COURSE DESCRIPTION CARD - SYLLABUS

Course name
Electromechanical Propulsion Systems [N2Eltech2>ESN2]

Course

Field of study	Year/Semester
Electrical Engineering	2/3
Area of study (specialization)	Profile of study
Drive Systems in Industry and Electromobility	general academic
Level of study	Course offered in
second-cycle	polish
Form of study	Requirements
part-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
10	10	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge in the area of theory, characteristics and the method of electrical machine control. Matrix calculus on the basic level. Ability of the effective self-education in the field associated with chosen subject. The student is aware of a need to expand its competence, readiness to undertake the cooperation in the team.

Course objective

The student should obtain knowledge of the mathematical models of induction and synchronous machines, as well as the brushed and brushless direct current motors. Getting knowledge about modern algorithms of vector control of induction motor and optimal control of the synchronous motor. Understanding of the principles of operation of regulated driving systems

Course-related learning outcomes

Knowledge:

1. Student has a knowledge about developmental trends and the most significant new achievements in the electrical engineering, electronics, computer science and energetics.
2. Student has a knowledge about formulating equations describing simple driving systems, principles of the identification and using computer simulations software; has a knowledge in the scope of designing simple driving systems.
3. Student has a knowledge in the possibility and restrictions of methods used in CAD in the area of electrical engineering.

Skills:
1. Student is able to work individually and in the team, is able to assess tasks the time consumption; is able to manage the small team in the way guaranteeing the completion of setting in the established time.
2. Student is able to draw up detailed documentation of results of the experiment, of design or research task.
3. Student is able to assess the possibility of using new technological achievements for the design and productions of the electrical devices and systems, containing innovative solutions.

Social competences:
1. The student understands the need of formulating both handing over to the society information and opinions of achievements in the area of electrical engineering and other aspects of activity of an electrical engineer.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
- constant judging on every classes (awarding a bonus to the activity and qualities of the perception),
- evaluation of the knowledge and abilities on a written examination.

Laboratory:
- the test and awarding a bonus to the essential knowledge of problems for the accomplishment stated in given area of laboratory tasks,
- constant judging, on every classes - awarding a bonus to the increase in the ability of using with found principles and methods,
- the evaluation of the knowledge and the abilities associated with the accomplishment of the exercise task, the evaluation of the report from the performed exercise.

Getting additional points for the activity during classes, particularly for:
- proposing discussing additional aspects of the issue,
- ability of the cooperation in the team performing the task in the laboratory;
- remarks about improving teaching materials.
- quality of the elaborated reports.

Programme content

Lecture:
Circuit models of induction machine, voltage equation in natural coordinate frame. Two-axis model of induction machine, transformation of impedance matrix. Equilibrium equations of drive with induction motors: steady state and transients. Scalar and field-vector control of induction motor drives. Magnetic circuits and models of synchronous machines. Converter fed motor. Drives with stepper motors. Brushes DC motors and universal motors. Drives with brushless DC motors. Structures of control systems of electric drives. New trends in the area of electric drive control.
Laboratory:
Measuring systems and stands for testing electromechanical converters. Basic measuring tests of electric machines. Determination of parameters and characteristics of the tested electromechanical converters on the basis of measurements. Analysis and interpretation of obtained measurement and calculation results.

Teaching methods

Lectures:
- lecture with multimedia presentation supplemented with examples given on the board,

- interactive lecture with questions to students,
- student activity is taken into account during the course of the assessment process.
Laboratory:
- detailed review of the reports by the teacher, discussion,
- demonstrations and presentations,
- teamwork.

Bibliography

Basic:
1. R. Crowder, Electric Drives and Electromechanical systems, Elsevier, 2006.
2. M. S. Sarna, Electric Machines, Steady-State Theory and Dynamic Performance, West Publishing Company, wyd. 2, 1994 i wyd. następne.
3. Wykłady z elektromechanicznych przemian Energii, Sobczyk T., Węgiel T., Wydawnictwo Politechniki Krakowskiej, Kraków 2014.
4. Zasady elektromechanicznego przetwarzania energii (tłum. z angielskiego), Meisel J., Wydawnictwo Naukowo Techniczne, Warszawa, 1970.
5. Napęd elektryczny i jego sterowanie, Sidorowicz J., Oficyna Wydawnicza Politechniki Warszawskiej , Warszawa, 1994.
6. Wprowadzenie do napędu elektrycznego, Koczara W., Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2012.
7. Automatyka napędu elektrycznego, Deskur J., Kaczmarek T., Zawirski K., Wydawnictwo Politechniki Poznańskiej, Poznań 2012.

Additional:
1. Sterowanie silnikiem synchronicznym o magnesach trwałych, K. Zawirski, Wydawnictwo Politechniki Poznańskiej, Poznań, 2005.
2. Bezczujnikowe układy napędowe z silnikami indukcyjnymi, Orłowska-Kowalska T., Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2003.
3. Comparative analysis of energy performance of squirrel cage induction motor, line-start synchronous reluctance and permanent magnet motors employing the same stator design, Łyskawinski W. Archives of Electrical Engineering 2020, vol. 69, no. 4, s. 967-98.
4. Finite element analysis and experimental verification of high reliability synchronous reluctance machine, Łyskawiński W., Jędryczka C., Dorota Stachowiak D., Łukaszewicz P., Czarnecki M., Eksploatacja
i Niezawodność – Maintenance and Reliability 2022, vol. 24, no. 2, s. 386-393.

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	20	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00