UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

OPTIMAL DESIGN IN ELECTROMAGNETISM AND ELECTROMAGNETIC ENVIRONMENTAL COMPATIBILITY

Enrollment year	2021/2022
Academic year	2021/2022
Regulations	DM270
Academic discipline	ING-IND/31 (ELECTROTECHNICS)
Department	DEPARTMENT OF ELECTRICAL,COMPUTER AND BIOMEDICAL ENGINEERING
Course	
Curriculum	PERCORSO COMUNE
Year of study	1°
Period	2nd semester (07/03/2022 - 17/06/2022)
ECTS	6
Lesson hours	59 lesson hours
Language	English
Activity type	WRITTEN AND ORAL TEST
Teacher	DI BARBA PAOLO (titolare) - 2 ECTS HAUSMAN SLAWOMIR - 1 ECTS MOGNASCHI MARIA EVELINA - 3 ECTS
Prerequisites	Base knowledge of electric and magnetic field in low frequency, elementary vector analysis and operators as curl, divergence and gradient. In particular, the knowledge of vector operators for field analisys is needed.
Learning outcomes	Advanced knowledge of electric, magnetic and electromagnetic fields. Base knowledge of commercial codes for finite element simulations. Knowledge of inverse problems and optimization methods. Knowledge of technical European norms about environmental electromagnetic compatibility.

Course contents	Computer aided design Introduction to computer aided design by means of commercial software e.g. Magnet by Infolytica or Comsol Multiphysics. Finite element analysis of a simple case study. Inverse problems Direct and inverse problems. Well-posed and ill-posed problems. Fredholm's integral equation of the first kind. Under- and over-determined systems of equations. Least-squares solution. Classification of inverse problems. Optimization Solutions of inverse problems by the minimization of a functional. Constrained optimization. Multiobjective optimization. Gradient-free and gradient-based methods. Deterministic vs non-deterministic search. Numerical case studies. Industrial electromagnetic compatibility Field in low and high frequency, wave propagation, reflection and refraction. Near- and far-field. Biological effects of electromagnetic field. ICNIRP, Italian and European laws. Sources in low and high frequency. Antennas: properties (gain, directivity and polarization), kind of antennas, signal modulation. Theory of measurements of electric, magnetic and electromagnetic fields. Instruments for field measurements. Measurements of electromagnetic field radiated by microwave antennas and devices, radiofrequency antennas and fields produced by electric-power transmission plants.
Teaching methods	The lectures are held with the help of blackboard and slide based presentations. For the CAD module, Finite element codes and Matlab programming are also used. These codes are made available to students. For the Laboratory module measurements of electric and magnetic fields are done close to field sources.
Reccomended or required readings	For the CAD module: P. Di Barba, A. Savini, S. Wiak. Field models in electricity and magnetism. Springer, 2008. For the Laboratory module, slides shown during the lessons.
Assessment methods	For the CAD module, the final examination consists in solving an inverse problem. This work is discussed with the teacher. For the Laboratory module, the final examination consists of a finite element simulation in order to asses the field measurements.
Further information	
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile