UCLouvain

lphys1322

2023

Electromagnetism 2

5.00 credits	37.5 h + 22.5 h	Q1

Teacher(s)	Degrande Céline ;
Language :	French > English-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	It is recommended that students master the mathematical methods for physics as covered in the LPHYS1202 course, and it is strongly recommended that the student master the notions of electromagnetism as taught in the LPHYS1221 course.
Main themes	This teaching unit expands on the study of electromagnetism as well as on the application of advanced mathematical methods put to use in the rich and diversified context of Maxwell's equations in vacuum and in matter.
Learning outcomes	**At the end of this learning unit, the student is able to :** **a. Contributions of this teaching unit to the learning outcomes of the programme** AA1 : 1.1, 1.4 AA2 : 2.1 AA3 : 3.3, 3.5, 3.6 AA6 : 6.3 **b. Specific learning outcomes of the teaching unit** At the end of this teaching unit, the student will be able to : 1. derive Maxwell's equations in vacuum from basic notions: electromagnetic forces, Faraday's law, and the charge continuity equation; 2. establish the connection between the macroscopic Maxwell equations in matter and microscopic models of matter; 3. apply the laws of electromagnetism to a large variety of electromagnetic phenomena; 4. master in the resolution of problems a number of mathematical techniques which are tailored to symmetries of the electromagnetic configurations of the considered systems; 5. identify a variety of descriptions and a diversity of expressions for the equations of electromagnetism; 6. deepen the knowledge of the physics of electromagnetic waves; 7. understand the mechanisms of electromagnetic radiations; 8. understand relativistic effects and their applications in the electromagnetism of moving charges; 9. address the diverse forms of energy and momentum of the electromagnetic fields in vacuum and in matter.
Evaluation methods	· Written final exam. · Individual oral presentations during the tutored practicals.
Teaching methods	Traditional blackboard teaching. Suggested exercises for personal study by students. Individual student resolution of problems in preparation for oral presentations during the tutored exercise practicals.
Content	1. Electrostatics and Gauss' law, the Poisson equation, Green's theorem; Green's function and the method of image charges, separation of variables and orthogonal functions (with rectangular, spherical and cylindrical symmetry). 2. Electrostatics of macroscopic media, multipole expansions, dielectric constants, polarisability, electrostatic energy; boundary valued problems in electrostatics. 3. Magnetostatics and Ampère's law, vector potential, current distributions, magnetic moment, magnetisation, Faraday's law, energy density of the magnetic field. 4. Maxwell's equations, gauge transformations, Green's function of the wave equation and retarded fields, Poynting theorems and fields in matter, impedance and admittance. 5. Wave propagation, plane waves and polarisation, multipole expansion of fields and radiations, wave guides and resonant cavities. 6. Scattering and diffraction, relativistic charges in motion.

Bibliography	L'UE s'articule en premier lieu autour de l'ouvrage - John David Jackson, Electrodynamique Classique (Dunod, Paris, 2001) mais peut, par ailleurs, s'appuyer sur des développements présentés dans - Andrew Zangwill, Modern Electrodynamics (Cambridge University Press, Cambridge, 2013, reprinted 2015), - David J. Griffiths, Introduction to Electrodynamics (Cambridge University Press, Cambridge, 4th edition, 2017), ouvrages pouvant également servir de références bibliographiques pour cet enseignement. ---------- The UE is firstly based on the book - John David Jackson, Classical Electrodynamics (Dunod, Paris, 2001) but can also rely on developments presented in - Andrew Zangwill, Modern Electrodynamics (Cambridge University Press, Cambridge, 2013, reprinted 2015), - David J. Griffiths, Introduction to Electrodynamics (Cambridge University Press, Cambridge, 4th edition, 2017), books that can also be used as bibliographic references for this teaching.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Minor in Physics	MINPHYS	5		🔍
Bachelor in Physics	PHYS1BA	5		🔍