UCLouvain

lphys1322

2019

Electromagnetism 2

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

5 credits	37.5 h + 22.5 h	Q1

Teacher(s)	Govaerts Jan ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	LPHYS1202 and LPHYS1221 or equivalent teaching units from another programme. Having followed and passed LPHYS1231 is an asset. *The prerequisite(s) for this Teaching Unit (Unité d'enseignement – UE) for the programmes/courses that offer this Teaching Unit are specified at the end of this sheet.*
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.
Aims	**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; 1 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. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** · Written final exam. · Individual oral presentations during the tutored practicals.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** 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.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Minor in Physics	LPHYS100I	5	LPHYS1221	🔍
Bachelor in Physics	PHYS1BA	5	LPHYS1202 AND LPHYS1221	🔍