Electrical machines and drives - course description

General information

Course name	Electrical machines and drives
Course ID	06.2-WE-ELEKTP-EMaD-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	4
ECTS credits to win	5
Course type	obligatory
Teaching language	english
Author of syllabus	• prof. dr hab. inż. Robert Smoleński

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	30	2	-	-	Credit with grade
Lecture	30	2	-	-	Credit with grade

Aim of the course

- familiarizing of students with the construction, principle of operation and electromechanical characteristics of the basic electrical machines;
- creations of skills in the exploitation of basic electrical machines;

Prerequisites

Physics I and II, Fundamentals of Electrical Engineering, Circuit Theory I, Materials Engineering, Fundamentals of electronics and power electronics

Scope

Basic electrodynamics' laws in electric machines theory. Induced voltage. Conditions of electromagnetic torque formation. Electromagnetic torque asynchronous, synchronous (excited and reluctance) and electromagnetic torque of commutator motors.
Construction elements of electric machines.
Transformers. One-phase-transformer, three-phase-transformer, winding connections, transformer ratio, voltage, hour indication of vector group, parallel work of three-phasetransformers. Power balance, efficiency.
Induction motors (asynchronous). Mathematical model of three-phase induction motor. Steady state of induction motor. Equivalent circuit. No load and short-circuit condition, power balance, currents and torque in steady state. Mechanical characteristic, Kloss formula, electrodynamics and electromagnetic transients of induction motors. Typical waveforms of currents, speed and torque. Two-phase induction motors. Power balance, efficiency.
Synchronous motors. Construction, basis of work of three-phase synchronous motor. Mathematical model of three-phase synchronous motor. Synchronization, field forcing, field suppression. Synchronous motor start-up, steady state of synchronous motor. Equivalent circuit, vector diagram for motor and generator state. Load, no-load and shorting condition. Electric grid and single generator work. Reluctance motors. Permanent magnet motors. Synchronous motor fed-by current source inverter. Power balance, efficiency.
Direct current motors. Mathematical model of DC motor. Separately excited DC motor, series connected DC motor. Start-up, speed control, braking of DC motors. Printed circuit DC motors, brushless DC motors. Power balance, efficiency

Teaching methods

Lecture, laboratory exercises.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Can explain conditions for occurrence of electro-magnetic moment, electro-magnetic asynchronous and synchronous (ignition and reluctance) moment, commutator machine electromagnetic moment		• an evaluation test • an oral response	• Lecture • Laboratory
Can select a machine matching driving requirements		• an evaluation test • an oral response	• Lecture • Laboratory
Can analyze operating properties of machines in the technical and economic context		• an evaluation test • an oral response	• Lecture

Outcome description	Outcome symbols	Methods of verification	The class form
Is aware of the effects of individual drives on the electric power system		• an evaluation test • an oral response	• Lecture • Laboratory

Assignment conditions

Lecture – in order to get a credit it is necessary to pass all of the required tests (oral or written)
Laboratory - in order to get a credit it is necessary to earn positive Grades for all laboratory works defined by tutor
Calculation of the final grade: lecture 60% + laboratory 40%

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
3. Kaźmierkowski M. P., Tunia H., Automatic Control of Converter-Fed Drives, Warsaw - Amsterdam - New York - Tokyo: PWN-ELSEVIER SCIENCE PUBLISHERS, 1994
4. Kaźmierkowski M. P., Blaabjerg F., Krishnan R., Control in Power Electronics, Selected Problems, Elsevier, 2002
5. Kaźmierkowski M. P. and Orłowska-Kowalska T., Neural Network estimation and neurofuzzy control in converter-fed induction motor drives, Chapter in Soft Computing in Industrial Electronics, Springer Verlag, Heidelberg, 2002
6. Leonhard W., Control of Electrical Drives, Springer, Berlin, New York, 2001
7. Miller T. J. E., Brushless Permanent-Magnet and Reluctance Motor Drives, Oxford University Press, Oxford, England, 1989

Further reading

Notes

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