COURSE DESCRIPTION CARD - SYLLABUS

Course name
Coupled phenomena in technology [S2MwT1>ZSwT]

Course

Field of study
Mathematics in Technology

Year/Semester
1/2

Area of study (specialization)
Modelling in Technology

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
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

Knowledge: Knowledge about methods of analysis of selected phenomena occurring in electromechanical and magnetic energy converters; knowledge of how to generate forces and moments in complex mechanical and electromagnetic systems; knowledge about energy forms and methods of their transformation; knowledge of materials science with particular regard to ferromagnetic and conductive materials; knowledge of integral and differential notation of state equations Skills: Ability to analyze electrical and magnetic circuits; using commercial utility programs to develop the results of a physical experiment; ability to connect electrical circuits and perform measurements of electrical and mechanical quantities Social competences: Awareness of the need to expand the scope of acquired knowledge and skills. Ability to comply with the rules in force during lectures and laboratories, the ability to communicate with the closest environment during lectures and exercises, and to work in a laboratory team

Course objective

Systematizing and deepening knowledge about energy forms and ways of transforming one form of energy into another. Understanding the phenomenon of heating and cooling of conductive bodies and the formation of eddy-current and hysteresis losses in ferromagnetics; Causes of forces and deformations in electromagnetic and electromechanical systems. Understanding piezo- and magnetoelectric phenomena; phenomena of magnetostriction and magneto-elasticity. Understanding the basics describing heat transfer in typical thermokinetic systems and electrothermal devices as well as methods of heat transport and temperature measurements. Electromagnetic interference emitted by electrical equipment. Learning methods of measuring selected environmental parameters - emission of electromagnetic interference

Course-related learning outcomes

Knowledge:
1. Understanding the parasitic phenomena that accompany the processes of converting various forms of energy into other forms with particular emphasis on transformation into electricity.
2. Learning methods of eliminating or limiting the negative effects of selected parasitic phenomena.
3. The student has advanced knowledge of the principles of ergonomics, health and safety at work as well as hazards in industry, etc.

Skills:
1. The student has the ability to use a mathematical apparatus to describe mutually correlated phenomena and processes
2. The student is able to identify phenomena occurring in complex electromechanical systems
3. The student has the ability to develop a method of studying interrelationships between selected coupled phenomena.
4. The student is able to select the appropriate sources of knowledge and obtain the necessary information from them, make a critical analysis and assessment of solutions of complex and unusual engineering tasks or simple research problems and propose their improvement

Social competences:
1. The student is aware of the possibility of making mistakes by himself and others, shows prudent criticism of received content and received results
2. The student is aware of the role and importance of knowledge in solving problems of a cognitive and practical nature typical for professions and jobs appropriate for graduates studied direction; is aware of the need to deepen and expand knowledge

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture - assessment of the student"s knowledge and skills based on a written test
Laboratory exercises:
- test and rewarding the knowledge necessary to carry out subsequent laboratory exercises in electromagnetic energy conversion,
- continuous assessment of student activity and level of his knowledge and skills, as well as social competences related to teamwork,
- assessment of knowledge and skills related to the implementation of a specific exercises, evaluation of the report of the exercise.
Obtaining additional points for activity during classes, in particular for:
- the ability to cooperate as part of a team performing a task in a laboratory,
- the effectiveness of the group performing laboratory exercises,
- comments related to improving teaching materials,
- diligence aesthetic of reports and tasks prepared as part of self-study

Programme content

Basics of modelling coupling phenomena in a selected programming environment.

Course topics

Formation of electromagnetic forces in conductive environments; electrodynamic forces. Magnetization processes of objects made of ferromagnetic and conductive materials. Hysteresis and eddy current losses. The phenomenon of magnetostriction simple and inverse. Heating processes of conductive bodies. Basics of heat exchange. Mechanical stresses and deformations of the shape of a conductive body placed in magnetic and temperature fields. Energy transformations in transient states. Energy emission. Magnetorheological transducers.

Teaching methods

Lecture with multimedia presentation (including drawings, photos, animations, sound, films) supplemented with examples given on the board.
Lecture conducted in an interactive way with the formulation of questions for a group of students or specific students indicated

Bibliography

Basic
1. Turowski J.: Elektrodynamika Techniczna , PWN Warszawa 2003
2. Hoffman M.: Magnetosptężystość materiałów, Wydawnistwo Politechniki Poznańskiej, 2004
3. Idziak P.: Wybrane zjawiska sprzężone zachodzące w maszynach prądu stałego, Monografie nr 510. Politechnika Poznańska 2013
4. Szeląg W., Przetworniki elektromagnetyczne z cieczą magnetoreologiczną, Wydawnictwo Politechniki Poznańskiej, Poznań, 2010
5. Barański M., Polowa-obwodowa analiza nieustalonych stanów elektromagnetycznych i cieplnych w silniku indukcyjnym, Rozprawa doktorska, Wydział Elektryczny Politechniki Poznańskiej, Poznań 2010, s. 131.
6. Szeląg W., Analiza stanów pracy i synteza silników synchronicznych magnetoelektrycznych, Wydawnictwo Politechniki Poznańskiej, Poznań, 1998
Additional
1. Pryor R., W.: Multiphysics Modeling Using COMSOL, Mercury Learning and information Dulles, Virginia, Boston, 2012
2. Kwartalnik Archives of Electrical Engineering

Breakdown of average student's workload

	Hours	ECTS
Total workload	81	3,00
Classes requiring direct contact with the teacher	54	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	27	1,00