UE Theory and Computation of Electromagnetic Fields

ECTS
6 crédits

Composante
UFR PhITEM (physique, ingénierie, terre, environnement, mécanique)

Période de l'année
Automne (sept. à dec./janv.)

- **Langue(s) d'enseignement:** Anglais
- **Ouvert aux étudiants en échange:** Oui
- **Code d'export Apogée:** PAX9COAE

Présentation

Description

The aim of the course is to provide students with knowledge on the formulation of electromagnetic problems and their numerical solving using the finite element method. This course introduces the formulation of electromagnetic problems into mathematical boundary-value problems, the numerical discretization of continuous problems into discrete problems, and the development of rudimentary computer codes for simulation of electromagnetic fields in engineering problems, with aims of providing a general overview of the finite element method commonly used to model and simulate electromagnetic devices in electrical energy applications.

The main topics tackled are:

- Electromagnetic field models: electrostatics, electrokinetics, electrodynamics, magnetostatics, magnetodynamics and wave propagation,
- Electromagnetic field and potential formulations,
- Treatment of nonlinear materials (saturation, hysteresis) and permanent magnets,
- Computation of global quantities: lumped circuit elements (resistance, inductance, capacitance), flux linkage, Joule losses, iron losses,
- Coupling of electromagnetic field and circuit models,
- Computation of electromagnetic forces.

Informations non contractuelles.
Dernière mise à jour le 04 octobre 2024

Particular attention is paid to state-of-the-art finite element techniques, modeling of problems and interpretation of numerical results. Practical work consists in simulating different electromagnetic problems by using the open-source mesh generator Gmsh (http://geuz.org/gmsh) and the own codes developed during the sessions.

Assessment: The grading policy comprises homework and lab assessments plus a final examination. The grade of the module is the weighted average of the marks of each assessment.

Heures d'enseignement

CMTD	Cours magistral - Travaux dirigés	35h
TP	TP	15h

Pré-requis recommandés

Electromagnetism, matrix algebra, interpolation and numerical integration

Bibliographie

- The finite element method for electromagnetic modeling, Gérard Meunier and al., Wiley-ISTE, 2008.
- Electromagnetic modeling by finite element methods, J.P.A. Bastos and N. Sadowski, Ed. Marcel-Decker, 2003.
- Numerical methods in electromagnetism, M.V.K. Chari, S.J. Salon, Ed. Academic Press, 2000.
- Classical electrodynamics, J. D. Jackson, third edition, Wiley, 1998.
- Electromagnetic theory, J.A. Straton, McGraw – Hill, 1941.

Infos pratiques

Campus

Grenoble - Domaine universitaire

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