Oppenheimer approximation in order to determine the electronic structure of the hydrogen molecule-ion and hydrogen molecule using molecular orbital (linear combination of atomic orbitals –LCAO) and valence bond theories.
- Analyze the electronic structure (energy diagrams, bonding-antibonding molecular orbitals and terms, HOMO-LUMO, bond order and spin) of diatomic and polyatomic molecules and construct the sp^n hybrid orbitals.
- Describe analytically nuclear motion (rotation, vibration) in diatomic molecules taking into account the effects of centrifugal distortion and anharmonicity and analyze the corresponding molecular spectra (rotational, vibrational and vibration-rotation) in order to calculate experimentally physical quantities of the molecules, such as the moment of inertia and equilibrium bond length.
- Distinguish the fine structure of electronic transitions due to vibrations-rotations and the spectral intensity variation based on the Franck-Condon principle.
- Apply the tight binding method to calculate the energy band structure of one-dimensional chain of atoms, polycatelyne and graphene (π and σ energy bands, linear energy dispersion relation, density of states).
- Describe the electronic band structure of carbon nanotubes (direct-reciprocal lattice, 1st Brillouin zone, zone folding-energy dispersion relation, metallic condition) classify them to metals and semiconductors according to their structural characteristics. Also, distinguish the density of states (Van Hove anomalies) of metallic and semiconducting nanotubes and the corresponding electronic transitions in relation to their diameter.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*

The course aims at the following general competences:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Working independently
- Analytical and synthetic thinking
- Critical thinking
- Problem solving

(3) SYLLABUS

- Electronic structure of molecules, molecular binding, the hydrogen molecule, diatomic and polyatomic molecules (molecular orbitals, valence bond method), molecular orbitals hybridization and delocalization.
- Molecular spectroscopy, vibrational and rotational spectra of diatomic and polyatomic molecules, electronic transitions, Frank-Condon principle.
- Physics of nanomaterials, electronic structure of graphene and carbon nanotubes, electronic transitions, van Hove singularities.
- Imaging methods for nanomaterials, atomic force microscopy, tunneling microscopy, near-field optical microscopy.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>26</td></tr>
<tr><td>Exercises</td><td>26</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>50</td></tr>
<tr><td>Writing reports/ essays</td><td>20</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek (90%)
Writing essays (10%)</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Notes «Introduction to Molecular Physics», M. Calamiotou, NKUA, 1992, Athens
Molecular Quantum Mechanics, P.S. Atkins, Editions PAPAZISI, 1999, Athens
Solid State Physics, H. Ibach, H. Luth, Editions P. & S. ZITI 2011, Thessaloniki

M. Karplus, R. N. Porter, Atoms and Molecules: An Introduction for Students of Physical Chemistry, W. A. Benjamin, 1970.
C. N. Banwell, Fundamentals of Molecular Spectroscopy, McGraw-Hill, 1994.
R. Saito, M. S. Dresselhaus, G. Dresselhaus, Physical Properties of Carbon Nanotubes, London: Imperial College Press, 1998.
S. Reich, C. Thomsen, J. Maultzsch, Carbon Nanotubes: Basic Concepts and Physical Properties, Wiley-VCH, Berlin, 2004.
H. Rasa, Graphene Nanoelectronics. Metrology, Synthesis, Properties and Applications, Springer-Verlag Berlin Heidelberg 2012.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3512**	SEMESTER	6
COURSE TITLE	Solid Earth Physics and Earthquake 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
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS276/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

1 In this course the student acquires the necessary knowledge for the understanding of physical microscopic processes in condensed matter and relation to large scale phenomena occurring in the earth's interior. Static and dynamic properties ofdense matterat extreme conditions of pressure and temperature, earth;s equation of state, pressure and temperature gradients in deep earth, phase transitions, non-equilibrium statistical mechanics, classic and quantum mass and charge transport, stress fields, electro-mechanical correlation with earthquake occurrence and critical phenomena are interpreted. Quantum phase transitions of dense hydrogen in the interion of large planets, cold melting and metal to insulator transition.

2. With the completion of the course the student is able to

Describe large scale phenomena in terms of atomic scale mechanisms.
Identify physcal laws in microscopic scale that underlie large scale phenomena in the earth's and planetary interior.
Combine knowledge of statistical mechanics, thermodynamics, electromagnetism and quantum physics.

Describe correlations between atomic – scale physical phenomena with planetary scale ones.
Calculate the values of quantities of solid and liquid state at extreme conditions of pressure and temperature, that occur in the earth;s and planetary interior.
Explain critical phenomena occurring in the earth;s interior.

Compose concepts and physical laws in microscopic scale, to explain physical phenomena under extreme conditions
Combine elementary physical laws to interpret complex phenomena.
Suggest models for critical and exotic states of matter..

General Competences

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

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

The course aims at the following general competences

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
New Technology skills
Creativity
Determination
Information management
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Pressure and temperature gradient in earth's interior, arth as a collection of harmonic oscillators, equation of state of yje earthmelastic wave propagation for exploring earth's interiorGruneisen theory, anharmonicity and melting.
- Non-equilibrium statistical mechanics, relaxation, diffusivity, conductivityviscosity
- Pont and linier defectsin solids. Critical stress field. Shear, fracture Ετερογένεια, αταξία, εντοπισμός ηλεκτρονικών καταστάσεων.
- Microscopic electro-mechanical coupling and geo-electric signal emission and earthquake occurrence.
- The interior of large planets, dense hydrogen inextreme gravitational field, solid metallic hydrogen, cold melting.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures/ exercises</td><td>52</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>71</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Educational Visits</td><td>2</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving
Mid-term written examination</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography
Lecture Notes a. A. Papathanassiou «Earth Physics"

