Technology
Arts Sciences
TH Köln

# Course Manual FEM

Finite element method in electrical engineering

Version: 2 | Last Change: 29.04.2022 18:23 | Draft: 0 | Status: vom verantwortlichen Dozent freigegeben

## General information

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|---|---|
| **Long name** | Finite element method in electrical engineering |
| **Approving CModule** | SIM_MaET |
| **Responsible** | Prof. Dr. Wolfgang Evers<br>Professor Fakultät IME |
| **Valid from** | summer semester 2021 |
| **Level** | Master |
| **Semester in the year** | summer semester |
| **Duration** | Semester |
| **Hours in self-study** | 78 |
| **ECTS** | 5 |
| **Professors** | Prof. Dr. Wolfgang Evers<br>Professor Fakultät IME |
| **Requirements** | - Electrostatic: field strength, flux density, dielectrics<br>- Electromagnetism: field strength, flux density, flux, magnetic circuits, induced voltage |
| **Language** | German |
| **Separate final exam** | No |

### Literature

Thomas Westermann, Modellbildung und Simulation

Thomas Westermann: Mathematik für Ingenieure

## − Lecture / Exercises

### Learning goals

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

### Special requirements

none

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| **Accompanying material** | - electronic lecture slides for the lecture<br>- electronic exercise task collection |
| **Separate exam** | Yes |

### Separate exam

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| **Exam Type** | EN andere studienbegleitende Prüfungsform |

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| **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.<br>The examinations during the course consist of three tasks with different scope and correspondingly different influence on the grade:<br>1. Simulation of two electrostatic arrangements. Exploitation of model symmetries. (20 %)<br>2. Simulation and optimisation of a magnetic arrangement with materials with linear and non-linear magnetisation characteristic. (20 %)<br>3. Automation of a simulation of a magnetic arrangement with Python and calculation of characteristics by parameter variation and output to a diagram. (60 %)<br><br>Translated with www.DeepL.com/Translator (free version) |
| **Minimum standard** | - Functional simulation with physically meaningful results.<br>- Comprehensible presentation of the results in the respective report.<br>- Achievement of 50% of the total points to be awarded. |