Technology
Arts Sciences
TH Köln

Course
FEM - Finite element method in electrical engineering

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General information

Long name	Finite element method in electrical engineering
Approving CModule	SIM_MaET
Responsible	Prof. Dr. Wolfgang Evers Professor Fakultät IME
Level	Master
Semester in the year	summer semester
Duration	Semester
Hours in self-study	78
ECTS	5
Professors	Prof. Dr. Wolfgang Evers Professor Fakultät IME
Requirements	- Electrostatic: field strength, flux density, dielectrics - Electromagnetism: field strength, flux density, flux, magnetic circuits, induced voltage
Language	German
Separate final exam	No

Lecture / Exercises

Learning goals

Skills

Discretisation of physical problems using the example of an electrostatic arrangement
- One-dimensional model
- Two-dimensional model
- Replacement of partial derivatives by finite differences
- Boundary conditions
- Setting up the linear system of equations
- Different methods for solving the system of equations
- Result representation with interpolation
- Use of boundary-fitted grids
- Solving a two-dimensional electrostatic problem with FEM software
- Exploiting symmetries in the simulation
- Solving a two-dimensional magnetic problem with FEM software
- Extending the magnetic problem to include non-linear material properties
- Extension of the simulation by program-controlled variation of parameters and automatic output of characteristic diagrams with Python

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Carry out and critically evaluate FEM simulations on various physical effects

Expenditure classroom teaching

Type	Attendance (h/Wk.)
Lecture	2
Exercises (whole course)	2
Exercises (shared course)	0
Tutorial (voluntary)	0

Separate exam

Exam Type

other course-related type of test

Details

The students independently solve tasks in which given physical arrangements are to be calculated with an FEM programme. Subsequently, a report is written in the form of a conference paper.
The examinations during the course consist of three tasks with different scope and correspondingly different influence on the grade:
1. Simulation of two electrostatic arrangements. Exploitation of model symmetries. (20 %)
2. Simulation and optimisation of a magnetic arrangement with materials with linear and non-linear magnetisation characteristic. (20 %)
3. Automation of a simulation of a magnetic arrangement with Python and calculation of characteristics by parameter variation and output to a diagram. (60 %)

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Minimum standard

- Functional simulation with physically meaningful results.
- Comprehensible presentation of the results in the respective report.
- Achievement of 50% of the total points to be awarded.