- Related academic journals:
J. - P. Poirier,Introduction to the Physics of the Earth;s Interior, Cambridge University Press (2003)
S. Karato, Physics and Chemistry of the Deep Earth, Wiley (2013)
R. Kubo et al, Statistical Physics II (Nonequilibrium Statistical Mechanics),, Springer (1991)
K. Mao et al, Solid, liquids and gases under high pressure, Rev. Mod. Phys. 90, 015007, (2018)

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3513**	**SEMESTER**	**8**
COURSE TITLE	**Energy Conversion Devices**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises) and Laboratory practice	6	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 Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English/German language for Erasmus students
COURSE WEBSITE (URL)	: https://eclass.uoa.gr/courses/PHYS287/

(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 student acquires the necessary knowledge for understanding the principles of operation, the corresponding performance and the environmental impact of established as well as contemporary energy conversion devices (ECD). The presentation is fully analytical and quantitative. Laboratory exercises on four topics of teached matter are implemented as part of the course. The corresponding written lab reports are evaluated. The course is further supported by elaboration of problems covering all the teached matter. With the completion of the course the student is able to • *Describe the principles of operation of ECD's and recognize the nature of the conversion (direct, indirect)* • *Combine knowledge from different regions of physics which are necessary for understanding the principles of operation of conversion devices* • *Determine the basic operation parameters and corresponding technological limitations* • *Recognize the environmental impact of conversion devices and become sensitized on energy saving by rational use* • Explain basic concepts and microscopic mechanisms necessary for the operation of contemporary energy conversion devices. • Calculate basic parameters applying adequate concepts and equations • Estimate the influence of variation of external parameters on the performance of each individual conversion device • *Experimental Determination of physical properties and evaluation of the experimental data* • *Evaluate existing devices and propose ideas for possible improvement of their performance*
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Adapting to new situations Working independently Team work Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking

(3) SYLLABUS

- Physics of Photovoltaics: Elements of semiconductor physics, absorption of light, creation, recombination and life time of photocarriers. Characteristic of a photovoltaic cell, coefficient of performance, internal losses photovoltaic panels. Light trapping, concentration of light, Tandem cells.
- Thermoelectric phenomena and devices: Thermoelectric phenomena (Seebeck, Peltier, Thompson). Origin and relationship of these phenomena and relevant applications. Thermoelectric generator and Peltier cooling devices. Thermoionic phenomena, applications and thermoionic generator
- Thermodynamic cycles and Cooling devices: Thermodynamic analysis of power cycles (Rankine, Brayton, Stirling, Otto, Diesel) and applications of reversed cycles (refrigerator, air conditioner), heat pumps. Cooling with the aid of Joule-Thompson effect
- Magnetothermal effect adiabatic demagnetisation: magnetothermal effect, corresponding cooling devices. Demagnetisation of electronic spins.
- Introduction to fuel cells and electrochemical devices. Elements of fuel cells. Principle of operation, electrochemical devices, ionic conductors.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVRY *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*	**Yes** Computer-aided lectures, eclass platform
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*	see table below
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 in Greek Open-ended questions, Problem solving Laboratory reports

Activity	*Semester workload*
Lectures	13weeks x 4h/week 52
Exercises	15
Individual Study/ Study and Analysis of bibliography / Preparation	25
Laboratory practice	10
Writing reports/ essays	20
Written exams	3
Course Total	***125***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

- *«Thermodynamics and advanced thermodynamics», A. Polizakis, self-edition 2017*
- Lecture notes « Energy Machines», E. Syskakis. 2001

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	E3508	SEMESTER	7	
COURSE TITLE	Physics of Semiconductor Devices and Quantum Heterojunctions			

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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*	Specialised Knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	eclass: https://eclass.uoa.gr/courses/PHYS239/

(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 student acquires the necessary knowledge for the understanding of semiconductor physics and the functionalities of semiconductor devices. With the completion of the course the student is able to: • To describe the properties of semiconductors • To describe transport phenomena under the influence of electric and magnetic fields • To describe the operation principles of basic semiconductor devices • To identify the role of the impurities in the conductivity of semiconductors and to understand how the different carrier scattering mechanisms affect conductivity • To understand the mechanism of carrier generation and recombination and how these mechanisms affect the conductivity • To identify the specific characteristics of semiconductor junctions (p-n, Schottky, MIS, Heterojunction) • To explain the operational properties of fundamental semiconductor devices (JFET, MESFET, MOSFET) taking into consideration their structural characteristics and the corresponding physical mechanisms • To compare the different semiconductor devices, to estimate their maximum achievable performance in correlation to their corresponding functionalities and applications
General Competences
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim? *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences • Search for, analysis and synthesis of data and information, with the use of the necessary technology • Working independently • Analytical and synthetic thinking • Critical thinking • Problem solving

(3) SYLLABUS

- The Semiconductor in Equilibrium
- Carrier Transport Phenomena
- Nonequilibrium Excess Carriers in Semiconductors
- The p-n junction.
- Metal-semiconductor junction (Ohmic, Schottky).
- Heterojunctions (formation of quantum well)
- MIS and MOS junctions.
- Field Effect Transistor (JFET, MESFET).
- MOSFET transistor.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures. /exercises</td><td>52hr</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>70,5 h</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Exams</td><td>2,5 hr</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125 hr</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Oral examination during the lectures</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

Εισαγωγή στις Διατάξεις Ημιαγωγών, A. Neamen, ΕΚΔΟΣΕΙΣ ΓΡΗΓΟΡΙΟΣ ΧΡΥΣΟΣΤΟΜΟΥ ΦΟΥΝΤΑΣ,2014,Αθήνα, ***41956294***

