Energy-saving converter drives - course description

General information

Course name	Energy-saving converter drives
Course ID	06.0--ELEKTP-EzNapPrzeksz-Er
Faculty	Faculty of Computer Science, Electrical Engineering and Automatics
Field of study	Electrical Engineering
Education profile	academic
Level of studies	First-cycle Erasmus programme
Beginning semester	winter term 2021/2022

Course information

Semester	6
ECTS credits to win	4
Course type	optional
Teaching language	english
Author of syllabus	• dr hab. inż. Paweł Szcześniak, 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
Laboratory	15	1	-	-	Credit with grade
Lecture	30	2	-	-	Credit with grade

Aim of the course

- Modern converter drives and their control methods.
- Construction, operation and basic characteristics of energy efficient drives using modern engines with improved energy consumption characteristics and modern power electronic control systems.
- Formation of basic knowledge in the field of work and operation of electric drives and selection of components for modern electric drives.
- To develop skills in calculating the characteristic electrical quantities determining the selection of devices in modern energy-saving electric drives.
- To develop skills in calculating the costs of purchasing and operating modern propulsion systems.
- Awareness of the impact of new technologies on reducing the energy consumption of electrical systems.

Prerequisites

Electromechanical drive systems, Selected issues of circuit theory I, Selected issues of power electronics

Scope

Energy efficiency of electric drives. Energy classes of electric drives. Design and construction of energy-efficient electric drives. Selection of electric drive power. Converter systems in AC drives. Converter systems in DC drives. Selection of drive system in terms of operating mode. Energy efficiency in group drives. Modern energy-saving control and regulation systems for drives with induction, synchronous and DC motors. Selection of additional equipment for electric drives.

Power converter drives. Two- and four quadrant asynchronous drives. DC converter drives, permanent magnet and reluctance converter drives. Brushless DC motors.Control methods of converter drives. Scalar control. Field oriented control. Direct torque control. Sensorless control. Automatic control systems for speed, torque and position. Dynamics of closed loop drive systems. Follow-up and position servo drives.

Teaching methods

Lecture, laboratory exercises.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Can point the advantages and disadvantages of drives: two- and four-quadrant asynchronous drives, DC converter drives, synchronous and reluctance motors and brushless DC motors.		• an evaluation test • an oral response	• Lecture
Student is able to apply known mathematical methods and mathematical models - can use them in order to analyze and design drive systems.		• an evaluation test • an ongoing monitoring during classes • an oral response	• Lecture • Laboratory

Outcome description	Outcome symbols	Methods of verification	The class form
Can distinguish speed, torque and position control systems.		• an evaluation test • an ongoing monitoring during classes • an oral response	• Lecture • Laboratory
Can choose the proper converter drive on the basis of the economic and technical analysis.		• a discussion • an ongoing monitoring during classes	• Laboratory
Can distinguishe and characterize scalar as well as field oriented control methods.		• an evaluation test • an oral response	• Lecture

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 50% + laboratory 50%

Recommended reading

1. Boldea I., Nasar S.A, Electric Drives, CRC Press, 1999.
2. Sen P.C.: Principles of Electrical Machines and Power Electronics, John Willey and Sons, Inc., New York, USA. 1997.Kaźmierkowski M. P., Tunia H.: Automatic Control of Converter-Fed Drives, Warsaw - Amsterdam - New York - Tokyo: PWN-ELSEVIER SCIENCE PUBLISHERS, 1994.
3. Kaźmierkowski M. P., Blaabjerg F., Krishnan R.: Control in Power Electronics, Selected Problems, Elsevier 2002.
4. Kaźmierkowski M. P. and Orłowska-Kowalska T.: Neural Network estimation and neuro-fuzzy control in converter-fed induction motor drives, Chapter in Soft Computing in Industrial Electronics, Springer-Verlag, Heidelberg, 2002.
5. Leonhard W.: Control of Electrical Drives, Springer, Berlin, New York, 2001.
6. Miller T.J.E.: Brushless Permanent-Magnet and Reluctance Motor Drives, Oxford University Press, Oxford, England, 1989.

Further reading

1. Kwang Hee Nam: AC Motor Control and Electrical Vehicle Applications 2nd Edition, CRC Press, November 2018.
2. Berker Bilgin, James Weisheng Jiang, Ali Emadi: Switched Reluctance Motor Drives: Fundamentals to Applications, 1st Edition, CRC Press, November 2018.
3. Warsame Hassan Ali, Matthew N. O. Sadiku, Samir Abood: Fundamentals of Electric Machines: A Primer with MATLAB: A Primer with MATLAB, 1st Edition, CRC Press June 2019.

Notes

Modified by dr hab. inż. Paweł Szcześniak, prof. UZ (last modification: 08-07-2021 21:49)

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