

ADVANCED TECHNOLOGY ELECTRONIC DEVICES

COURSE OUTLINE

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Electrical and Computer Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0811.7.016.0	SEMESTER	1st
COURSE TITLE	Advanced Technology Electronic Devices		
INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	WEEKLY TEACHING HOURS	CREDITS	
	0	4	
Total	0	4	
COURSE TYPE general background, special background, specialised general knowledge, skills development			
PREREQUISITE COURSES	None		
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English		
OFFERED TO ERASMUS STUDENTS	Yes (in English)		
COURSE WEBSITE (URL)			
2. LEARNING OUTCOMES			
Learning outcomes			
The aim of the course is to familiarize students with the physical and electrical properties of organic semiconductors and the corresponding devices. Upon successful completion of the course, the student will be able to: • Assess the physical and electrical properties of organic semiconductors. • Understand the mechanisms of current conduction through these materials. • Understand the procedures and methodology for studying the structure and properties of organic materials, and be acquainted with the modern fabrication methods currently used in the design of flexible materials and devices. • Describe and analyze the operating principles of the basic organic electronic devices: from transistors to photovoltaic cells & systems, organic light-emitting diodes (OLEDs) and lasers. • Know and apply the appropriate characterization protocols for the electrical and optical characterization of the various electronic devices for the reliable evaluation of their performance. • Be able to use bibliographic databases to find and evaluate the most relevant articles in the field of their work.			
General Competences			

The course aims at the acquisition, by the graduate, of the following general competences:

- Understand the procedures and methodology for studying the structure and properties of organic materials, and be familiar with the modern fabrication methods currently used in the design of flexible materials and devices.
- Describe and analyze the operating principles of the basic organic electronic devices.
- Know and apply the appropriate protocols for electrical characterization in order to evaluate the performance of the various electronic devices.
- In the context of the literature searches they will be asked to carry out, be able to independently evaluate and extract the most useful information, thereby developing critical thinking both as a reader and as a writer.
- In the context of presenting their results, be able to function as a member of a research team and within an interdisciplinary environment.

3. SYLLABUS

Here's the English translation:

The aim of the course is familiarization with "printable" electronic devices that are not based on inorganic semiconductors, such as silicon, but on organic semiconductors fabricated using printing technologies, which constitute a pioneering category of electronics with enormous market potential in four key application areas: displays, photovoltaics, lighting and bio-electronic systems. To achieve this goal, the course is structured as follows:

Theory

A. Organic Semiconductors

- Conductive Conjugated Polymers and Small Organic Molecules.
- Electronic Structure and Electronic Properties.
- Correlation between chemical structure and optoelectronic properties.
- Synthesis and Characterization Techniques for Organic Semiconductors

B. Organic optoelectronic devices

- Photovoltaic Cells (OPVs)
- Light-Emitting Diodes (OLEDs)
- Organic Semiconductor Lasers
- Optical displays
- Colorimetry and cathode ray tube displays
- Field-Effect Transistors (OFETs)

C. Flexible electronic devices

- Printing techniques for electronic devices
- Flexible sensors
- Printed organic thin-film transistors
- Flexible bio-electronic devices

D. Characterization Techniques for Semiconductor Devices

- Morphological Characterization (AFM)
- Structural Characterization (X-ray spectroscopy)
- Elemental Characterization (Absorption, Raman and FTIR)
- Electrical Characterization (Hall characterization)

Laboratory: Fabrication and characterization of OPVs

- Processing of organic electronic thin-film layers by spin coating
- Thermal deposition of metals
- Optical characterization of organic electronic thin films
- Fabrication of PVs (perovskite)
- PV performance analysis (J/V, EQE, IQE)
- PV stability analysis

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY

Face-to-face, Distance learning, etc.

Πρόσωπο με πρόσωπο στην τάξη

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	• Use of ICT in laboratory education • Use of ICT in communication with students via the e-class electronic platform • Specialized software in laboratory exercises • Support of the learning process via the e-class electronic platform					
TEACHING METHODS The manner and methods of teaching are described in detail.	<table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Course total</td><td></td></tr></table>	Activity	Semester workload	Course total		
Activity	Semester workload					
Course total						
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	Students are assessed through: • Laboratory work: performance and participation in the laboratory exercises • Written laboratory report on the fabrication and characterization of PV devices • Oral presentation of the results					

5. ATTACHED BIBLIOGRAPHY
1. E. Cantatore (ed.), <i>Applications of Organic and Printed Electronics: A Technology-Enabled Revolution</i>, Springer, 2013, ISBN 978-1-4614-3160-2 2. H. Klauk (ed.), <i>Organic Electronics II: More Materials and Applications</i>, Wiley-VCH, 2012, ISBN 978-3-527-32647-1 3. C. Brabec, U. Scherf, V. Dyakonov (eds.), <i>Organic Photovoltaics: Materials, Device Physics, and Manufacturing Technologies</i>, 2nd Edition, Wiley-VCH, 2014, ISBN 978-3-527-65693-6 4. S. R. Forrest, <i>Organic Electronics: Foundations to Applications</i>, Oxford University Press, 2020, ISBN 978-0-19-852953-3 5. P. Cosseddu, M. Caironi (eds.), <i>Organic Flexible Electronics: Fundamentals, Devices, and Applications</i>, Woodhead Publishing (Elsevier), 2021, ISBN 978-0-12-818890-3 6. G. Nisato, D. Lupo, S. Ganz (eds.), <i>Organic and Printed Electronics: Fundamentals and Applications</i>, Jenny Stanford Publishing, 2016, ISBN 978-981-4669-74-0