Φυσική Ημιαγωγών, Γ.Π. Τριμπέρης, LIBERAL BOOKS ΜΟΝΟΠΡΟΣΩΠΗ ΕΠΕ, 2013,Αθήνα, ***50659222***

- Related academic journals

- *IEEE Journal of Quantum Electronics*
- *Physical Review*
- *Physical Review Letters*
- *Physica Status Solidi*
- *Journal of Applied Physics*
- *Applied Physics Letters*
- *J. Electrochem. Soc.*
- *International Journal of Nanotechnology,*
- *Microelectronic Engineering,*
- *Superlattices and Microstructures*
- *Semiconductor Science & Technology*

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3515	SEMESTER	7
COURSE TITLE	SOFT MATTER 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
Lectures (theory and exercises)	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*	*Specialised Knowledge*
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	*https://eclass.uoa.gr/courses/PHYS226/*

(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 student acquires the necessary knowledge for the understanding of several physical quantities related to the soft matter physics. With the completion of the course the student is able to Recognize and describe soft matter systems. Understand the molecular interactions and how these are combined to give rise to complex systems. Explain the basic concepts, principles and laws related to the organization and properties of polymers, liquid crystals, colloids, membranes, proteins. Acquire the basic theoretical knowledge relevant to some applications of soft matter physics. Use knowledge from electrostatic, statistical physics, thermodynamics, mechanics, and mathematical methods of physics for understanding of complex systems in soft matter physics. Calculate various physical parameters using the proper mathematical formulas. Compose concepts and physical laws that lead to the problem solving of complex physical systems. Combine mathematical formulas in complex physics problems. Evaluate the results of the physics 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…* *…….*
The course aims at the following general competences Search for, analysis and synthesis of data and information, with the use of the necessary technology Production of free, creative and inductive thinking Analytical and synthetic thinking Meeting Deadlines and Keeping Schedules	

(3) SYLLABUS

- What is soft matter, intermolecular interactions, interfaces.
- Mesophases, mesogens, order, disclinations, elasticity, anchoring, phase transitions, physical propreties, Fredericks transition, liquid crystal displays.
- Amphiphiles, micelles, self-organization, shape and geometry, membranes, vesicles, curvature elasticity.
- Solutions, electrolytes, double layer, screening potential, Poisson-Boltzmann theory, Debye-Huckel approximation.
- Colloids, Brown motion, Langevin equation, DLVO theory, stabilization, aggregation kinetics, osmotic pressure with interactions, electrokinetic effects.
- Polymers, chain models (ideal, freely rotated, worm like, gaussian chain) entropy, energy, radius of gyration, Kahn length, persistence length, Flory - Huggens theory, θ-temperature, self-similarity, self-avoidance, Flory theory.
- Proteins, coil-globule and helix-coil transition.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>Yes
Electronic communication with the students usingICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclassplatform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>40</td></tr>
<tr><td>Exercises</td><td>12</td></tr>
<tr><td>Individual Study Preparation</td><td>50</td></tr>
<tr><td>Study and Analysis of bibliography</td><td>9</td></tr>
<tr><td>Exercises</td><td>8</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Exams</td><td>6</td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>CourseTotal</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving
Mid-term written examination</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography

- Διεπιφανειακά Φαινόμενα και Κολλοειδή Συστήματα, Κ. Παναγιώτου, ΕΚΔΟΣΕΙΣ ΖΗΤΗ Ο.Ε, 1998.
- Σημειώσεις «ΦΥΣΙΚΗ ΒΙΟΛΟΓΙΚΗΣ ΥΛΗΣ», Ι. Λελίδης, 2014.
- P.G. de Gennes, J. Prost, The Physics of Liquid Crystals, Oxford, 2003.
- T. A. Witten, Structured Fluids, Oxford University Press (2004).
- J. Israelachvili. Intermolecular and surface forces. Academic Press, London, second edition (1992).
- S.A. Safran. Statistical thermodynamics of surfaces, interfaces and membranes. Westview Press, Boulder, CO, (2003).
- P.-G. de Gennes, Scaling concepts in polymer physics, Cornell University Press (1979).
- T. L. Hill, An introduction to statistical thermodynamics, Dover (1986).
- S. Chandrasekhar, Liquid crystals, Cambridge University Press, 1993.

- Related academic journals:

COURSE OUTLINE

(1) GENERAL

<table>
<tr><td>SCHOOL</td><td colspan="4">School of Science</td></tr>
<tr><td>ACADEMIC UNIT</td><td colspan="4">Physics</td></tr>
<tr><td>LEVEL OF STUDIES</td><td colspan="4">Undergraduate</td></tr>
<tr><td>COURSE CODE</td><td>E3910</td><td colspan="2">SEMESTER</td><td>6</td></tr>
<tr><td>COURSE TITLE</td><td colspan="4">Applied Optics</td></tr>
<tr><td colspan="3">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</td><td>WEEKLY TEACHING HOURS</td><td>CREDITS</td></tr>
<tr><td colspan="3">Lectures (theory and exercises)</td><td>2</td><td></td></tr>
<tr><td colspan="3">Laboratory practice</td><td>2</td><td></td></tr>
<tr><td colspan="3"></td><td></td><td>5</td></tr>
<tr><td colspan="3">Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</td><td></td><td></td></tr>
<tr><td>COURSE TYPE
general background, special background, specialised general knowledge, skills development</td><td colspan="4">Specialized Knowledge and Skills Development</td></tr>
<tr><td>PREREQUISITE COURSES:</td><td colspan="4">No</td></tr>
<tr><td>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</td><td colspan="4">Greek</td></tr>
<tr><td>IS THE COURSE OFFERED TO ERASMUS STUDENTS</td><td colspan="4">Yes,in the Greek language for Erasmus students</td></tr>
<tr><td>COURSE WEBSITE (URL)</td><td colspan="4">eclass website: https://eclass.uoa.gr/courses/PHYS161/</td></tr>
</table>

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

In this course the student acquires the necessary knowledge for the understanding of several physical quantities related to the nature of glass, which is the main component of all optical elements. The macroscopic characteristics of optical elements (radius of curvature, focal length, refraction index etc) are used in applications of several optical instruments in science. These applications are presented, analyzed, while at the same time experimental exercises are conducted for better understanding of optical characteristics.

