POWER ELECTRONICS

COURSE OUTLINE

1. GENERAL			
SCHOOL	School of Engineering		
ACADEMIC UNIT	Department of Electrical and Computer Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	0811.7.003.0	**SEMESTER**	1st
COURSE TITLE	Power Electronics		

INDEPENDENT TEACHING ACTIVITIES if credits are awarded for separate components of the course	**WEEKLY TEACHING HOURS**	**CREDITS**
	4	4
Total	**4**	**4**

COURSE TYPE general background, special background, specialised general knowledge, skills development	Special background / Core
PREREQUISITE COURSES	None
LANGUAGE OF INSTRUCTION and EXAMINATIONS	English
OFFERED TO ERASMUS STUDENTS	Yes (in English)
COURSE WEBSITE (URL)	https://eclass.hmu.gr/courses/ECE141/

2. LEARNING OUTCOMES

Learning outcomes

The course "Power Electronics I" aims to provide students with basic knowledge on the semiconductor power modules and power converters built based on them. More specifically, it refers to the structure, operation, special features and applications of different types of power converters. It also covers elements of Fourier analysis and electric power quality.
Upon successful completion of the course, students will be able to:
1. describe and explain the structure, the characteristics, the capabilities and operation of basic power semiconductor elements
2. identify and describe the basic topologies of power converters (rectifiers, AC regulators, choppers, inverters)
3. identify and describe the basic control techniques of the above converters
4. examine and analyze the operation of converters and explain the characteristics of voltage-current waveforms at their input and output
5. explain the principles of Fourier analysis and apply it to the calculation of harmonic components, distortion, etc. of voltage-current waveforms
6. select the appropriate power converter for a given application.

General Competences

• Search, analysis and synthesis of data and information, using the necessary technologies
• Adaptation to new situations
• Autonomous work
• Teamwork
• Work in an interdisciplinary environment
• Production of new research ideas

3. SYLLABUS

Theoretical Lecture Sections

• Introduction to power electronics - relation to other scientific fields. Classification of electronic power converters and their applications.
• Structure and functional characteristics of semiconductor power components (power diode, thyristor, BJT, MOSFET, GTO, IGBT, …).
• Uncontrolled rectifier circuits (using power diodes): Single-phase and three-phase rectifier topologies. Effect of the network's internal inductance (transition).
• Controlled rectifiers (using thyristors): Topologies of single-phase and three-phase fully controlled inverters, voltage and current waveforms, calculation of active and reactive power.
• AC converters: AC regulators with anti-parallel thyristors, reference to cycloconverters.
• DC to DC converters: Basic topologies of DC to DC converters (step-down, step-up). Analysis of the Pulse Width Modulation (PWM) technique and its application to them.
• AC to DC converters: Topology of single-phase (half-full bridge) and three-phase switching inverter. Analysis of operation with PWM.
• Principles of Fourier analysis and calculation of harmonic components. Derivation of spectrum. Calculation of active / reactive power, RMS value, total harmonic distortion and application to AC converters.

4. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY Face-to-face, Distance learning, etc.	Project-based, Individual study
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY Use of ICT in teaching, laboratory education, communication with students	
TEACHING METHODS The manner and methods of teaching are described in detail.	
STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure	Project evaluation (60%) Oral exam on given Power electronics syllabus (40%)

Activity	Semester workload
Lectures	0
Laboratory Exercises	10
Study and report writing	50
Independent study	50
Study and literature review	10
Course total	**120**

5. ATTACHED BIBLIOGRAPHY

- *Suggested bibliography*

• Mohan N., Undeland T. M., Robbins W. P., “Introduction to Power Electronics”, 3rd edition, Publisher: Tziola, Thessaloniki, 2010.
• Rashid M., “Power Electronics”, 1st edition, Publisher: "ION" Publishing Group, Athens, 2010.
• Manias St. “Power Electronics”, 2d edition, Publisher: Symeon, Athens, 2017.
• Kioskeridis I., “Power Electronics”, 1st edition, Publisher: Tziola, Thessaloniki, 2008.

- *Relevant scientific journals:*

• IEEE Transactions on Power Electronics
• IEEE Transactions on Industrial Electronics
• IEEE Transactions on Industry Applications
• IEEE Journal of Emerging and Selected Topics in Power Electronics
• IET Power Electronics