COURSE OUTLINE

(1) GENERAL

SCHOOL	SCIENCE		
ACADEMIC UNIT	DEPARTMENT OF PHYSICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**42**	**SEMESTER**	**4**
COURSE TITLE	Modern 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**
	5	7
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	General background
PREREQUISITE COURSES:	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	http://ecourse.uoi.gr/course/view.php?id=113 http://nuclear.physics.uoi.gr/classes/ModPhysII.html https://alpha.physics.uoi.gr/foudas_public/ModernPhys-II-NuclearParticles/ModernPhys-II-NuclearParticles.html

(2) LEARNING OUTCOMES

Learning outcomes

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

Consult Appendix A

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

The principal aim of this course is to develop an understanding of the structure of matter, i.e. the elementary particles, the nuclei, the atoms, the molecules and the solids. Furthermore, it aims towards the development of effective and efficient self-directed study and problem solving skills. Upon successful completion of this course the student will be able to:

- solve the Schrödinger equation in three dimensions for hydrogenic atoms.
- describe the angular momentum and spin quantization.
- explain the influence of external fields on atomic spectra.
- explain the Pauli's exclusion principle and its consequences on atomic structure.
- describe the concept of molecular bond and define the bond length and strength (for diatomics) based on experimental data.

- explain the difference between Bose-Einstein and Fermi -Dirac quantum statistics.
- explain basic concepts concerning the Nuclear Structure.
- describe nuclear de-excitation processes and calculate the corresponding quantities.
- describe basic concepts of the Nuclear Reactions theory and be able to perform simple calculations on this discipline.
- explain basic principles of Nuclear Astrophysics and Nucleosynthesis
- explain the operation principles of Nuclear Physics application in energy production, medicine, materials characterization, etc.
- describe the fundamental interactions in nature as well as their fundamental symmetries.
- describe the fundamental characteristics of the Standard Model.

General Competences

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

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

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

(3) SYLLABUS

Atomic structure: the Hydrogen atom. Electron spin. Stern-Gerlach experiment. Multielectron atoms. Pauli exclusion principle and periodic system. Stimulated light emission and laser. Molecules and solids: molecular bonds. Spectra of diatomic molecules. Basics of band theory and conduction. Nuclear structure: classification of nuclei. Nuclear structure models. Alpha and beta decay. Fission and fusion. Elementary particles: fundamental forces. Particle classification. The Standard model description.

(4) TEACHING and LEARNING METHODS - EVALUATION

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

The manner and methods of teaching are described in detail. *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	<table><tr><td>Lectures</td><td>52</td></tr><tr><td>tutorials</td><td>13</td></tr><tr><td>Study of bibliography</td><td>87</td></tr><tr><td>Non-directed study</td><td>20</td></tr><tr><td>exams</td><td>3</td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td>Course total</td><td>175</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.*	Written exams for the evaluation of conclusive understanding and problem solving capabilities

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- notes (available in the website of the course).
- Hugh, D. Young, R.A. Freedman, Μετ. Από ομάδα Πανεπιστημιακών, Πανεπιστημιακή Φυσική με Σύγχρονη Φυσική, Τόμος Γ, (Θερμοδυναμική- Σύγχρονη Φυσική) 2η Ελληνική Ἐκδοση, ISBN 978-960-02-2535-8, Παπαζήση ΑΕΒΕ, 2011, Αθήνα
- R. Serway - C. Moses- C. Moyer, Σύγχρονη Φυσική, ISBN 978-960-524-059-2 , Παν/κες Εκδόσεις Κρήτης, 2009, Ηράκλειο
- A. Beiser, Σύγχρονη Φυσική, ISBN 978-960-8041-52-X, Τυπωθήτω - Γ. Δαρδανός, 2003, ΑΘΗΝΑ