Principles of power electronics - course description

General information

Course name	Principles of power electronics
Course ID	06.5-WE-AutP-PofPE-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	3
ECTS credits to win	5
Course type	obligatory
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	-	-	Credit with grade
Laboratory	30	2	-	-	Credit with grade

Aim of the course

Familiarize students with the properties of terminal and limit parameters of the switches and power electronic topologies and basic characteristics of the power converters types AC / DC, DC / DC, AC / AC and DC / AC.

Formation among the students understand the basic issues concerning the quality of the electrical energy conversion; - shaping skills in the selection of the type of power electronic converter in the power systems.

Prerequisites

Mathematical analysis, Linear algebra, Electrical engineering principles, Circuit theory.

Scope

Basic power electronics circuits (general description). Power electronics historical outline. Application area. Types of power electronic converters (PEC), their classification and basic functions. A semiconductor device as a power electronics switch and its thermal model. Basic parameters and conversion quality evaluation of the PEC. Coefficients or factors: efficiency, total harmonics distortion, power, deformations, displacement, non-symmetry at non-sinusoidal current circumstances. Non-controlled and controlled rectifiers (AC/DC converters).

Topologies and properties of single-, two and six-pulsed non-controlled rectifiers. Single- and three-phase thyristor rectifiers with phase control. Influence of the rectifiers on supplying source. Examples of applications.

DC/DC PWM voltage and current stabilizators (DC/DC converters). Topologies and properties of the impulse DC stabilizators types buck, boost, buck-boost and H-bridge with PWM control. Examples of applications.

Single-phase AC choppers (AC/AC converters, f1 = f2). Solid state relay and thyristor choppers. Phase angle and integral control. Operation and static characteristics at R and RL load, power factor. Examples of applications.

Inverters (DC/AC converters). Single-phase voltage source inverters. Functioning and properties of the transistorized inverters at different load. The PWM control strategy in the inverters. Output voltage and frequency control. Operation general description of three-phase voltage source inverter with square wave modulation and sinus PWM. Examples of applications.

Problems and development trends of the PEC. Intelligent power module, multilevel converters, resonance converters. Future trends.

Teaching methods

Lecture, laboratory exercises, project

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Has an elementary knowledge on the functions of basic power converters, terminal properties of basic power switches		• an evaluation test • an ongoing monitoring during classes	• Lecture • Laboratory

Outcome description	Outcome symbols	Methods of verification	The class form
Has an elementary knowledge on the application areas of basic power converters		• an evaluation test • an ongoing monitoring during classes	• Lecture • Laboratory
Has an elementary knowledge on topologies and properties of basic AC/DC, DC/DC, AC/AC and DC/AC converters		• an evaluation test • an ongoing monitoring during classes	• Lecture • Laboratory

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., Maksimowić 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: 30-04-2020 07:40)