COURSE OUTLINE

1. GENERAL

SCHOOL			
DEPARTMENT	DEPARTMENT OF PHYSICS		
LEVEL OF STUDIES	ISCED level 6 – Bachelor's or equivalent level		
COURSE CODE	Y603-2023	**SEMESTER**	6th Semester
COURSE TITLE	Material Science and Technology		

TEACHING ACTIVITIES If the ECTS Credits are distributed in distinct parts of the course e.g. lectures, labs etc. If the ECTS Credits are awarded to the whole course, then please indicate the teaching hours per week and the corresponding ECTS Credits.	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
	4	6.0

COURSETYPE Background, General Knowledge, Scientific Area, Skill Development	Scientific Area
PREREQUISITES	
TEACHING & EXAMINATION LANGUAGE:	Greek
COURSE OFFERED TO ERASMUS STUDENTS:	NO
COURSE URL:	https://eclass.emt.duth.gr/courses/PHYSICS259/

2. LEARNING OUTCOMES

Learning Outcomes Please describe the learning outcomes of the course: Knowledge, skills and abilities acquired after the successful completion of the course.
The course is a continuation of the knowledge acquired by the student in the Solid State Physics course and concerns their application to materials and devices. Specifically, the course aims to provide knowledge on: A) The concepts of the electrical behavior of materials, the concepts of resistance-conductivity, as well as the understanding of the temperature dependence of the conductivity of metallic materials, alloys and the criteria for selecting a metallic material as a conductor depending on the applications. B) In semiconductor technology, their electrical and optical properties, the categories that appear depending on the type of their conductivity (intrinsic - extrinsic, extrinsic p-type or n-type), their technological importance and the limitations in their use, as well as the properties and applications of optoelectronic materials. C) Insulating (dielectric) materials, their behavior in static electric and alternating fields, their possible uses. D) In ??the magnetic properties of materials and their applications. E) In the phenomenon of superconductivity, in the materials that exhibit it, the limitations of its use, as well as in the possibilities that

open up as the temperature at which we observe it increases.
Upon successful completion of the course, the student will be able to:
• Understand the concepts of resistance-conductivity-electrical resistance-specific electrical conductivity, and be able to classify a material from theoretical elements as a conductor, semiconductor, insulator, superconductor.
• Be able to experimentally calculate the conductivity of a material using an appropriate device that he/she will build.
• Be able to predict the electrical behavior of a material at a different temperature from that of the environment.
• Be able to select a material for use as a conductor or insulator and be able to evaluate how safe it is in use.
• Be able to exploit the properties of optoelectronic materials for applications.
• To have understood the magnetic properties of materials.
• To have understood the importance of superconductivity.

General Skills

Name the desirable general skills upon successful completion of the module

Search, analysis and synthesis of data and information,	Project design and management
ICT Use,Adaptation to new situations,	Equity and Inclusion
Decision making,	Respect for the natural environment
Autonomous work,	Sustainability
Teamwork,	Demonstration of social, professional and moral responsibility
Working in an international environment,	and sensitivity to gender issues
Working in an interdisciplinary environment, Production of new research ideas	Critical thinking
	Promoting free, creative and inductive reasoning

Search, analysis and synthesis of data and information, ICT Use
Decision making
Working in an interdisciplinary environment
Production of new research ideas

3. COURSE CONTENT

I) Conductive materials
A. Conductivity and Resistance
B. Conductivity standard in metallic materials
C. Specific electrical resistance – Specific electrical conductivity
D. Classification of materials based on the value of specific electrical conductivity.
E. Dependence of specific electrical resistance on temperature
F. Conductivity in alloys
G. Criteria for selecting conductive materials
H. Study of typical materials (Cu, Ag, Au, Al, W)
II) Semiconductors and Devices
A. Semiconductor Materials
B. Semiconductor Devices and Applications
C. Optical Processes in Semiconductors and Semiconductor Devices
D. Photovoltaic Cells
E. LED - Laser Diode
III) Dielectric materials
A. Introduction to Dielectric (insulating) materials.
B. Dielectric constant of materials- Characteristics of dielectric materials.
C. Dielectric materials in constant fields
D Dielectric materials in alternating fields
E. Categories of dielectrics according to their polarization mode-Dielectric hysteresis.

