

COURSE OUTLINE

(1) GENERAL

SCHOOL	SCHOOL OF SCIENCES		
ACADEMIC UNIT	DEPARTMENT OF PHYSICS		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	201	SEMESTER	7
COURSE TITLE	ATOMIC PHYSICS		
INDEPENDENT TEACHING ACTIVITIES <i>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</i>	WEEKLY TEACHING HOURS	CREDITS	
	4	5	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	Specialized general knowledge		
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=591		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p><i>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.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> • <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i> • <i>Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i> • <i>Guidelines for writing Learning Outcomes</i> 								
<p>The central aim of the course is the detailed understanding of the electronic structure of the atoms and the atomic processes under the presence of external fields . The course offers the necessary specialized knowledge on Quantum theory for the description of many electron systems as well as computational techniques related to the atomic structure and dynamics in case external fields are present.</p> <p>After the successful attendance of the course the student will have the capacity to:</p> <ul style="list-style-type: none"> • explain the quantum mechanical description of many-electron atoms. • explain the quantum mechanical description of atoms under interacting with constant as well as time-dependent external fields. • perform quantum mechanical calculations corresponding to realistic atomic processes. • infer the time evolution of physical processes related to atomic theory. • appraise the spectrum of the application of the atomic processes to the other fields in Physics, in related sciences as well as in technology. 								
<p>General Competences</p> <p><i>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?</i></p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"><i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i></td> <td style="width: 50%; border: none;"><i>Project planning and management</i></td> </tr> <tr> <td style="border: none;"><i>Adapting to new situations</i></td> <td style="border: none;"><i>Respect for difference and multiculturalism</i></td> </tr> <tr> <td style="border: none;"><i>Decision-making</i></td> <td style="border: none;"><i>Respect for the natural environment</i></td> </tr> <tr> <td style="border: none;"></td> <td style="border: none;"><i>Showing social, professional and ethical responsibility and</i></td> </tr> </table>	<i>Search for, analysis and synthesis of data and information, with the use of the necessary technology</i>	<i>Project planning and management</i>	<i>Adapting to new situations</i>	<i>Respect for difference and multiculturalism</i>	<i>Decision-making</i>	<i>Respect for the natural environment</i>		<i>Showing social, professional and ethical responsibility and</i>
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<i>Decision-making</i>	<i>Respect for the natural environment</i>							
	<i>Showing social, professional and ethical responsibility and</i>							

<i>Working independently</i>	<i>sensitivity to gender issues</i>
<i>Team work</i>	<i>Criticism and self-criticism</i>
<i>Working in an international environment</i>	<i>Production of free, creative and inductive thinking</i>
<i>Working in an interdisciplinary environment</i>
<i>Production of new research ideas</i>	<i>Others...</i>

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

(3) SYLLABUS

Elements of Quantum Mechanics. One electron atomic systems. Interaction of one electron atomic systems with radiation, transitions, dipole approximation, selection rules, atomic spectra, lifetimes, spectral distributions. Fine and Hyperfine structure. One electron atoms in external fields, Zeeman and Stark effects. Two electron atomic systems, wavefunctions, notation, excited states. Many electron atomic systems, Central Field Approximation, Thomas-Fermi model, Hartree-Fock method, LS coupling, Hund rules, Periodic Table, Alkali spectra, X-ray spectra. Special Topics of Atomic Physics, Photoionization, Rabi oscillations, interaction with strong laser fields.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	The Course Management System "e-course" of the University is used for uploading notes, homework exercises and essays. The communication with students outside the classroom is primarily through e-mail.	
TEACHING METHODS <i>The manner and methods of teaching are described in detail.</i> <i>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.</i> <i>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</i>	Activity	Semester workload
	Lectures	26
	Tutoring	13
	Study and analysis of bibliography	55
	Essay writing	20
	Free study	8
	Exams	3
	Course total	125
STUDENT PERFORMANCE EVALUATION <i>Description of the evaluation procedure</i> <i>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</i> <i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i>	Written exams at the end of the semester which include (multiple choice questionnaires) MCQs and problem solving. Homework on problem solving on a weekly basis. Optional oral presentation of an essay on a special subject.	

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Books and/or notes on Quantum Mechanics offered by the Department of Physics of the University of Ioannina to the students during their course enrolment.
2. "Ατομική Φυσική", Σημειώσεις διδάσκοντα.
3. "Physics of Atoms and Molecules", B.H. Bransden and C.J. Joachain, Longman Scientific and Technical, 1983.
4. "Κβαντομηχανική II", Σ. Τραχανάς, Πανεπιστημιακές Εκδόσεις Κρήτης, 2009.
5. "Atoms Molecules and Photons", W. Demtröder, Springer, 2010.
6. "Atomic Physics", M. Born, Dover, 8th edition, 1969.

- *Related academic journals:* Phys. Rev. Lett, Phys Rev. A, J. Phys. B, New J. Physics