

## COURSE OUTLINE

### (1) GENERAL

<b>SCHOOL</b>	ENGINEERING		
<b>ACADEMIC UNIT</b>	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
<b>LEVEL OF STUDIES</b>	Postgraduate		
<b>COURSE CODE</b>	<b>ENE_APP-105</b>	<b>SEMESTER</b>	<b>1</b>
<b>COURSE TITLE</b>	MODERN APPLICATIONS OF POWER ELECTRONICS		
<b>INDEPENDENT TEACHING ACTIVITIES</b> <i>if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits</i>		<b>WEEKLY TEACHING HOURS</b>	<b>CREDITS</b>
Lectures		2	
Tutorial/Practical Exercises		1	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).</i>		3	6
<b>COURSE TYPE</b> <i>general background, special background, specialised, general knowledge, skills development</i>	Special Background, Specialised		
<b>PREREQUISITE COURSES:</b>	No. Students are advised to have already attended the courses: Power Electronics I, Power Electronics II, Electrical Drive Systems		
<b>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</b>	Greek		
<b>IS THE COURSE OFFERED TO ERASMUS STUDENTS</b>	No		
<b>COURSE WEBSITE (URL)</b>	<a href="https://eclass.uop.gr/courses/3475/">https://eclass.uop.gr/courses/3475/</a>		

### (2) LEARNING OUTCOMES

<p><b>Learning outcomes</b></p> <p><i>The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <li>• <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i></li> <li>• <i>Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i></li> <li>• <i>Guidelines for writing Learning Outcomes</i></li> </ul>
<p>The aim of the course "Modern Power Electronics Applications" is for postgraduate students to deepen their knowledge on Modern Power Electronics Converters, along with the corresponding pulsing techniques. Additionally, the interaction of the converters with all the parameters of the electrical energy systems is examined.</p> <p>In the context of the course, the basic topologies of power electronic converters (AC-AC, AC – DC, DC – DC and DC – AC) in modern applications are examined. The most important of them are analyzed and advanced pulse techniques are emphasized. These techniques are intended to improve power quality as well as increase system efficiency. Additional are also presented topologies for the: a) connection of RES to the grid and b) charging electric accumulators.</p> <p>Η ανάλυση και μελέτη της λειτουργίας των ηλεκτρονικών μετατροπέων ισχύος γίνεται με την βοήθεια εξειδικευμένου λογισμικού (Matlab/Simulink).</p>

## Learning Outcomes

Upon successful completion of the course the student is in a position to:

### At the knowledge level:

- identify the structure of the most important modern power electronic converters.
- understand the operation of modern power electronic converters.
- choose the appropriate power electronic converter topology as well as how to control a complete system with converters.
- know the possibilities provided by the operation of modern power electronic converters.
- know how power electronic converters interact with electric machines.
- know the structure and operation of basic electrical energy systems consisting of power electronic converters.

### At the skill level:

- understand the use of modern power electronics in different applications.
- calculate and analyze the components of a modern power electronic converter.
- understand and analyze basic pulse circuits of power electronic converters.
- understand the effects on voltage quality of modern power electronic converters operation.
- analyze a basic electric motor drive system.
- to understand new topologies of power electronic converters as well as new ways of controlling and pulsing them.
- at a research level, to obtain the basis to propose new topologies and control pulse - techniques .

### At the level of abilities:

- be able to repair devices containing modern power electronic converters.
- select appropriate systems with modern power electronic converters as component.
- use modern power electronic converters to increase efficiency.
- use modern power electronic converters to improve electricity distribution.
- use modern power electronic converters to improve electricity utilization for both conventional and emerging (modern) loads.
- communicate with technical subordinates and superiors in a common language.

