

## COURSE OUTLINE

### (1) GENERAL

<b>SCHOOL</b>	School of Science		
<b>ACADEMIC UNIT</b>	Physics		
<b>LEVEL OF STUDIES</b>	Undergraduate		
<b>COURSE CODE</b>	10E/AE05	<b>SEMESTER</b>	7
<b>COURSE TITLE</b>	States and properties of matter.		
<b>INDEPENDENT TEACHING ACTIVITIES</b> <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>	<b>WEEKLY TEACHING HOURS</b>	<b>CREDITS</b>	
Lectures (theory and exercises)	4	6	
<b>COURSE TYPE</b> <i>general background, special background, specialised general knowledge, skills development</i>	General knowledge		
<b>PREREQUISITE COURSES:</b>	No		
<b>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</b>	Greek		
<b>IS THE COURSE OFFERED TO ERASMUS STUDENTS</b>	Yes, in the English language for Erasmus students		
<b>COURSE WEBSITE (URL)</b>	<a href="https://eclass.uoa.gr/courses/PHYS348/">https://eclass.uoa.gr/courses/PHYS348/</a>		

## (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, 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, which e.g. can be found in quasi crystals and fractals. Move from the world of ideal gases to real gases and liquids. Learn to use phase diagrams and state equations. Study states or phase transitions. Introduced to symmetry: symmetry types, operations, point in molecules and lattices. Learn the size molecules, the bonds between atoms and hybridization.

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.

### 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

States of matter. Phase or state transitions. Phase diagrams. Classification of solids into periodic and quasi crystals, amorphous and fractals. Self-similarity. Classification of liquids and gases into ideal and real. Symmetries. Bonds between atoms. Hybridization. Symmetry of lattices and molecules. Symmetry types, operations, point groups in molecules and lattices. Classification of point groups. 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.

Linear elasticity. Continuum concept.. Deformation. Strain and stress tensors. Cauchy stress formula. Compatibility relations. Strain-deformation relations. Gradient of deformation. Young's and Lamé's state equations. Elastic constants. Saint-Venant's principle. True stress and strain. Elastic deformation energy. First thermodynamic law. Entropic elasticity. Elastic waves. Navier equation, Navier-Stokes equations. Elasticity of liquids. State equations. Rate of deformation. Viscoelasticity. Time dependence of deformation. Linear viscoelastic elements. Stress relaxation and creep . Maxwell and Kelvin-Voigt models, generalization. Applications.

#### (4) TEACHING and LEARNING METHODS - EVALUATION

<p><b>DELIVERY</b> <i>Face-to-face, Distance learning, etc.</i></p>	Face-to-face													
<p><b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b> <i>Use of ICT in teaching, laboratory education, communication with students</i></p>	<p>Yes</p> <p>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.</p> <p>There is e-mail communication with students.</p> <p>There is a regularly renewed e-class website: <a href="https://eclass.uoa.gr/courses/PHYS348/">https://eclass.uoa.gr/courses/PHYS348/</a></p> <p>The e-book States of matter, open access for everybody, can be found at the Kallipos repository: K. Σιμσερίδης [C. Simserides], 2015. ΚΑΤΑΣΤΑΣΕΙΣ ΤΗΣ ΥΛΗΣ [States of matter]. Αθήνα [Athens]: Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών [HEALLINK]. Γλώσσα [Language]: Ελληνικά [Greek]. Pages 271. URI: <a href="http://hdl.handle.net/11419/2117">http://hdl.handle.net/11419/2117</a> ISBN: 978-960-603-289-9 Eudoxus ID: 320167</p>													
<p><b>TEACHING METHODS</b> <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></p> <p><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></p>	<table border="1"> <thead> <tr> <th>Activity</th> <th>Semester workload</th> </tr> </thead> <tbody> <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>95</td> </tr> <tr> <td>Exams</td> <td>3</td> </tr> <tr> <td><b>Course Total</b></td> <td><b>150</b></td> </tr> </tbody> </table>		Activity	Semester workload	Lectures	42	Exercises	10	Individual Study/ Study and Analysis of bibliography / Preparation	95	Exams	3	<b>Course Total</b>	<b>150</b>
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<p><b>STUDENT PERFORMANCE EVALUATION</b> <i>Description of the evaluation procedure</i></p> <p><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></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	Final written exams in Greek with open-ended questions and problem solving.													

## (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 έκδοση, W. D. Callister, ΕΚΔΟΣΕΙΣ ΤΖΙΟΛΑ & ΥΙΟΙ 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.