UCLouvain

lphys2102

2021

Detectors and sensors

5.00 credits	22.5 h + 7.5 h	Q1

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 from the laboratories: (30%) • wriite exam: (70%) • 6 short questions • 3 numerical problems
Teaching methods	This training has two activities: 1. Theory course and exercise sessions - Lecture in audience - Problem solving in audience 2. Mandatory practical work consisting of laboratories. - Assembly and measurement - Data analysis and report writing All the material (syllabus, course slides, exercise lists, lab books, electronic components and tutorials for the simulation program) can be found on the MoodleUCL site of the teaching unit
Content	Sensors. 1. Sensor fundamentals. 2. Measurement bridges (Wheatstone, Nerst, Sauty, Maxwell, Hay). 3. Voltage and current. 4. Temperature, pressure, humidity, vacuum. 5. Position and motion sensors. 6. Velocity, flow rate (in fluids). 7. Force, strain, mechanical shock, accelerometers.

	8. Optical sensors. 9. Acoustic sensors. Radiation detection. 1. Counting statistics. 2. Radiation sources. 3. Radiation-matter interactions. 4. General characteristics of detectors. 5. Gas detectors. 6. Semiconductor detectors. 7. Scintillation detectors. 8. Neutron detectors. 9. Nuclear electronics. Laboratoires. 1. Introduction to simulation codes SRIM and VGATE . 2. Cyclotron : Bragg peak measurement. 3. Geiger-Mueller : counting statistics,. 4. NaI and HPGe : Gamma spectrometry. 5. Surface barrier detector : Alpha spectroscopy. 6. Neutron detection. 7. Sensor readout with RaspberryPI and/or Arduino.
Bibliography	G.F. Knoll, Radiation Detection and Measurement. C. Grupen & B. Schwartz, Particle Detectors (2nd Edition).
Faculty or entity in charge	PHYS

Programmes containing this learning unit (UE)

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