COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
DEPARTMENT	Electrical and Computer Engineering		
LEVEL OF STUDY	Undergraduate		
COURSE UNIT CODE	7.003	**SEMESTER OF STUDY**	7th
COURSE TITLE	Power Electronics I		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory (Lectures)	3	2
Tutorial/Project	1	1
Laboratory	1	1
TOTAL	**5**	**4**

COURSE UNIT TYPE	Specialized Background / Core course
PREREQUISITES	
LANGUAGE OF INSTRUCTION/EXAMS	Greek
COURSE DELIVERED TO ERASMUS STUDENTS	Yes (in Greek)
WEB PAGE (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 Skills

- 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.

Laboratory Exercises

Laboratory exercises and simulations using MATLAB-Simulink.

1. Study of rectifiers with diodes.
2. Fourier analysis, spectrum extraction, calculation of Total Harmonic Deformation.
3. Study of a controlled 1-pulse rectifier.
4. Study of a controlled 2-pulse rectifier.
5. Study of a controlled 4-pulse rectifier.
6. Study of an AC regulator.
7. Study of a DC-DC step-down converter.
8. Study of a DC-DC step-up converter.
9. Study of an Inverter.

(4) TEACHING METHODS - ASSESSMENT

MODE OF DELIVERY	In-Class Face-to-Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	▪ Use of I.C.T. in teaching ▪ Use of I.C.T. in laboratory training ▪ Use of I.C.T. in communicating with students through the eClass electronic platform
TEACHING ORGANISATION	see table below
ASSESSMENT METHODS	Language of Evaluation: Greek Evaluation methods: 1. Written - oral midterm examination (20%) 2. Written final exam (60%) • by short answer questions • by problem solving 3. Laboratory exercises-reports (20%) The evaluation criteria are announced to the students at the

Method description / Activity	**Semester Workload**
Lectures	52
Laboratory exercises	13
Study - Writing laboratory reports	20
Independent study	25
Study and bibliography analysis	10
Total Contact Hours	**120**

	beginning of the semester and are posted on the course website in eClass.

(5) RECOMMENDED 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*