COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Science		
ACADEMIC UNIT	Physics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**10EKA05**	**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, Tutorials, Laboratory Exercises	5 +1 (LAB)	7

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialization Course
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.
- Understand the effect of electric conductivity, in the framework of a semiclassical theory that describes the dynamic response of electrons in a crystal to an external field, and evaluate the electric conductivity tensor.
- Combine knowledge from classical mechanics, electromagnetism, quantum and statistical physics for the description of crystalline solids.
- Consolidate knowledge of crystalline structure and electronic band theory by means of laboratory experiments on electron diffraction by pollycrystalline graphite and determination of the energy band gap of germanium through electric conductivity measurements at different temperatures.

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
- 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.
- Semiclassical electron dynamics in a crystal. Crystal momentum, effective mass. Relaxation time, electric conductivity tensor.
- Laboratory experiments: The energy gap of germanium (Ge) semiconductor. Electron diffraction by pollycrystalline graphite.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face

Live streaming (distance learning in special circumstances)</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>Tutorials</td><td>26</td></tr>
<tr><td>Laboratory practice</td><td>6</td></tr>
<tr><td>Individual Study/ Study and Analysis of bibliography / Preparation</td><td>101</td></tr>
<tr><td>Exams</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Total</td><td>175</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>• Theory (written exams in Greek): 75%
• Laboratory (oral examination, reports): 25%</td></tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

- C. Kittel, Introduction to Solid State Physics, Scientific Editions A.G. Pnevmatikos, 1979, Athens
- P. Varotsos, C. Alexopoulos, Solid State Physics, Editions A. & S. Savvalas, 1995, Athens
- H. Ibach, H. Lüth, Solid State Physics, Editions P. Ziti & Co., 2001, Thessaloniki
- M. Razeghi, Fundamentals of Solid State Engineering, HEAL-Link Springer ebooks, 2006
- G. Iadonisi, G. Cantele, M. L. Chiofalo, Introduction to Solid State Physics and Crystalline Nanostructures, HEAL-Link Springer ebooks, 2014

- Related academic journals:

- Physics Today
- Scientific American