With the completion of the course the student is able to:

Describe an optical system.
Define the physical parameters and optical characteristics of an optical system.
Combine theoretical knowledge in optics with its applications on optical setups and optical and astronomical instruments.

Explain the basic concepts of optics.
Distinguish optical instruments and explain their operation.
Calculate physical parameters of an optical system and be in position to solve an optical system, using the proper mathematical formulas, in various ways (geometrical optics, matrix method, etc).

Compose concepts and physical laws that lead to the problem solving of complex optical systems.
Combine mathematical formulas in complex optics problems.
Evaluate the results of the physics problems.
Set up an experiment on the optical bench, in order to solve an optical system.

General Competences

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

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

The course aims at the following general competences

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
Analytical and synthetic thinking
Critical thinking
Time management
Planning
Taking initiative/responsibility
New Technology skills
Learning C / Matlab programming language ...
Learning word/excel/ppt/ origin/spss
Creativity
Determination
Communication skills
Information management
Self control skills
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- Optical imaging theory (first and third order), ray tracing, optical aberrations (lens and mirrors), optical aberration correction.
- Optical systems, image quality criteria.
- Interference, interferometry, diffraction (near and far field), spectrographs.
- Holography, optical guidance systems, optical materials, optics of solids.
- Polarization, polarimetry, Fourier optics.
- Laboratory exercises.

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, eclass platform
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*	see table below

Activity	***Semester workload***
Lectures	(10w x 2hr/w) = 20
Exercises	(10w x 2hr/w) = 20
Individual Study/Study and Analysis of bibliography / Preparation	(13w x 4hr/w) = 52
Laboratory practice	(6w x 2hr/w) = 12
InteractiveTeaching	(9w x 2hr/w) = 18
EducationalVisits	(2w x 1,5hr/w) = 3
CourseTotal	***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.*	Final written exams in Greek Open-ended questions, Problem solving Oral examination Laboratory reports

(5) ATTACHED BIBLIOGRAPHY

- Suggestedbibliography

Οπτική, E. Hecht (Shaum's outline series) (Μετάφραση: I. Σπυριδέλης, Σ. Σπυριδέλη, Α. Καπνίδου), ΕΣΠΙ Εκδοτική

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	E3911	SEMESTER	8
COURSE TITLE	Stochastic Processes in 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
Lectures (theory and exercises)	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*	General background
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (occasionally English for ERASMUS students)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS246/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The aim of this course is to introduce the student to stochastic processes and their relevance in physical phenomena. After an introduction to probability theory and estimation theory, the student is exposed to the concept of random walks, where the analysis focuses on their properties and the importance of dimensionality. Taking the continuum limit, the concept of Brownian motion is introduced. Its properties are analyzed using stochastic differential equations, and the corresponding Fokker-Planck equation. Finally, Brownian path-integrals are introduced and their relationship with quantum mechanics are analyzed.

With the completion of the course the student is able to:

- master the basic concepts of probability and estimation theory;
- understand the concepts behind the central limit theorem, as well as the criteria for its failure;
- explain the role of dimensionality in the properties of random walks;
- understand the notion of Brownian motion and its applications
- use the tools and methodologies of Brownian motion to solve advanced problems by first finding the correct differential equations, and then solving them;
- understand the concept of Brownian path-integrals and where they are applicable;
- solve simple problems in probability, estimation and detection
- solve first passage time problems using the diffusion equation with various boundary conditions
- apply techniques from stochastic processes in a wide range of situations;
- use the tools, methodologies, language and conventions of stochastic processes to test and communicate ideas and explanations not only in Physics but in other fields as well;

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…*
	…….

By successfully attending and completing the course the student will acquire the following skills:

- Ability to search, analyze and compose data and information, using the appropriate technological tools.
- Ability to work autonomously.
- Train free, creative and inductive thinking.
- Train analytical and synthetic thinking.
- Ability to solve problems.
- Ability to making a convincing presentation of a technical subject and the ability to think on their feet, answering questions on the material

3. SYLLABUS

1. Introduction: Random variables, distributions, moments, moment generating function, Bayes Theorem.
2. Estimation Theory: Hypothesis testing, estimation of variables using MMSE, MAP
3. Central Limit Theorem: proof, examples where it fails (Cauchy)
4. Discrete random walks: Fundamental equation, Polya Theorem, Mean number of distinct sites visited
5. Levy processes
6. Diffusion Equation: Properties, Probability Current, Boundary conditions, First passage time calculation
7. Green's function
8. Brownian motion: Properties, nondifferentiability, Ito – Stratonovich differences
9. Stochastic Diff. Equation
10. Fokker Planck Equation: Properties
11. Ornstein-Uhlenbeck Process – Langevin Equation
12. Classical Caldeira – Leggett Model
13. Introduction to Brownian path integrals: Feynman - Kac formula, Derivation, Applications

(3) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures, use of Overhead Projectors, e-class platform
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*	see table below
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.*	Homeworks Presentation at the end of the semester on an application of the course material in a real physical situation

Activity	*Semester workload*
Lectures/ exercises	52
Individual Study/ Study and Analysis of bibliography / Preparation	73
Course Total	**125**