F. Dielectric materials and new trends
IV) Magnetic Materials
A. Magnetic properties of matter
B. Classification of materials based on their magnetic behavior
C. Special applications of magnets
V) Superconducting materials.
A. Superconductivity
B. Magnetic properties of superconductors
C. Applications of superconductors (superconducting cables, superconducting magnets, superconducting computers)
D. Interpretation of the phenomenon

4. LEARNING & TEACHING METHODS - EVALUATION

TEACHING METHOD Face to face, Distance learning, etc.	Face to face
USE OF INFORMATION & COMMUNICATIONS TECHNOLOGY (ICT) Use of ICT in Teaching, in Laboratory Education, in Communication with students	Use of ICT in Teaching Use of ICT in Communication with students
TEACHING ORGANIZATION The ways and methods of teaching are described in detail. Lectures, Seminars, Laboratory Exercise, Field Exercise, Bibliographic research& analysis, Tutoring, Internship (Placement), Clinical Exercise, Art Workshop, Interactive learning, Study visits, Study / creation, project, creation, project. Etc. The supervised and unsupervised workload per activity is indicated here, so that total workload per semester complies to ECTS standards	
STUDENT EVALUATION Description of the evaluation process Assessment Language, Assessment Methods, Formative or Concluding, Multiple Choice Test, Short Answer Questions, Essay Development Questions, Problem Solving, Written Assignment, Essay / Report, Oral Exam, Presentation in audience, Laboratory Report, Clinical examination of a patient, Artistic interpretation, Other/Others Please indicate all relevant information about the course assessment and how students are informed	**Student evaluation languages** Greek **Method (Formative or Concluding)** Formative **Student evaluation methods** — **Rate** Written Exam with Problem Solving — 85 Written Assignment — 15

Activity	Workload/semester
Lectures	52
Writing project	48
Bibliographic research & analysis	25
Total	**125**

5. Suggested Bibliography

- Αναγνωστόπουλος Α., Δημητριάδης Κ , Παπαδημητρίου Π.,"Σημειώσεις στη Φυσική Ημιαγωγών", Θεσσαλονίκη (1993).
- Μαγκαφάς Λ. "Ανάπτυξη Ιδιότητες και Εφαρμογές Κραμάτων Άμορφων Ημιαγωγών", Διδακτορική Διατριβή, Δ.Π.Θ. Ξάνθη, (1992).
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- Θαναηλάκη Α.Κ., "Τεχνολογία Ηλεκτροτεχνικών και Ηλεκτροτεχνικών Υλικών" Τόμος Α΄ Αθήνα (1987).
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- I. Jones,"Materials Science for Electrical and Electronic Engineers", Oxford University Press,2001
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- L.Solymar, D.Walsh, R.Syms."Electrical Properties of Materials", Oxford University Press,2014.
- R.Smith,"Electrical Component Reliability Handbook", exida.com LLC; 3rd Edition,2012.
- R. Swingler,"Reliability Characterization of Electrical and Electronic Systems", Woodhead Publishing, 2015.
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- M.Getzlaff, "Fundamentals of Magnetism", Springer Berlin Heidelberg New York , 2008.
- O.Sergiyenko, Ed. " Optoelectronic Devices and Properties", InTech, 2011.

Eudoxus

Βιβλίο [102071492]: Επιστήμη και Τεχνολογία των Υλικών, 10η Έκδοση, Callister Wıllıam D., Rethwisch David G. Λεπτομέρειες
Βιβλίο [10996]: Επιστήμη και τεχνολογία υλικών, Βατάλης Αργύρης Σ. Λεπτομέρειες
Βιβλίο [59396169]: Τεχνολογία Υλικών, Μαγκαφάς Λ.- Χανιάς Μ. Λεπτομέρειες