UCLouvain

lfsab1203

2017

PHYSICS 3

5 credits	30.0 h + 30.0 h	Q1

Teacher(s)	Charlier Jean-Christophe ;Lherbier Aurélien (compensates Charlier Jean-Christophe) ;Louveaux Jérôme ;Oestges Claude coordinator ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	*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	The course deals with wave physics, with a special emphasis on electromagnetic waves. It starts by writing Maxwell's equations, followed by a derivation of the wave equation from Maxwell's equations or from classical mechanics, and discusses its general solutions. The characteristics of simple waves are presented (frequency, wavelength, Doppler effect, polarisation,...). The behaviour of waves at the interface between two systems is then studied (Snell's and Fresnel's equations). Interference phenomena, including diffraction, are presented for local point and extended sources. Standing waves are then considered, as well as wave packets. The generation of electromagnetic waves is finally discussed (antennas and oscillating dipoles).
Aims	**Contribution of the course to the program objectives**: Regarding the learning outcomes of the program of Bachelor in Engineering, this course contributes to the development and the acquisition of the following learning outcomes: • LO 1.1 • LO 2.7 • LO 3.2 • LO 4.2, 4.5 **Specific learning outcomes of the course:** At the end of the course, he student will be able : 1 • To write Maxwell's equations for the electromagnetic field and to explain their different terms; • To derive the wave equation from Maxwell's or Newton's equations, and to give the general solution of the wave equation for an electromagnetic or a mechanical wave; • To identify the main characteristics of a periodic wave (frequency, wavelength, speed), and the consequences of the Doppler effect on them; • To enumerate the possible polarizations for various waves, and to represent a wave of given polarization by an appropriate mathematical expression; • To define, explain and provide a mathematical justification for the following effects : refraction, reflection, interference (in the Fraunhofer approximation), diffraction, standing waves, beating; • To explain in simple words the origin of the electromagnetic radiation, and to compute the radiation intensity away from an elementary source; • To explain in simple words the limits of classical physics and the need for quantum physics; • To describe with quantum mechanics the behavior of particles in a flat potential, in a potential well, close to a potential barrier, as well as the tunnel effect and the atomic structure of the hydrogen atom; • To use the mathematical expressions describing the effects dealt with in the course in order to solve numerically small problems involving these effects; to characterize experimentally some of these effects. - - - - *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	Written exam at the end of the quadrimester; a mid-quadrimester interrogation is also organized; a public presentation by the students of their group work (APP or LABO) is also organized at the start of some lectures. The students are provided for the exam (and the interrogation) with a reference formula sheet available for download on the course website.
Teaching methods	Lectures (CM). Learning based on exercises (APE), problems (APP) or laboratory (LABO) work by groups of students.
Content	Waves 1.1. Displacement current' integrated approach of electromagnetism

	1.2. Maxwell's equations and the wave equation 1.3. Solutions to the wave equation; mechanical waves 1.4. Polarization; reflection et refraction 1.5. Interferences 1.6. Diffraction 1.7. Standing waves and wave packets 1.8. Electromagnetic radiation and antennas
Inline resources	http://moodleucl.uclouvain.be/course/view.php?id=7223
Bibliography	Les transparents présentés au cours, les énoncés et les solutions des exercices et laboratoires, et des animations pédagogiques sont disponibles sur le site du cours. Ouvrage de référence : une édition récente de H. D. Young et R. A. Freedman, University Physics with Modern Physics, Addison Wesley: San Francisco.
Faculty or entity in charge	BTCI

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Bachelor in Engineering	FSA1BA	5	LFSAB1201 AND LFSAB1202	🔍