UCL Université catholique de Louvain

LFSAB1203A

2012-2013

Physique 3 A

3.0 credits	20.0 h + 20.0 h	1q

Teacher(s) :	Jonas Alain ; Sobieski Piotr ; Raskin Jean-Pierre ;
Language :	Français
Place of the course	Louvain-la-Neuve
Main themes :	The course is divided in three parts. The first part (2 ECTS) deals with wave physics, with a special emphasis on electromagnetic waves; the second part (1.3 ECTS) is an introduction to the principle of virtual powers of classical mechanics; the third part (1.7 ECTS) introduces the student to quantum physics. The two first parts are logical sequels of courses FSAB 1201 (Physics I) and FSAB 1202 (Physics II). The third part makes use of notions developed in the first part (waves) and the second part (Hamilton's equations derived from Lagrange's equations) to demonstrate the continuity and sheer novelty of quantum physics with respect to classical physics. The first part starts with 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, wavevector, polarisation,...). The behaviour of waves at the interface between two systems is then studied (Snell's and Fresnel's equations). Wave generation is then considered (antennas, oscillating dipoles, accelerated charge,...), and interference phenomena, including diffraction, are presented for local point and extended sources. Finally, stationary waves are considered. The second part makes use of the principle of virtual powers to solve some mechanical problems of increasing complexity. Lagrange's equations are introduced at the end. The third part presents the limitations of classical physics. The concepts developed in quantum physics to solve these limitations are presented (Schrödinger's equation). A few simple cases are solved (free particle, particle in a quantum well or near a potential barrier). The course ends with a description of atom properties (based on the model of the Hydrogen atom), in order to open to the notion of orbitals used by chemists. 3. Summary : content and methods Part 1: Waves 1.1 Wave equation 1.2 Polarisation - reflection et refraction 1.3 Antennas et oscillating dipoles 1.4 Interferences (interferences from point sources; diffraction; stationary waves) Part 2 : Principle of virtual powers and Lagrange's mechanics Part 3 : Quantum Physics 1.1 Limitations of classical mechanics 1.2 Schrödinger's equation and wave function 1.3 Quantum particles 1.4 Model of the Hydrogen atom Methods : Problem-based learning, exercises, lectures, practical classes (part I only) 4. Prerequisites FSAB 1201 (Physics 1) or a similar course. FSAB 1202 (Physics 2) or a similar course. FSAB 1101 (Mathematics 1) or a similar course. FSAB 1102 (Mathematics 2) or a similar course.
Aims :	*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”.*
Content :	The course is divided in three parts. The first part (2 ECTS) deals with wave physics, with a special emphasis on electromagnetic waves; the second part (1.3 ECTS) is an introduction to the principle of virtual powers of classical mechanics; the third part (1.7 ECTS) introduces the student to quantum physics. The two first parts are logical sequels of courses FSAB 1201 (Physics I) and FSAB 1202 (Physics II). The third part makes use of notions developed in the first part (waves) and the second part (Hamilton's equations derived from Lagrange's equations) to demonstrate the continuity and sheer novelty of quantum physics with respect to classical physics. The first part starts with 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, wavevector, polarisation,...). The behaviour of waves at the interface between two systems is then studied (Snell's and Fresnel's equations). Wave generation is then considered (antennas, oscillating dipoles, accelerated charge,...), and interference phenomena, including diffraction, are presented for local point and extended sources. Finally, stationary waves are considered. The second part makes use of the principle of virtual powers to solve some mechanical problems of increasing complexity. Lagrange's equations are introduced at the end. The third part presents the limitations of classical physics. The concepts developed in quantum physics to solve these limitations are presented (Schrödinger's equation). A few simple cases are solved (free particle, particle in a quantum well or near a potential barrier). The course ends with a description of atom properties (based on the model of the Hydrogen atom), in order to open to the notion of orbitals used by chemists.
Cycle and year of study :	> Bachelor in Engineering : Architecture
Faculty or entity in charge:	BTCI