POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name

Electromechanical Propulsion Systems [S2Eltech2>ESN1]

Course

Field of study
Electrical Engineering

Year/Semester
1/1

Area of study (specialization)
Power Networks and Electric Power Systems Protection

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge about electrical and magnetic circuits. The knowledge of the principles of electrical machines. Differential and integral 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

Getting the knowledge in the methods of calculation of integral parameters of electromagnetic systems and getting the ability of analysis and design of electromagnetic actuators and electrical motors. Practical taking control of principles of formulating and solving equations of dynamics of electromechanical systems. Strengthening abilities of the selection of elements of driving systems in different operation modes. To acquire practical skills in the selection and parameterization of industrial drive inverters.

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 use methods and mathematical models for analysis and designing electrical devices and systems.
2. Student is able to compare design solutions and production processes in respect to functional and economic criteria.
3. Student is able to assess the possibility of using new technological achievements for the design and manufacturing of the electrical devices and systems, containing innovative solutions.
4. Student is able to plan the process of testing assembled electrical devices and systems.

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, rating students.

Classes:
- the test and awarding a bonus to the essential knowledge for stated implementations of problems in the given area of theoretical tasks,
- constant judging, on every classes - awarding a bonus to the increase in the ability of using with found principles and methods.

Getting additional points for the activity during classes, particularly for:
- proposing discussing additional aspects of the issue,
- effectiveness of applying the acquired knowledge while solving a set problem,
- remarks about improving teaching materials.
- drawing up individual test and design tasks.

Programme content

Nonlinear and non-stationary circuits. Forces and torques of magnetic origin. Classification of electric drives. Dynamics of electromechanical systems. Acyclic electromechanical transducers. Motor as a component of an automatic control system. General structure of a drive automatic control system. Control algorithms of industrial drive inverters. Management of braking energy in electric drive systems.

Course topics

Lectures:
Magnetic circuits. Non-linear and variable structure circuits. Sommerfeld theory: energy and co-energy. Analogies of electrical, magnetic and mechanical Systems. Electromagnetic forces and torques. Virtual work principle. Forces in linear and non-linear systems. Forces in alternating current circuits. Mechanical system dynamics: the Hamilton principle and Lagrange equations. Unified coordinates; unified energy and co-energy. Lagrange equations for electromechanical systems. Linear movement electromagnetic actuators: basic structures; the steady-state characteristics and dynamics. Heating of electrical devices. Electrical machines operation modes. Reducing transmission gears. The electric motor as the element of the automatic control system. General structure of the automatic control drive system. Classification of electric drives. General structure of the drive automatic control system. Basic control algorithms implemented in industrial drive inverters. Management of braking energy.

Classes:
Simple and branched magnetic circuits. Equivelent permeance. System inductance. Energy stored In magnetic field. Forces acting in linear and non-linear magnetic circuits. Work of the induction and direct current motor under different supply and load conditions. Selection of electric drive components for sample industrial applications.

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.

Classes:
- solving example tasks on the board,
- a detailed review of the exercise by the teacher, discussion.

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. W.H. Yeadon, A.W. Yeadon, Handbook of small electrical motors, McGraw-Hill, 2001.
4. Electric Machinery Fundamentals by Stephen J. Chapman, 4th Edition, McGraw-Hill, 2005.
5. Electric Motor Drives – Modeling, Analysis and Control by R. Krishnan Pren. Hall Inc., NJ, 2001.
6. Wykłady z elektromechanicznych przemian Energii, Sobczyk T., Węgiel T., Wydawnictwo Politechniki Krakowskiej, Kraków 2014.
7. Wprowadzenie do napędu elektrycznego, Koczara W., Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2012.
8. 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. Torque Ripple Minimization of the Permanent Magnet Synchronous Machine by Modulation of the Phase Currents, Jędryczka C, Danielczyk D, Szeląg W., Sensors. 2020; 20(8):2406. https://doi.org/10.3390/s20082406.
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	70	3,00
Classes requiring direct contact with the teacher	45	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	25	1,00