(4) ATTACHED BIBLIOGRAPHY

- A. Παπούλης, «Πιθανότητες, Τυχαίες Μεταβλητές και Στοχαστικές Διαδικασίες», McGraw Hill.
- Itzykson, Drouffe, “Statistical Field Theory”, Cambridge University Press
- H. Risken, “The Fokker-Planck Equation”, Springer Verlag
- D. Lemons, “Introduction to Stochastic Processes in Physics”, J. Hopkins University Press
- W. Paul, J Baschnagel, “Stochastic Processes, from Physics to Finance”, Springer Verlag
- Selected Journal Papers

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	E3991		SEMESTER	7
COURSE TITLE	Current issues on Cell Biology			

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	3	
Laboratory practice	2	
		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 Knowledge General Background Skills Development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (Teaching in Greek language, Exams in English language)
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/BIOL216/

(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 deals with the organization, structure and function of the cell, including biological membranes and cellular organelles. It examines the first step in the flow of genetic information and organization of DNA, and the later steps that end in protein synthesis. Students will study the post-translational modifications, the sorting and targeting of proteins and the mechanisms behind cellular polarity. Emphasis will be given in the structure and role of peroxisomes, lysosomes, mitochondria, chloroplasts, and cytoskeleton. Introduction in the concepts of intra-, extra- and inter-cellular communication, as well as in signal transduction. By the end of the lectures and the laboratory exercises, students are expected to be able to:

- describe the organization of a model cellular system
- identify the composition and function of intra-cellular and extra-cellular structures
- describe the flow of genetic information from nucleic acids (encoding, storage - packaging and expression of genetic information) to biogenesis of mature, functional proteins (prokaryotic / eukaryotic ribosome and the mechanisms of protein synthesis)
- identify and describe the flow of energy in cells, and the mechanisms of cellular communication
- select, apply and interpret the results of conventional Cell Biology techniques, such as Electron Microscopy, Optical Microscopy and Staining.

Knowledge

At the end of the course students should:

- understand the concepts related to the structure of a model cellular system, such as building blocks, biological membranes, cytoskeleton, cellular organelles and extracellular matrix
- identify and explain the organization of the flow of genetic information and cellular organelles
- describe the mechanisms of protein synthesis and the organelles via which it is performed
- explain and describe processes of the modification and degradation of bio-molecules in a model cellular system, through mechanisms implicated in the lysosomal - proteasomal degradation, endocytosis and autophagy
- identify and understand the cell-cycle function
- explain and understand the processes of intra-/inter-cellular communication of a model animal cell system
- dissect and describe the mechanisms of production and cellular management of energy and heat
- identify the post-translational protein modifications, sorting and targeting processes, as well as cellular polarity
- apply the appropriate research methodology and techniques required to study the structure, organization and operation of a model cellular system

Skills

At the end of the course students should:

- be able to explain the processes of signal transduction and intra-/inter-cellular communication of a model animal cell system

- manage to handle scientific instruments with ease and reliability
- have the ability to implement and adapt a research protocol accordingly
- identify and classify the various cell types and cellular organelles
- develop the ability to examine cellular behavior, with respect to mechanisms governing cellular function and organization

Abilities

At the end of the course students should:

- combine techniques in order to successfully respond to biological questions about the animal cell
- interpret results, draw conclusions and make new assumptions regarding the structure and operation of an animal system
- be able to comment on the physiological or pathological organization, flow of information and function of the animal cell, and to review the data
- develop competence to compare and evaluate data with respect to signaling, energy metabolism and cellular response to signal-transduction mechanisms

General Competences

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

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

The course aims at the following general competences

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

(3) SYLLABUS

INTRODUCTION: STRUCTURAL ELEMENTS - CELLULAR ORGANIZATION (3 Hours): Origin and evolution of organisms. Structural elements - from bio-molecules to cells. Bonds of structural elements and bio-molecules. Cellular organization. Historical overview of Cell Biology. The status of Cell Biology among Biosciences. Dynamics of cellular structure and function. Structure and function of representative cell types. Ultra-structural analysis of cellular organization

BIOLOGICAL MEMBRANES - SEPARATIVE FUNCTIONAL DOUBLE LAYERS (6 Hours): Components of biological membranes. Fluidity and its regulation in organisms. Specialized methodology. Properties of biological membranes. Models describing the structure and function of biological membranes. Specialized membrane systems

FIRST STEP IN THE FLOW OF GENETIC INFORMATION: DNA ORGANIZATION LEVELS (3 Hours): Coding, storage - packaging and decoding of genetic information. Nucleus, nucleolus and chromosomal components. Nuclear envelope, nuclear skeleton and nuclear pores. Human Genome Project (HGP)

SECOND STEP IN THE FLOW OF GENETIC INFORMATION: PROTEIN SYNTHESIS (3 Hours): Protein synthesis. The prokaryotic ribosome. The eukaryotic ribosome. Mechanisms of protein synthesis. Simultaneous translation of an mRNA transcript from multiple ribosomes

POST-TRANSLATIONAL MODIFICATION - PROTEIN SORTING, TARGETING AND CELLULAR POLARITY (3 Hours): Compartmentalization - Fundamental pathways of protein sorting. “Gated” transport of bio-molecules between cytosol and nucleus. Protein transport across membranes. Sorting, transport and protein targeting through vesicle-mediated processes

CELLULAR ORGANELLES PRODUCING AND CONVERTING ENERGY: MITOCHONDRIA AND CHLOROPLASTS (3 Hours): Morphology, molecular composition and function of mitochondria. Structure - Function, relationship. Morphology, composition and function of chloroplasts. Origin and distribution of their molecular components. Structure and function semi-autonomy. Information flow - Transcription and Translation

