lphy2360

2024

Physique atomique, nucléaire et des radiations

2.00 credits	22.5 h	Q1

Teacher(s)	Cortina Gil Eduardo ;
Language :	French
Place of the course	Louvain-la-Neuve
Main themes	This course is intended for students of different specialisations: Nuclear Medicine, Radio-pharmacy, Hospital Physics, Radioprotection, Public Health, Civil and Industrial Engineers. - Generalities, orders of magnitude, physical units and conversion factors. - Waves, Duane-Hunt expression and general structure of matter. - Mass-Energy Equivalence (Principles of Special Relativity) and applications such as electron kinematics - Duality Wave - Corpuscular and consequences. - The Atomic Models - Bohr's simple model for the electron. The Sommerfeld-Wilson elliptical model - The atomic structure seen by Quantum Mechanics and the notions of quantization - Spin of the electron - Moseley's empirical law - Klechkowski's rule and the filling order of the electronic layers - Consequences. - Absorption and emission of energy by the electronic structure of the atom - Ionisation and ionisation potentials - Fluorescence and the Auger effect - X-rays (K, L,) and Sieghban nomenclature - X-ray spectra and the so-called Kramer description - Bremsstrahlung process. The Nuclear Core : - Static Aspects: (Nuclear Radiation, Nuclear Mass, Notions of isotopes, isotones and isobars, Binding Energy) - (Generalities on the energy structure of nuclei - Weizsaeker mass formula and its consequences in b decay and fission - Introduction to nuclear structure in the Meyer-Jensen layered model). - Dynamic Aspects: (Nuclear Radioactivity - Simple Decay Law and Bateman's Progeny Equations and their consequences) - (Nuclear, biological and effective lifetimes) - (Branching ratios in radioactive decay). - Description of decays: b-, b+ , electron capture a, g and fission illustrated by examples in the industrial and medical fields. - Nuclear isomerism and its consequences (Internal conversion and emission of characteristic X-rays). - Interactions of ionising radiation with matter: - Absorption of a charged particle. - Linear energy loss and stopping power - Specific ionisation and ionisation potentials. - The Bethe-Block law for a heavy charged particle and its applications The Bethe-Block law for a heavy charged particle and its applications -- Notions of path or o Bragg range and peak o Specific electron-matter interaction. Notions of energy loss by collisions and by braking radiation or Bremsstrahlung o Electron stopping power and practical examples o Delta electrons - Production of X-rays (emitting tubes). - Interactions of NEUTRAL radiation with matter. General notions on neutrons and gamma rays (developed according to the audience). Volume 2 will be devoted to exercises such as visits to the Cyclotron, more detailed mathematical demonstrations of some of the principles quickly explained in the course.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 The objective of this course is to remind the students from other orientations than physics the basic principles and the fundamental notions of atomic, nuclear and radiation physics, which they will need to follow their specialization (Radioprotection, Nuclear Medicine, Radio-pharmacy, Nuclear Engineer,

	) . We develop, notably, this basic knowledge to suit the specific needs of the auditorium.
Evaluation methods	The assessment is based on two parts: • Written exam: (12 points) • 6 question over theory and problems • Daily Work Rating: (8 points) • This rating is based on the exercises to be handed in during the course. • This daily work is compulsory.
Teaching methods	The courses will be of two types : • Lectures, where the teacher explains the material, emphasizing the basic concepts and notions. As the level of the students may be too different, the lectures in the audience will deal only with the most important topics and references for the students who wish to go deeper into the subject will be suggested. In all sessions there will be time for questions from the students. • Exercise sessions. Exercise statements are available before the session on Moodle. The teacher will insist on basic calculations. It is essential to prepare the exercises in advance in order to benefit from the session. Student participation during these sessions will be encouraged.
Content	1. Principles of special relativity and quantum physics 2. Atomic physics. Excitation and de-excitation of the atom's electron procession - X-ray spectra. 3. Nuclear physics. Static aspects. Dynamic aspects. Radioactive phenomena 4. Radiation-matter interaction.
Inline resources	Moodle website : https://moodleucl.uclouvain.be/course/view.php?id=15981 Many documents available : Course slides. Exercise outlines. Additional exercises.
Other infos	A good knowledge of mathematics and general physics such as Newtonian mechanics, waves and electromagnetism is desirable. The level required is that of the mathematics and general physics courses of the first health sciences courses.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Biomedical Engineering	GBIO2M	2		
Advanced Master in Nuclear Medicine	MNUC2MC	2		
Certificat universitaire en physique d'hôpital	RPHY9CE	4		
Certificat universitaire en radioprotection pour les médecins du travail	RMDT9CE	4		
Certificat universitaire en radiopharmacie	RFAR9CE	4		