UCLouvain

# lphys2102

*2019*

# Detectors and sensors

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

| 5 credits | 22.5 h + 7.5 h | Q1 |
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| Teacher(s) | Cortina Gil Eduardo ;Piotrzkowski Krzysztof ; |
| Language : | English |
| Place of the course | Louvain-la-Neuve |
| Main themes | - Study of basic techniques used in physical measurements : temperature, pressure, force, ...<br>- Study of the detection of ionizing radiations. |
| Aims | **a. Contribution of the teaching unit to the learning outcomes of the programme (PHYS2MA)**<br>AA1: 1.3, 1.4, 1.5, 1.6<br>AA2: 2.2, 2.3, 2.5<br>AA5: 5.1<br>AA6: 6.1, 6.4,<br>AA7: 7.1, 7.3<br>AA8: 8.1,8 .2<br>1 **b. Specific learning outcomes of the teaching unit**<br>At the end of this teaching unit, the student will be able to:<br>1. define the characteristics of the fundamental sensors used in physics,<br>2. Identify and explain the physical processes related to these sensors.<br>3. select the appropriate reading system for elementary sensors.<br>4. define the characteristics of a radiation detector and describe its mode of operation:<br>5. identify and explain the physical processes associated with these detectors.<br>6. use, in an operational manner, the different types of detectors / sensors described during the teaching unit.<br>- - - -<br>*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 | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>The evaluation is based on:<br>- reports from the laboratories,<br>- a written exam,<br>- a personal project. |
| Teaching methods | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>This training has two activities:<br>1. Theory course and exercise sessions<br>- Lecture in audience<br>- Problem solving in audience<br>2. Mandatory practical work consisting of laboratories.<br>- Assembly and measurement<br>- Data analysis and report writing<br>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.<br>1. Sensor fundamentals.<br>2. Measurement bridges (Wheatstone, Nerst, Sauty, Maxwell, Hay).<br>3. Voltage and current.<br>4. Temperature, pressure, humidity, vacuum.<br>5. Position and motion sensors. |

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| | 6. Velocity, flow rate (in fluids).<br>7. Force, strain, mechanical shock, accelerometers.<br>8. Optical sensors.<br>9. Acoustic sensors.<br>Radiation detection.<br>1. Counting statistics.<br>2. Radiation sources.<br>3. Radiation-matter interactions.<br>4. General characteristics of detectors.<br>5. Gas detectors.<br>6. Semiconductor detectors.<br>7. Scintillation detectors.<br>8. Neutron detectors.<br>9. Nuclear electronics.<br>Laboratoires.<br>1. Introduction to simulation codes SRIM and VGATE .<br>2. Cyclotron : Bragg peak measurement.<br>3. Geiger-Mueller : counting statistics,.<br>4. NaI and HPGe : Gamma spectrometry.<br>5. Surface barrier detector : Alpha spectroscopy.<br>6. Neutron detection.<br>7. Sensor readout with RaspberryPI and/or Arduino. |
| Bibliography | Partie capteurs :<br>Jon S. Wilson, Sensor Technology Handbook .<br>J. Fraden, Handbook of Modern Sensors.<br>Partie radiation :<br>G.F. Knoll, Radiation Detection and Measurement.<br>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 | Aims |
|---|---|---|---|---|
| Master [120] in Biomedical Engineering | GBIO2M | 5 | | |
| Master [120] in Physical Engineering | FYAP2M | 5 | | |
| Master [60] in Physics | PHYS2M1 | 5 | | |
| Certificat universitaire de contrôle physique en radioprotection (Classe I) | RCPA9CE | 5 | | |
| Master [120] in Physics | PHYS2M | 5 | | |