

# 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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## 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

