COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
DEPARTMENT	Electrical and Computer Engineering		
LEVEL OF STUDY	Undergraduate		
COURSE UNIT CODE	1.005	**SEMESTER**	1st
COURSE TITLE	Electrotechnical Materials I		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory (Lectures)	3	3
Tutorial/Exercises	1	1
TOTAL	**4**	**4**

COURSE UNIT TYPE	Specialized knowledge/Skills development
PREREQUISITES	
LANGUAGE OF INSTRUCTION/EXAMS	Greek
COURSE DELIVERED TO ERASMUS STUDENTS	No
WEB PAGE (URL)	https://eclass.hmu.gr/courses/ECE101/

(2) LEARNING OUTCOMES

Learning Outcomes

A) The **knowledge**, which the students will acquire upon successful completion of the course includes:
a) introduction in the field of materials science and technology regarding their electronic behaviour through solid state physics, chemistry and materials science in general.
b) basic principles that follow the electronic structure of the atom as well as the crystalline structure of solid materials for the estimation of particular properties of materials.
c) properties of semiconductors and basic aspects of semiconductor devices in order to explain and predict their behaviour.
d) basic laws governing the physics phenomena and processes in areas related with the electrical properties of materials.

B) The **skills**, which the students will obtain upon successful completion of the course are:
a) understanding of the relationship between the structure, physical processes and properties of materials with their production technology.
b) correlation of the materials properties with their applications for the selection of the most suitable material through a wide range of materials.
c) appropriate selection of parameters for the design of materials with improved properties.
d) understanding and analyzing experimental data through exercises from mathematical calculations.
e) writing a project based on literature review from books, papers, newspapers in Greek and English that includes Introduction, Main Body, Conclusions, and References.
f) utilization of a computer in writing and presenting a project.

C) The **abilities**, which the students will get upon the successful completion of the course are:
a) the explanation and prediction of the semiconductor devices performance.
b) the identification of the appropriate methodology to correlate the semiconductor and dielectric materials with their applications.
c) the cooperation with other people, as part of a team, in writing project.

General Skills
• Autonomous work • Teamwork • Search, analysis and synthesis of data and information, using the necessary technologies • Decision making • Promoting liberal, creative and inductive/deductive thinking • Work in an interdisciplinary environment

(3) SYLLABUS

Introduction (Structure of the atom. Bonds and types in solids. Thermally activated processes. Crystalline state. Defects and their significance. Crystalline and amorphous semiconductors)

Electronic Structure of Atoms (Pauli exclusion principle. Atomic orbitals. Periodic table.).

Crystal structure (Crystal structure. Unit cell. Miller indices. Filling factor. Types of crystals and their different structures).

Structural Defects (Point defects. Linear defects. Flat defects. Volume defects.)

Electrical and thermal conductivity of solids (Matthiessen and Nordheim Rules. Variation of temperature with resistance. HALL effect. Electrical conductivity of non-metal materials.)

Semiconductors (Semiconductor crystals. Types of semiconductors. Temperature dependence of conductivity. Minority carrier life. Optical absorption. Piezoresistance. SCHOTTKY contact. Ohmic contacts. Sliding speed. Energy band theory. Types of energy bands.)

Semiconductor devices (Basic techniques for the production of electronic components including thermal processes, physical and chemical vapour deposition, photolithography. p-n junction. Diffusion capacity and dynamic resistance. Basic working principles of LEDS. Principles of operation of photovoltaic devices. General principles of metal-oxide-semiconductor field effect transistor (MOSFET).)

Dielectric materials (Mechanisms of polarization. GAUSS Law. Dielectric strength. Dielectric materials for capacitors. Piezoelectricity.)

(4) TEACHING METHODS - ASSESSMENT

<table>
<tr><td>MODE OF DELIVERY</td><td>In-Class Face-to-Face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGY</td><td>▪ Use of ICTs in lecturing
▪ Use of ICTs for the communication with students via the e-class platform</td></tr>
<tr><td>TEACHING ORGANIZATION</td><td>
<table>
<tr><th>Method description/Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>35</td></tr>
<tr><td>Project (journal/paper reading and theoretical study)</td><td>20</td></tr>
<tr><td>Tutorials</td><td>35</td></tr>
<tr><td>Non-guided personal study</td><td>30</td></tr>
<tr><td>Total Contact Hours</td><td>120</td></tr>
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<tr><td>ASSESSMENT METHODS</td><td>All announcements for the course regulations and complementary reading material are permanently posted in the course web page. The course grade incorporates the following evaluation procedures:

1. Written examination I (20 %)
• Problem solving.
• Short answer questions
2. Written examination II (20 %)
• Problem solving.
• Short answer questions
3. Project - bonus (10 %).
4. Final written examination (60 %)
• Problem solving.
• Short answer questions
• Multiple choice questions</td></tr>
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(5) RECOMMENDED BIBLIOGRAPHY

-Recommended Bibliography:

- *Electrotechnical Materials Principles & Applications, S.O. Kasap, Tziola, 2016* ***(in Greek).***
- *Optoelectronics: An Introduction, J. Wilson, J. Hawkes, NTUA., 2004* ***(in Greek)****.*

Relevant Scientific Journals:

- *Journal of Materials Chemistry*
- *Chemistry of Materials*
- *Journal of Electronic Materials*
- *Journal of Physics C: Solid State Physics*