## General Competences

*Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

*Search for, analysis and synthesis of data and information, with the use of the necessary technology*

*Adapting to new situations*

*Decision-making*

*Working independently*

*Team work*

*Working in an international environment*

*Working in an interdisciplinary environment*

*Production of new research ideas*

*Project planning and management*

*Respect for difference and multiculturalism*

*Respect for the natural environment*

*Showing social, professional and ethical responsibility and sensitivity to gender issues*

*Criticism and self-criticism*

*Production of free, creative and inductive thinking*

*.....*

*Others...*

*.....*

- Decision making
- Work in an international environment
- Work in an Interdisciplinary environment
- Development of new research ideas
- Respect to the natural environment
- Criticism and self-criticism

- Promotion of free, creative and inductive thinking

### (3) SYLLABUS

#### Lectures:

Presentation – analysis – study and applications of Power Electronic Converters:

1. AC – AC current- **1<sup>st</sup>Lecture**.The operation of controlable AC switches with pulse at both low and high frequency is studied.Also, the operation of Cycloconverters and Matrix converters is presented.
2. DC – DC current- **2<sup>nd</sup>Lecture**.Classic topologies are presented, a)step-down DC voltage (back converters), b) boost convertersas well as c) back - boost converters. Then the principle of operation of DC converters with galvanic isolation is presented.
3. DC – AC current (inverters)- **3<sup>rd</sup>Lecture**.The operation of inverters with low switching frequency equal to the operating frequency is studied.Then the operation of the inverters with various modern techniques of high switching frequency is studied.
4. AC – DC current (rectifiers) FACTS's- **4<sup>rd</sup>Lecture**.The impact of rectifier devices on power quality as well as the effect of the pulse technique in improving this quality are studied. Also, the techniques used by modern systems to improve the power factor are highlighted.
5. For R.E.S's  
**5<sup>th</sup>Lecture**.R.E.S.'sofPowerElectronicConvertersconnectiontopologiesarepresented.Also, special issues during the operation of the converters in systems with R.E.S's are presented.
6. Electrical accomulators chargers - **6<sup>th</sup>Lecture**.Connection circuits of Power Electronic Converters to electric battery chargers are presented.Also, special issues during the operation of the converters in battery chargers are presented.
7. Analysis of the converters auxiliary circuits - **7<sup>th</sup>Lecture**.Typical circuits are presented for the pulsation of power electronic converters, their protection and proper operation.

#### Operation study of converters through simulation

After the end of the lectures, Power Electronic Converters will be studied practically through simulation.Also, small projects will be given which will be presented orally.Students will be graded from these projects and this grade will count towards the final.

### (4) TEACHING and LEARNING METHODS - EVALUATION

<b>DELIVERY</b> <i>Face-to-face, Distance learning, etc.</i>	In lecture
<b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b> <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> <li>• Learning process support through the e-class electronic platform (lectures and communication).</li> <li>• Additional video conferences via Teams and Webex</li> </ul> <p>Simulation programs (Matlab), through which the structure and operation of electromechanical systems are examined</p>

<p style="text-align: center;"><b>TEACHING METHODS</b></p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.</i></p> <p><i>The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS</i></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 70%;"><b>Activity</b></th> <th style="width: 30%;"><b>Semester workload</b></th> </tr> </thead> <tbody> <tr> <td>Lectures</td> <td>39hours</td> </tr> <tr> <td>Analysis through simulation</td> <td>37hours</td> </tr> <tr> <td>Oral projects through simulation</td> <td>37hours</td> </tr> <tr> <td>Lecture &amp; bibliography study (at home)</td> <td>37 hours</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td style="text-align: center;"><b>Course Total</b></td> <td style="text-align: center;"><b>150 hours (5 ECTS)</b></td> </tr> </tbody> </table>		<b>Activity</b>	<b>Semester workload</b>	Lectures	39hours	Analysis through simulation	37hours	Oral projects through simulation	37hours	Lecture & bibliography study (at home)	37 hours									<b>Course Total</b>	<b>150 hours (5 ECTS)</b>
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<p style="text-align: center;"><b>STUDENT PERFORMANCE EVALUATION</b></p> <p><i>Description of the evaluation procedure</i></p> <p><i>Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<p><b>Examination language:</b> Greek</p> <p><b>Evaluation Method:</b></p> <p>I. Theory (70% of grade):</p> <ul style="list-style-type: none"> <li>- Written final exam (90% of theoretical grade) which involves theoretical questions and exercises.</li> <li>- Weekly, from the student's interest in the lecture (10% του βαθμού της θεωρίας).</li> </ul> <p>II. Oralexamined project in Simulink/Matlab software (30% του συνολικού βαθμού).</p>																					

## (5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

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- K. Georgakas, A. Safacas "Modified sPWM Operation Technique of an AC-AC Single Phase Converter to Optimize the Power Factor", *IET Power Electronics*, Vol. 3, Issue 3, 2010, page 454-464.
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