UCLouvain

lphys2102

2023

Ionizing Radiation Detection and Nuclear Instrumentation

6.00 credits	26.0 h + 26.0 h	Q1 and Q2

Teacher(s)	Cortina Gil Eduardo ;
Language :	English
Place of the course	Louvain-la-Neuve
Prerequisites	No prerequisites for students who have obtained a Bachelor's degree in physics and who therefore already have knowledge of the energy loss of particles in matter and a basic knowledge of semiconductor physics and PN junction.
Main themes	- Study of basic techniques used in physical measurements : temperature, pressure, force, ... - Study of the detection of ionizing radiations.
Learning outcomes	**At the end of this learning unit, the student is able to :** **a. Contribution of the teaching unit to the learning outcomes of the programme (PHYS2MA)** AA1: 1.3, 1.4, 1.5, 1.6 AA2: 2.2, 2.3, 2.5 AA5: 5.1 AA6: 6.1, 6.4, AA7: 7.1, 7.3 AA8: 8.1,8 .2 **b. Specific learning outcomes of the teaching unit** At the end of this teaching unit, the student will be able to: 1. define the characteristics of the fundamental sensors used in physics, 2. Identify and explain the physical processes related to these sensors. 3. select the appropriate reading system for elementary sensors. 4. define the characteristics of a radiation detector and describe its mode of operation: 5. identify and explain the physical processes associated with these detectors. 6. use, in an operational manner, the different types of detectors / sensors described during the teaching unit.
Evaluation methods	The evaluation is based on: • reports and presentations about laboratory work. • written exam.
Teaching methods	This training has two activities: 1. Theory course and exercise sessions - Lecture in auditorium - Problem solving in auditorium 2. Mandatory practical work consisting of laboratories. - Initial laboratory projects - Assembly and measurement of a radiation detection experiment - Data analysis and report writing All the material (syllabus, course slides, exercise lists, lab books and tutorials) can be found on the Moodle (UCLouvain) site and Toledo (KU Leuven) of the teaching unit
Content	1. Introduction: (Special relativity, Atomic and Nuclear Physics, Statistics), 2. Radiation sources (including basics on accelerators and production of radioisotopes), 3. Radiation-matter interaction, 4. General characteristics of detectors, 5. Gas detectors, 6. Scintillation detectors. Gamma spectroscopy, 7. Semiconductor detectors, 8. Neutron detectors, 9. Nuclear Electronics

	10. Accelerators and Artificial Radioactivity Laboratoires (a selection from the following list; not exhaustive): 1. Geiger-Mueller: Counting statistics. 2. Introduction to simulation codes SRIM and VGATE. 3. Cyclotron: Bragg peak measurement. 4. NaI, HPGe, CdZnTe: Gamma spectrometry. 5. Surface Barrier detector: Alpha spectroscopy. 6. Neutron detection. 7. Scintillation: SiPMs, PMTs, coincidence techniques. 8. Proportional counter: X-ray fluorescence. 9. Angular Correlations with HPGe and/or NaI detectors. 10. Muon detection: muon lifetime and angular distribution
Bibliography	G.F. Knoll, Radiation Detection and Measurement. H. Kolanoski, N. Wermes, Particle Detectors fundamentals and applications C. Grupen & B. Schwartz, Particle Detectors (2nd Edition) W.R. Leo Techniques for Nuclear and Particle Physics Experiments D. McGregor, J. Kenneth Shultis, Radiation Detection: Concepts,Methods and Devices.
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [60] in Physics	PHYS2M1	5		
Certificat universitaire de contrôle physique en radioprotection (Classe I)	RCPA9CE	6		
Master [120] in Biomedical Engineering	GBIO2M	5		
Certificat universitaire de contrôle physique en radioprotection (Classe II)	RCPB9CE	6		
Master [120] in Physical Engineering	FYAP2M	5		
Certificat universitaire en physique d'hôpital	RPHY9CE	6		
Master [120] in Physics	PHYS2M	5		
Certificat universitaire en radioprotection pour les médecins du travail	RMDT9CE	6		
Certificat universitaire en radiopharmacie	RFAR9CE	6		
Master [120] in Medical Physics	PHMD2M	6		