COURSE DESCRIPTION CARD - SYLLABUS

Course name
Computer methods in electrodynamics

Course

Field of study
Electrical Engineering
Area of study (specialization)
Electrical Systems in Mechatronics
Level of study
Second-cycle studies
Form of study
part-time

Year/Semester
2 / 4
Profile of study
general academic
Course offered in
polish
Requirements
compulsory

Number of hours

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

Number of credit points

2

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:
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Prerequisites

Knowledge - Knowledge of electromagnetic field theory, electrical engineering, and computer science electrodynamics. Basic knowledge of numerical methods for solving equations of the electromagnetic circuit and electromagnetic field problems.
Skills - Programming skills in C++ and Pascal/Matlab/Scilab at the basic level, familiarity with programs for numerical analysis of electromechanical transducers at the basic level, The skill of effective self-education in a field related to the chosen major of studies.
Competencies - Skills in teamwork and proper verbal communication, the awareness of the need to broaden their skills and knowledge.

Course objective

Familiarization with the current knowledge of the recent methods used in electromagnetic field simulations of the nowadays electromechanical converters.

Course-related learning outcomes

Knowledge

1. The student has structurally organized knowledge of the numerical methods and software for the calculation of electromagnetic transducers using finite element method.
2. The student has knowledge about computer methods for the analysis of systems with the electromagnetic field.

Skills

1. The student will know how to use numerical methods for modeling phenomena in electromechanical transducers.
2. The student will be able to prepare a study on the numerical calculations of electromechanical transducers and systems with 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

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:

-assessment of knowledge and skills listed on the completion of a written,
-continuous evaluation for each course (rewarding activity and quality of the expression).

Laboratory:
- end test and favoring the knowledge necessary to complete tasks during laboratory,
- continuous evaluation for each course - rewarding gain skills,
- assessment of skills related to the practical implementation of lecture knowledge to solve laboratory tasks,
- evaluation of the reports from performed exercise.

Extra points for the activity in the classroom, and in particular for:
-discussion 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:

Electromagnetic field equations in regions with conducting and displacement currents. Differential and integral description of field equations. Circuit models of electromagnetic field. Plane wave. Penetration of an electromagnetic wave into a conducting region. Electromagnetic and magnetic shielding. Methods of field calculations. Field and potential formulations. Analogy between methods of circuit and field analysis. Numerical method of electromagnetic field analysis in electrical machines and apparatus. Finite element method - unified approach. Interpolation functions of nodal, edge, facet and volume element. Finite element graphs and circuit models of finite elements. Network representation of finite equations in the region with displacement and eddy currents. Finite element solution of eddy current problems. Simulation of the movement in the finite element analysis of electromagnetic converters. Methods describing the filamentary winding electrical machines using electrical potential V and T0. The applied methods of education: lectures - presentation of issues using multimedia resources, discussion of problematic tasks; laboratory - implementation of simulation and laboratory tests of electromagnetic fields.

Projects:

Analysis of electromagnetic field distribution in electromechanical converters using specialized programming tools.

Teaching methods

The applied methods of education: Lectures - presentation of issues using multimedia resources, discussion of problematic tasks; Laboratory - implementation of simulation and laboratory tests of electromagnetic fields.

Bibliography

Basic

1. Mazur D., Gołębiowski M., Rudy M., Modelowanie i analiza układów elektromechanicznych metodą elementów skończonych, Oficyna Wydawnicza Politechniki Rzeszowskiej, 2016.
2. Feynman L. S., Feynmana wykłady z fizyki. Elektrodynamika, fizyka ośrodków ciągłych, t. 2.2, PWN Warszawa 2012.
3. Sikora J., Numeryczne metody rozwiązywania zagadnień brzegowych, WUPL., Lublin 2009.
4. Demenko A., Obwodowe modele układów z polem elektromagnetycznym, WPP, Poznań, 2003.
5. Nowak L., Modele polowe przetworników elektromechanicznych w stanach nieustalonych, WPP, Poznań, 1999

Additional

1. Dolezel I., Karban P., Solin P., Integral methods in low-frequency electromagnetics, WileyandSon, New Jersey, 2009.
2. Binns K., Lawrenson P., Trowbridge C., The analytical and numerical solution of electric and magnetic fields, John WileyandSons, 1992.
3. Demenko A., Symulacja dynamicznych stanów pracy maszyn elektrycznych w ujęciu polowym, WPP, Poznań, 1997

Breakdown of average student's workload

	Hours	ECTS
Total workload	54	2,0
Classes requiring direct contact with the teacher	28	1,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	26	1,0

[1] delete or add other activities as appropriate