CELLULAR ORGANELLES FOR THE PROCESSING AND DEGRADATION OF BIO-MOLECULES: PEROXISOMES AND LYSOSOMES (3 Hours): Morphology and function of peroxisomes. Morphology and function of lysosomes. Participation of lysosomes in the processes of endocytosis (pinocytosis and phagocytosis) and autophagy Contribution of lysosomes to cellular function

CELLULAR FIBRILS - CYTOSKELETON (6 Hours): Microfilaments. Actin participation in the cellular mechanisms of movement. Intermediate Filaments (IF). Characteristic types, intracellular organization and distribution of Intermediate Filaments. Microtubules, nucleation mechanisms. Microtubule Organizing Centers (MTOCs). The role of microtubules in mitosis. Cilia and flagella. The Actin-Myosin system. Proteins of thick and thin myofibrils. Interactions of myofibrils with extracellular matrix. Filaments and cellular shape. Microvilli

CELLULAR COMMUNICATION AND CONJUNCTION (3 Hours): Morphological manifestation of communication: Cellular junctions. Communication junctions. Occluding junctions. Anchoring junctions. Cellular adherence. Chemotaxis

EXTRACELLULAR MATRIX (3 Hours): Components, organization and function of extracellular matrix. Collagens and elastins. Glycosaminoglycans (GAGs) and proteoglycans (PGs). Extracellular matrix proteins for multiple binding. Basement membrane. Supra-molecular structure of extracellular components

CELL CYCLE - REPRODUCTION (3 Hours): Cell growth and division. Inter-phase. Cell-cycle regulation during inter-phase. Cell-cycle progression and the distinct restriction - check points. Regulation of cell-cycle check points. Mitosis and cytokinesis. Mechanisms controlling mitosis. Meiosis. Stages of the meiotic divisions I and II

Laboratory Exercises:

1. Light Microscopy
2. Staining
3. Mitosis-Meiosis
4. Blood types
5. Osmosis
6. Electron Microscopy
7. DNA isolation

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39 hours (1,56 ECTS)</td></tr>
<tr><td>Exercises</td><td>14 hours (0,56 ECTS)</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography</td><td>50 hours (2 ECTS)</td></tr>
<tr><td>Preparation for evaluation</td><td>22 hours (0,88 ECTS)</td></tr>
<tr><td>Course Total</td><td>125 hours (5 ECTS)</td></tr>
</table></td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek and in English for ERASMUS students
Open-ended questions,
Problem solving

The average grade of Laboratory Exercises contributes 20% to the final, total, course grade.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

«Βιολογία Κυττάρου», Μαργαρίτης Λ. Χ., Γαλανόπουλος Β. Κ., Κεραμάρης Κ. Ε., Μαρίνος Ε. Σ., Παπασιδέρη Ι. Σ., Στραβοπόδης Δ. Ι., Τρουγκάκος Ι. Π., 4η Έκδοση, Ιατρικές Εκδόσεις Λίτσας Ο.Ε., Αθήνα, 2008 - ISBN: 90-372-077-1

«Βιολογία Κυττάρου - Μοριακή Προσέγγιση», Μαρμάρας Β., Λαμπροπούλου - Μαρμάρα Μ., 5η Έκδοση, TYPORAMA - Αγοριανίτης & ΣΙΑ Ε.Ε., Πάτρα, 2005 - ISBN: 960-7620-13-5

«Το Κύτταρο: Μια Μοριακή Προσέγγιση», Geoffrey M. Cooper & Robert E. Hausman, ΕΠΙΤΟΜΗ ΕΚΔΟΣΗ, Ακαδημαϊκές Εκδόσεις Ι. Μπάσδρα & Σια Ο.Ε., Αθήνα, 2013 - ISBN: 978-960-99895-8-9

«Μοριακή Βιολογία του Κυττάρου», B. Alberts, A. Johnson, J. Lewis, D. Morgan, M. Raff, K. Roberts, P. Walter, J. Wilson, T. Hunt, UTOPIA, Αθήνα, 2018, ISBN: 978-618-5173-29-6

- Related academic journals:

Journal of Cell Biology, Nature Cell Biology, Cell, Nature Reviews Molecular Cell Biology, Trends in Cell Biology, Journal of Molecular Cell Biology, Cell Biology and Toxicology, European Journal of Cell Biology, Cell Metabolism, Cell Research, Molecular Cell, Cell Reports

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3996**	SEMESTER	7
COURSE TITLE	Differential Geometry and Applications		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	6	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 - Specialised Knowledge.
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/

(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 concerns the development of the theory of Curves and Surfaces in a rigid, systematic and in depth fashion, as well as certain applications to specific problems in Geometry and Physics. After a successful and complete attendance of the course, a student is able to:

- Handle parametrised curves and find their reparametrization with arc length.
- Compute the curvature and torsion, as well as the Frenet frame for curves in 3-dimensional space.
- Find the form of the curve, given its curvature and torsion.
- Apply the equations of motion of the Frenet frame, in order to solve specific problems in Geometry and Physics.
- Calculate the first fundamental form, as well as geometric elements, such as angles, lengths and areas for parametrised surfaces.
- Calculate the primary curvatures, the shape operator, mean curvature, Gaussian curvature, as well as the primary directions for parametrised surfaces in 3-dimensional space.
- Applydifferential geometry techniques in order to find orthogonal reparametrizations as well as reparametrizations of primary directions of surfaces.
- Apply the Egregium theorem of Gauss in order to solve geometric problems for surfaces, and to distinguish elements of internal geometry of surfaces.
- Apply the Gauss Bonnet formula and compute the equations of geodesics.

