COURSE DESCRIPTION CARD - SYLLABUS

Course name
Technical Electrodynamics

Course

Field of study
Electrical Engineering
Area of study (specialization)

Level of study
First-cycle studies
Form of study
part-time

Year/Semester
4/8
Profile of study
general academic
Course offered in
polish
Requirements
compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
10	20	
Tutorials	Projects/seminars	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:
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Faculty of Control, Robotics and Electrical Engineering, ul. Piotrowo 3a, 60-965 Poznań

Prerequisites

Knowledge - Elementary knowledge of electrical engineering, electromagnetic field theory, electrical machines and numerical methods.
Skills - The skill of effective self-education in a field related to the chosen major of studies, the skill to make a right decisions to solve simple problems related to the theory of the electromagnetic field, the ability to use Windows OS.
Competences - Student is aware of the widening his competence, demonstrate a willingness to work in a team, the ability to comply with the rules in force on the lecture and laboratory.

Course objective

The student should obtain knowledge of the description and analysis of electromagnetic phenomena in electrical devices as well as knowledge of finite element method in electromagnetism.

Course-related learning outcomes

Knowledge

1. The student has a basic knowledge of technical electrodynamics
2. The student has structured knowledge of numerical methods and software for the numerical calculation of electromagnetic transducers.

Skills

1. The student will be able to use known methods and models for field analysis and synthesis of simple systems with the electromagnetic field
2. The student will be able to prepare a report on the numerical calculations of electromechanical transducers and systems with the electromagnetic field using professional software.

Social competences

1. The student is aware of the value of his work, respect the principles of teamwork, takes responsibility for collaborative work.
2. The student is able to identify the problem and choose the correct way to solve the subject of electrodynamics.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:
-assessment of knowledge and skills by the completion of a written test (solving problem),
-continuous evaluation for each lecture (rewarding activity and quality of the expression).

Laboratory:
- end test and rewarding of knowledge necessary to carry out subsequent tasks in class,
- continuous assessment of the student's activity and the increase of his knowledge and skills, as well as social competences related to team work,
- assessment of knowledge and skills related to the implementation of tasks, assessment of reports on the completed task.

Extra points for the activity in the classroom, and in particular for:
-discussion and proposition of additional aspects of the subjects,
-effectiveness of the application of the knowledge gained during solving the given problem,
-ability to work within a team, which performs the task detailed at the laboratory,
-quality and diligence of the developed reports.

Programme content

Lectrures:

The field approach in the description of electromagnetic phenomena. Differential, integral and circuit forms of electromagnetic field equations. Boundary conditions. Two dimensional (2D) fields. Methods of electromagnetic field analysis, field and potential formulations. Integral and finite difference methods of 2D electro and magnetostatic field analysis. Finite element method. Network models of systems with

magnetic and electric field. Inducted currents. Electromagnetic shields. Field method of electromagnetic torques and forces calculation. Methods describing the filamentary winding electrical machines using the electric potential vector T0. Electromagnetic levitation. Equations of 2D transient field. Numerical methods of solving diffusion equation. Methods of formulating and solving singular and non-singular equations of electromagnetic field. Implicit and explicit schemes, Crank-Nicholson method. Professional software for electromagnetic field analysis in electrical devices.

Laboratory:

Simulation of alternating current electromagnet in the different operation states, Simulation of dynamic states of a rotational electromagnetic transducer, Examination of material parameters of the system composed of the solenoid - conductive core , Examination of eddy current torque characteristics, Construction of numerical models of electromechanicadevices in the Maxwell and Magnet program, Simulation of the influence of material parameters and dimensions on the distribution of the electromagnetic field of the reactor with an air gap, Simulation of linear motor operating states including eddy currents in the runner, Simulation of electromagnetic field in the shields.

Teaching methods

Lectures - presentation of issues using multimedia, illustrated with examples given on a board, discussion of problem issues.

Laboratory - implementation of simulation and laboratory tests of electromagnetic fields in electrical devices.

Bibliography

Basic

1. Mazur D., Gołębiowski M., Rudy M., Modelowanie i analiza układów elektromechanicznych metodą elementów skończonych, Oficyna Wydawnicza Politechniki Rzeszowskiej, 2016
2. Balderes T. Finite element method, AccessScience, 2014.
3. Zienkiewicz O., Taylor R, Zhu J., The Finite Element Method: Its Basis and Fundamentals, Butterworth-Heinemann, 2013.
4. Michalski W., Podstawy teorii pola elektromagnetycznego. Statyczne pola elektryczne i magnetyczne, Oficyna Wydawnicza Politechniki Wrocławskiej, 2013.
5. Meunier G., The Finite Element Method for Electromagnetic Modeling, London - WILEY, 2008.
6. Demenko A., Obwodowe modele układów z polem elektromagnetycznym, WPP, Poznań, 2004.
7. Bossavit A., Computational electromagnetism, variational formulations, complementarity, edge element method, Academic Press Limited, London, 1998

Additional

1. Feynman L. S., Feynmana wykłady z fizyki. Elektrodynamika, fizyka ośrodków ciągłych, t. 2.2, PWN Warszawa 2012
2. Sikora J., Numeryczne metody rozwiązywania zagadnień brzegowych, WUPL., Lublin 2009

3. Dolezel I., Karban P., Solin P., Integral methods in low-frequency electromagnetics, Wiley and Son, New Jersey, 2009

Breakdown of average student's workload

	Hours	ECTS
Total workload	80	3,0
Classes requiring direct contact with the teacher	38	1,0
Student's own work (literature studies, preparation for laboratory classes, preparation for tests, project preparation) [1]	42	2,0

[1] delete or add other activities as appropriate