Selected issues of power electronics - course description

General information

Course name	Selected issues of power electronics
Course ID	06.2-WE-ELEKTD-SIoPE-SPiE-Er
Faculty	Faculty of Computer Science, Electrical Engineering and Automatics
Field of study	WIEiA - oferta ERASMUS / Electrical Engineering
Education profile	-
Level of studies	Second-cycle Erasmus programme
Beginning semester	winter term 2018/2019

Course information

Semester	2
ECTS credits to win	5
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	30	2	-	-	Exam
Laboratory	30	2	-	-	Credit with grade
Project	15	1	-	-	Credit with grade

Aim of the course

Familiarize students with modeling, analysis, properties and characteristics of PWM AC choppers and frequency converters without DC energy storage.

Formation among the students understanding of the need to develop of the multilevel and resonant converter solutions particular in power systems.

Prerequisites

Mathematical analysis, Circuit theory, Power electronics circuits.

Scope

Introduction. General description of the problems in the frame of power electronic circuits and new solutions of semiconductor power electronic devices. Analysis methods of the power electronic circuit properties.

PWM AC choppers. Topologies, operation description and properties of single- and three-phase matrix choppers (MC) and matrix-reactance choppers (MRC). Application examples of such converters.

Matrix converters. Properties of the matrix converters: with low frequency transfer matrix control strategy (Venturini and scalar control methods): with space vector and fictitious DC link control strategy. Application examples of such converters.

Matrix-reactance frequency converters. Description of conception of the frequency converters with buck-boost voltage transformation based on matrix-reactance PWM AC choppers. Topologies, operation description and properties of selected solutions.

Multilevel power electronic converters. Concept of multilevel converters. Topologies, operation description and properties of the voltage source inverters. Selected solutions of other multilevel converters and their applications.

Resonance converters. Converters with resonance switch types ZVS, ZCS, quasi- and multiresonance. Converters with resonance load and resonance DC link. Example of selected solutions and their applications.

Galvanic separation in power electronic converters. Galvanic isolation of the signals connected with electrical energy transfer by means of the electromagnetic or piezoelectric couple. Impulse transformer solution. Example of selected solutions and their applications.

Future trends of the power electronic circuits. A new semiconductor power electronic switches and intelligent power module. 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

Outcome description	Outcome symbols	Methods of verification	The class form
Has knowledge on circuit and mathematical models of PWM AC choppers and frequency converters without DC energy storage		• a project • an evaluation test • an ongoing monitoring during classes • an oral response • carrying out laboratory reports	• Lecture • Laboratory • Project
Can build the models of PWM AC converters using vector representations		• a project • an evaluation test • an ongoing monitoring during classes • an oral response • carrying out laboratory reports	• Lecture • Laboratory • Project
Can justify the need for multilevel and resonant power electronic circuits		• a project • an evaluation test • an ongoing monitoring during classes • an oral response • carrying out laboratory reports	• Lecture • Laboratory • Project

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.

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

Components of the final grade: lecture: 60% + laboratory: 20% + project: 20%

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., Maksimowić D.: Fundamentals of power electronics. Kluver Academic Publishers, 1999.

4. Fedyczak Z.: Impulse alternating voltage transforming circuits. University of Zielona Gora Publishing House. Zielona Gora 2003 (in Polish).

Further reading

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

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

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

Notes

Modified by dr hab. inż. Radosław Kłosiński, prof. UZ (last modification: 30-03-2018 00:06)