General Competences

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

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

The course aims at the following general competences

Working independently
Production of free, creative and inductive thinking
Analytical and synthetic thinking
Critical thinking
Problem solving

(3) SYLLABUS

• Regular curves, arc length, parametrization with arc length, curvature and torsion with respect to arc length, curvature and torsion, Frenet-Setter frame, Fundamental Theorem. • Regular surfaces, tangent plane, Gauss map and shape operator, second fundamental form, primary curvatures, Gauss curvature and mean curvature, isometries, Egregium Theorem of Gauss, internal geometry, geodesics, Gauss Bonnet theorem.

(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*	**No**
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*	(see table below)
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 in Greek Oral examination (when necessary)

Activity	*Semester workload*
Lectures	52
Exercises	26
Individual Study/ Study and Analysis of bibliography / Preparation	72
Course Total	***125***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography

1. Elementary Differential Geometry, Andrew Pressley, Translation: I. D. Platis. Crete University Press, 2011, Heraklion.
2. Elementary Differential Geometry, Barrett O'Neil, Translation: L. Papaloukas, A. Melas, Crete University Press, 2002, Heraklion.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3997**	**SEMESTER**	**8**
COURSE TITLE	**CHEMISTRY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures (theory and exercises)	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*	General background/Specialized general knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS267/

(2) LEARNING OUTCOMES

Learning outcomes
The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described. *Consult Appendix A* • *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area* • *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B* • *Guidelines for writing Learning Outcomes*
With the completion of the course the student is able to: Describe the atomic structure and the periodicity of the atomic properties. Define the type and the strength of the bonds between the atoms of a specific molecule as well as the intermolecular interactions. Determine the physical properties of chemical systems. Classify the chemical reactions in spontaneous or not spontaneous using thermodynamic criteria. Express the concentration of a solution in different ways. Describe the acidic or basic behavior of chemical substances as well as buffer solutions. Explain the atomic structure. Distinguish between acidic, basic and neutral solutions. Calculate the concentration of a solution. Estimate the strength of a chemical bond. Combine meanings such as the structure of the atoms which compose the materials and conclude their state and physical properties. Explain the spectral characteristics of the chemical molecules and propose their possible structure. Design a buffer solution with buffering capacity of specific range.

General Competences	
Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?	
Search for, analysis and synthesis of data and information, with the use of the necessary technology *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas*	*Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Adapting to new situations Decision-making Working independently Working in an interdisciplinary environment Production of new research ideas Project planning and management Respect for the natural environment Criticism and self-criticism Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management Planning	

New Technology skills
Creativity
Determination
Communication skills
Information management
Self control skills
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- *Atoms and Periodic System.*
- *Chemical Bond.*
- *States of Matter.*
- *Chemical Thermodynamics.*
- *Chemical Equilibrium and Chemical Kinetics.*
- *Solutions in Chemistry. Acids and Bases.*
- *Redox reactions.*
- *Topics in Spectroscopy.*

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises</td><td>13</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>60</td></tr>
<tr><td>Interactive Teaching</td><td>13</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Final written exams in Greek
Open-ended questions, Problem solving
Mid-term written examination
Writing essays</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography
1. Βασικές Αρχές Ανόργανης Χημείας, Πνευματικάκης Μητσοπούλου, Κ. Μεθενίτης, ΕΚΔΟΣΕΙΣ UNIBOOKS, 2006, ΑΘΗΝΑ.
2. Βασική Ανόργανη Χημεία, Ν. Κλούρας, ΕΚΔΟΣΕΙΣ ΤΡΑΥΛΟΣ & ΣΙΑ Ο.Ε., 2002.

- Related academic journals:
Journal of Chemical Education, American Chemical Society (ACS) Publications

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**E3998**	**SEMESTER**	**8**
COURSE TITLE	**LABORATORY OF CHEMISTRY**		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Laboratory practice/Exercises	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*	General background/Specialized general knowledge/skills development
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes, in the English language for Erasmus students
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PHYS259/

(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 practical course the student acquires the necessary knowledge for the understanding of several physicochemical processes related to salts' dissolution, solutions and solubility, thermochemical measurements, study of chemical kinetics and redox reactions. With the completion of the course the student is able to Prepare solutions of specific concentration and Express it in different ways. Describe the acidic or basic behavior of chemical substances. Handle buffer solutions. Classify the redox chemical reactions in spontaneous or not spontaneous using thermodynamic criteria. Recognize the products of chemical reactions. Calculate the concentration of a solution. Distinguish between acidic, basic and neutral solutions. Explain the effect of temperature on the solubility of various solids Judge whether a redox reaction can take place Criticise the strength of an acid or a base. Evaluate the experimental results.
General Competences *Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?* *Search for, analysis and synthesis of data and information, with the use of the necessary technology* *Adapting to new situations* *Decision-making* *Working independently* *Team work* *Working in an international environment* *Working in an interdisciplinary environment* *Production of new research ideas* *Project planning and management* *Respect for difference and multiculturalism* *Respect for the natural environment* *Showing social, professional and ethical responsibility and sensitivity to gender issues* *Criticism and self-criticism* *Production of free, creative and inductive thinking* *……* *Others…* *…….*
The course aims at the following general competences Adapting to new situations Decision-making Working independently Team work Working in an interdisciplinary environment Production of new research ideas Project planning and management Criticism and self-criticism Production of free, creative and inductive thinking Analytical and synthetic thinking Critical thinking Time management

Planning
Taking initiative/responsibility
New Technology skills
Creativity
Determination
Self control skills
Meeting Deadlines and Keeping Schedules
Flexibility / Adaptability
Problem solving

(3) SYLLABUS

- *Preparing Solutions and Making Dilutions.*
- *Solubility of Salts.*
- *Thermochemitry.*
- *Chemical Equilibrium.*
- *Titration, pH, pK_a of acetic acid and buffer solutions.*
- *Redox reactions and Titration of $KMnO_4$ solutions.*

(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*	**Yes** Electronic communication with the students using ICT (Information and Communications Technology) Computer-aided lectures via eclass platform.
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*	(see table below)
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 in Greek. Open-ended questions, Problem solving. Laboratory reports. Oral examination (when required).

