Multi-Physics Modelling and Simulation

Lecturer
Johan GYSELINCK (Coordinator)

Course mnemonic
ELEC-H419

ECTS credits
4 credits

Language(s) of instruction
English

Course period
First term

Campus
Solbosch

Course content

The prime focus is on the resolution of 2D and 3D low-frequency electromagnetic problems by means of the finite-element method and the ONELAB open-source software, but other physics and modelling methods are dealt with. See the list below.

Scope of the course:

- **physics covered**: electromagnetics (electrokinetics, magnetostatics, magnetodynamics), thermics (heat conduction), elasticity, and their coupling, plus optimisation
- **modelling methods:** mostly the finite-element (FE) method, but also finite-difference and equivalent-circuit modelling, and analytical resolution
- **space dimensions:** 1D, 2D and 3D problems
- **time dimension:** static, time-stepping, phasor-based and eigenvalue problems

Used Software:

- **ONELAB**, Open Numerical Engineering LABoratory, http://onelab.info/
- **Gmsh**, *A three-dimensional finite element mesh generator with built-in pre- and post-processing facilities*, https://gmsh.info/
- **GetDP**, FE solver, *A General Environment for the Treatment of Discrete Problems*, https://getdp.info/, https://gitlab.onelab.info/getdp/getdp
- **Atom**, *A hackable text editor for the 21st Century*, https://atom.io/

Objectives (and/or specific learning outcomes)

- have a general overview of the various numerical and analytical methods that are available and commonly used to solve PDEs and boundary-value problems
- understand the mathematical basis of these methods
- revise the various physics and related material modelling
- use extensively the open-source ONELAB/Gmsh/GetDP software and appreciate its great flexibility
- become aware of and critical about various practical issues, e.g. mesh density and accuracy

Teaching method and learning activities

- lectures, with live demonstration of the software and active participation of the students
- exercises and tests with the software

Contribution to the teaching profile

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of exact sciences with the specificity of their application to engineering
- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Has a broad scientific knowledge, understanding and skills to be able to design, produce and maintain complex mechanical, electrical and/or energy systems with a focus on products, systems and services.

Other information

Place(s) of teaching

Solbosch

Contact(s)

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https://scholar.google.com/citations?user=mV_VDDsAAAAJ&hl=en

Evaluation method(s)

written examination and Practice work

Determination of the mark (including the weighting of partial marks)

Written exam in January/September, with questions on theory and application (around 50% of the grade), and with exercises using the software (around 50% of the grade).

Main language(s) of evaluation

English

Programmes

Programmes proposing this course at the Brussels School of Engineering

MA-IREM | Master of science in Electromechanical Engineering | finalité Professional/unit 1