ADVANCED PHOTOVOLTAIC DEVICES

COURSE OUTLINE

Responsible: Emmanouil Kymakis

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Electrical and Computer Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0811.9.008.0	**SEMESTER**	1st
COURSE TITLE	Advanced Photovoltaic 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	Specialised general knowledge
PREREQUISITE COURSES	Ηλεκτροτεχνικά Υλικά Ι
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English) — Winter Semester
COURSE WEBSITE (URL)	https://eclass.hmu.gr/courses/ECE116

2. LEARNING OUTCOMES

Learning outcomes

The purpose of the course is to familiarize students with the operating principles and development of new technologies in modern photovoltaic systems, as well as their design and evaluation. Upon successful completion of the course, the student will be able to:

- Understand the operating principle of new-technology PV devices based on classical semiconductor theory.
- Explore the growth techniques of organic/hybrid materials and the fabrication stages of the corresponding PV devices at both small and large scale.
- Design electrical characterization techniques for the calculation of the PV parameters of the devices, along with the corresponding protocols for measuring PV lifetime.
- Use bibliographic databases to find and evaluate the most relevant articles in the field of their work.
- Orally present and explain in detail their research/literature project.

General Competences

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

- Search for, analysis and synthesis of data and information, with the use of the necessary technologies.
- Adapting to new situations.
- Working in an interdisciplinary environment.
- Team work.

- Promotion of free, creative and inductive thinking.
- Production of new research ideas.
- Search for, analysis and synthesis of data and information, with the use of the necessary technologies.

3. SYLLABUS

Here's the English translation:

The aim of the course is familiarization with the operating principles, fabrication methods and electrical characterization of third-generation photovoltaic devices, which are not based on silicon, but on organic and hybrid semiconductors that can be fabricated using printing technologies. To achieve this goal, the course is structured as follows:

- Introduction and Historical Review of third-generation PVs
- Operating Principles of organic photovoltaics (OPVs)
- Methods for OPV performance characterization
- Characterization methods and stability protocols for OPVs
- Introduction to hybrid perovskite photovoltaics (HPVs)
- Operating principles of HPVs
- The role of two-dimensional materials in HPVs
- Tandem devices
- Printing-based production technology for OPVs & HPVs
- Laboratory: Fabrication and electrical characterization of PV devices.

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.	**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. J. Bisquert, *The Physics of Solar Cells: Perovskites, Organics, and Photovoltaic Fundamentals*, CRC Press, 2017, ISBN 9781138099968
2. M. A. Green, *Third Generation Photovoltaics: Advanced Solar Energy Conversion*, Springer, 2003, ISBN 978-3-540-26562-7
3. C. Brabec, U. Scherf, V. Dyakonov (eds.), *Organic Photovoltaics: Materials, Device Physics, and Manufacturing Technologies*, 2nd Edition, Wiley-VCH, 2014, ISBN 978-3-527-65693-6

4. N.-G. Park, M. Gratzel, T. Miyasaka (eds.), *Organic-Inorganic Halide Perovskite Photovoltaics: From Fundamentals to Device Architectures*, Springer, 2016, ISBN 978-3-319-35112-4
5. T. Miyasaka (ed.), *Perovskite Photovoltaics and Optoelectronics: From Fundamentals to Advanced Applications*, Wiley-VCH, 2021, ISBN 978-3-527-34748-3
6. M. Pazoki, A. Hagfeldt, T. Edvinsson (eds.), *Characterization Techniques for Perovskite Solar Cell Materials*, Elsevier, 2020, ISBN 978-0-12-814727-6
7. F. C. Krebs (ed.), *Stability and Degradation of Organic and Polymer Solar Cells*, Wiley, 2012, ISBN 978-1-119-95251-
8. M. V. Khenkin et al., "Consensus statement for stability assessment and reporting for perovskite photovoltaics based on ISOS procedures," *Nature Energy* 5, 35–49 (2020) — directly supports the stability protocols unit