Activity	***Semester workload***
Exercises	13
Individual Study/ Study and Analysis of bibliography / Preparation	38
Laboratory practice	39
Writing reports/ essays	35
Course Total	***125***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography (in Greek)
Εργαστηριακές Ασκήσεις Γενικής και Ανόργανης Χημείας, Ι. Μαρκόπουλος, Χ. Μητσοπούλου, Α. Καραλιώτα, Κ. Μεθενίτης, Μ. Παπαρηγοπούλου, Δ. Σταμπάκη, Ν. Ψαρουδάκης, Γ. Καλατζής, Π. Κυρίτσης, ΕΚΔΟΣΕΙΣ UNIBOOKS, 2005, ΑΘΗΝΑ.

- Related academic journals:
Journal of Chemical Education, American Chemical Society (ACS) Publications.

COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science			
ACADEMIC UNIT	Physics			
LEVEL OF STUDIES	Undergraduate			
COURSE CODE	E3999		SEMESTER	7
COURSE TITLE	PHYSICS TEACHING METHODS			

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	WEEKLY TEACHING HOURS	CREDITS
Lectures (theory and exercises)	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 knowledge
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.uoa.gr/courses/PRIMEDU355/

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The aim of the course is Physics undergraduate students' familiarization with basic concepts of Science Education and Didactics of Physics in particular so that they can apply them to the design and implementation of teaching in Secondary Education.

With the completion of the course students have achieved goals related to knowledge, skills and abilities. In particular, they are able to:

- Describe the subject of Didactics of Physics and the main teaching models, such as constructivist and inquiry teaching models.
- Identify concepts such as scientific literacy and scientific citizenship and recognize them in the aims and objectives of science education curricula in Secondary Education.

- To identify and reconstruct students' misconceptions related to Physics' concepts.
- Design and implement Physics lessons using appropriate teaching strategies, appropriate teaching models as well as modern educational software.
- Explain the importance of non-formal learning sources in school practice and describe how to use them both in formal and non-formal education.

- Compare the proposed teaching models and choose the most appropriate for each case.
- Designing small projects for the classroom using the relevant scientific procedures.
- Combine different methods of Didactics of Physics in order to teach concepts, phenomena, experiments and interpretations of natural phenomena.
- Evaluate the results of a teaching proposal.

General Competences

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

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

The course aims at the following general competences

- Adapting to new situations
- Decision-making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Showing social, professional and ethical responsibility and sensitivity to gender issues
- Criticism and self-criticism
- Production of free, creative and inductive thinking

- Analytical and synthetic thinking
- Critical thinking
- Time management
- Planning
- Taking initiative/responsibility
- New Technology skills
- Creativity
- Determination
- Communication skills
- Self-control skills
- Flexibility / Adaptability
- Problem solving

(3) SYLLABUS

- Scientific literacy
- Theories of learning in science education
- Misconceptions
- Teaching models
- Inquiry-based Learning and scientific processes
- Didactic tools
- The Role of the History and Philosophy of Natural Sciences in Didactics of Physics.
- Non-formal and Informal learning
- Lesson Plans: Lesson Plan Guide and examples for Mechanics, Heat, Electricity, Optics.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

Electronic communication with the students using ICT (Information and Communications Technology)
Computer-aided lectures, use of Overhead Projectors, eclass platform</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.
Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.

The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</td><td>
<table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Lectures (X6)</td><td>18</td></tr>
<tr><td>Exercises/Implementation in class (X4)</td><td>12</td></tr>
<tr><td>Educational visits (X1)</td><td>3</td></tr>
<tr><td>Individual Study/ Preparation</td><td>53</td></tr>
<tr><td>Writing reports/ essays</td><td>33</td></tr>
<tr><td>Presentations (X2)</td><td>6</td></tr>
<tr><td>Course Total</td><td>125</td></tr>
</table>
</td></tr>
<tr><td>STUDENT PERFORMANCE EVALUATION
Description of the evaluation procedure

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

Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</td><td>Purpose of the evaluation:
Control students' progress in relation to the objectives of the course, their continuous feedback and the possible modification of the teaching.

The language of evaluation is Greek.
The evaluation method is formative and final.
I. Formative Evaluation (30%): During the course-sessions, students plan educational material (eg worksheets) and design teaching proposals. At each meeting there is feedback.
II. Final evaluation (70%): Final presentation of group or individual work and delivery of a written report that includes an integrated teaching proposal in formal or non-formal education.

Evaluation criteria:
I. Design of educational material during meetings according to the theoretical principles of didactics.
II. Theoretical and practical excellence of the final work and the way it is presented.</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

Chr. Chalkia (2012). Teaching Science, Patakis Publication, Athens (In Greek: Κρ. Χαλκιά (2012). Διδάσκοντας Φυσικές Επιστήμες, Εκδ. ΠΑΤΑΚΗ).
P. Kariotoglou (2006). Pedagogical Content Knowledge, Graphima Publications (In Greek: Καριώτογλου Π. (2006). Παιδαγωγική Γνώση Περιεχομένου, Εκδ. Γράφημα)

- Related academic journals:

Science & Education
Physics Education
International Journal of Science Education
Research in Science Education (RISE)