Power electronics systems - course description

General information

Course name	Power electronics systems
Course ID	06.2-WE-AutP-PES-Er
Faculty	Faculty of Computer Science, Electrical Engineering and Automatics
Field of study	Automatic Control and Robotics
Education profile	academic
Level of studies	First-cycle Erasmus programme
Beginning semester	winter term 2019/2020

Course information

Semester	5
ECTS credits to win	3
Course type	optional
Teaching language	english
Author of syllabus	• dr hab. inż. Zbigniew Fedyczak, prof. UZ

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	15	1	-	-	Credit with grade
Laboratory	30	2	-	-	Credit with grade

Aim of the course

Familiarize students with the modeling and analysis of the basic properties of the power converters AC / DC, DC / DC, AC / AC and DC / AC.

Formation among students understand the phenomena occurring in the transformation of electrical energy, in particular, the causes of deteriorating the quality of the conversion.

Shaping the basic skills of selection and parameter settings when using conventional control strategies of power converters.

Prerequisites

Mathematical analysis, Linear algebra, Electrical engineering principles, Circuit theory, Principles of power electronics.

Scope

Introduction. General description (outline) of the preceded course deals with Fundamentals of power electronics (basic power electronics semiconductor devices, basic power electronic converters, standards and conversion quality evaluation, basic control techniques, application field).

AC/DC and AC/AC with phase-angle control. Topologies review, operation description and properties of non-controlled and controlled (thyristorized) six- and multipulse rectifiers, three-phase AC choppers. Application Examples of such converters. Conversion quality of the AC/DC and AC/AC converters using phase-angle control. Influence of such converters on a voltage supplying source (displacement factor, deformation factor and power factor).

PWM DC/DC converters II. Operation descriptions and properties of the DC/DC converters with ideal switch circuit models: non-isolated higher level (types Ćuk, ZETA), isolated (types flyback and forward). Application Examples of such converters.

PWM DC/AC converters II. Topologies, operation descriptions and properties of single- and threephase voltage source and current source inverters (VSI, CSI) with sinus PWM (SPWM) control. PWM control techniques review. Properties of the VSI with space vector PWM (SVPWM) control. PWM AC/DC converters. Topologies, operation description and properties of single- and three-phase rectifiers with sinusoidal input current as well as buck and boost type. Suppliers with power factor correction (PFC). The impulse stabilizators control techniques in the suppliers with unity power factor. Integrated monolithic control circuit in the impulse stabilizators.

Indirect PWM AC/AC converters. Topologies, operation description and properties of PWM AC/DC/AC converters (frequency converters). Output and input current shaping methods in PWM AC/DC/AC converters. Application Examples of the AC/AC frequency converters.

Conversion quality of the circuits with PWM AC/DC and AC/AC converters. Influence of such converters on supplying source (displacement factor, deformation factor and power factor). Future trends of the power electronic circuits (general description).

A new semiconductor power electronic switches and intelligent power modul. Conversion quality improvement as well as new application areas of the power electronic converters.

Teaching methods

Lecture, laboratory exercises, project.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form

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Can indicate basic problems related to the application of power electronic systems		• a project • an evaluation test • an ongoing monitoring during classes	
Has knowledge on peripheral and mathematical models of basic AC/DC, DC/DC, AC/AC and DC/AC power electronic converters		• a project • an evaluation test • an ongoing monitoring during classes	
Can analytically demonstrate basic features of selected power electronic converters		• a project • an evaluation test • an ongoing monitoring during classes	
Understands the need for application of advanced control strategy for power electronic converters		• a project • an evaluation test • an ongoing monitoring during classes	

Assignment conditions

Lecture – obtaining a positive Grade in written or oral Exam.

Laboratory – the main condition to get a pass are sufficient marks for all exercises and tests conducted during the semester.

Calculation of the final Grade: lecture 60% + laboratory 40%.

Recommended reading

1. Mohan N., Power Electronics: Converters, Application and Design, John Wiley & Sons, 1998.

2. Trzynadlowski A., Introduction to modern power electronics, John Wiley & Sons, 1998.

3. Erickson R., W., Maksimović D.: Fundamentals of power electronics. Kluver Academic Publishers, 1999.

4. Holms D., G., Lipo T., A.: Pulse width modulation for power converters. Principles and practice. John Wiley & Sons Inc., 2003.

Further reading

1. Pirog S., Power electronics, AGH Publishing House, Cracow, 2006 (in Polish).

2. Mikołajuk K., Fundamentals of power electronic circuits analysis, PWN, Warsaw, 1998 (in Polish).

Notes

Modified by dr hab. inż. Wojciech Paszke, prof. UZ (last modification: 29-04-2020 09:11)