Degree: Industrial Engineer

ETSEIB

# 4º Q6 — 24418 DETECTION AND MEASUREMENT OF RADIATION

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| Department: | 721 Nuclear Physics & Engineering | |
| Coordinator: | Manuel Sevilla Sanz | Pavelló C Planta 0 |
| Type | Credits Theory / Problems / Laboratory: | 2 / 1 / 1,5 |
| Optative | European Credits ECTS: 4 | Language: Spanish |

## OBJECTIVES

### General Objective

Describing the structure and to analyze the radiation direct or the indirectly ionizing (full particles, photons and neutrons) detectors operation.

### Specific Objectives

** Describing the coverage of the different detectors in the engineering process, its operation characteristics as electrical transducer and the associated electronic instrumentation characteristics.

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## CONTENTS

**1. RADIATION INTERACTION APPLIED IN DETECTION** (5h)

1. Nature of the ionizing radiation. Interaction of the charged particles, ionization and excitement. Photons interaction, photoelectric effect, Compton effect, couples creation. Interaction of the neutrons, fast neutrons, slow neutrons. Transmission, backscattering, attenuation and scope of the radiation.

**2. DETECTORS MAIN CHARACTERISTICS** (10h)

1 Efficiency of detection and geometrical factor. Pulse detectors and average value detectors. Integral spectrum and differential spectrum amplitudes. Resolution. Counting curves. Dead Man Time. Detection statistics.

**3. IONIZING GASEOUS DETECTORS** ( 5h)

3.1 The gas ionization process. Characteristic curve of the gaseous ionization detectors. Ionization chambers, proportional counters, Geiger-Müller counter tubes. Filling gases. Gaseous ionization detectors for neutrons.

**4. SCINTILLATORS** ( 4h)

4.1 Organic and inorganic flash materials, liquid and gaseous solids. Scintillators for photons, for full particles and for neutrons. Photomultipliers. Photons spectroscopy.

**5. SEMICONDUCTOR DETECTORS** ( 4h)

5.1 Intrinsic and extrinsic semiconductors. Type P and of type N semiconductors. The PN joint. Diffuse joint detectors. Surface barrier detectors. Compensated detectors.

**6. THE DETECTORS AS TRANSDUCERS ELECTRICS (2 h)**

6.1 The pulse formation in the gaseous ionization detectors. Intensity induced in the polarization circuit by the dragging of the charges. Electron and ion movement in the bosom of the gases. Detection pulse calculation in the ionization chambers, in the proportional counters and in the Geiger-Müller counter tubes. Scintillator pulse calculation associated to photomultipliers. Detection semiconductor pulse calculation.

**7. DETECTORS INSTRUMENTATION**

7.1 Pulse preamplifiers and amplifiers. Pulse conformation circuits . Pulse transmission in coaxial lines. Monochannel analyzers. Multichannel analyzers. Electrometric Amplifiers.

## METHODOLOGY

The theory credits include the ones dedicated to the exposure of questions and to the accomplishment of exercises given by the professor and to the approach of others the student has to solve. The laboratory credits are part of the seven experiences programmed which will be carried out in groups of two or three people.

## EVALUATION

The evaluation is made by the exercises delivered by students, the final exam and by the memory related with the laboratory experiences.

**Qualification System**

$N_{final} = 0,4\ N_{lab} + 0,1\ N_{pb} + 0,5\ N_{ef}$

$N_{lab}$ = Laboratory experiences Mark (one per group)

$N_{pb}$ = Delivered exercises Mark

$N_{ef}$ = Final exam Mark

**Tests accomplishment norms**

The final examination consists of the resolution of five exercises in an available time of three hours. The students can consult the bibliographic material that consider convenient and to make use of the means of calculation that they have.

## RESOURCES

Bibliography
KNOLL, G.F. Radiation Detection and measurement. John Wiley and Sons
SEVILLA M. et al. F.N. Experiencies de laboratori. UPC
TEACHING STAFF AND SCHEDULE OF ATTENTION

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## EUROPEAN MASTER OF SCIENCE IN NUCLEAR ENGINEERING ( EMSNE):

The five ECTS corresponding to this subject count for the obtaining of the European Master of Science in Nuclear Engineering (EMSNE) from the European Nuclear Education Network (ENEN).

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