

**COURSE DATA****DATA SUBJECT**

**Code:** 43074  
**Name:** Radiation detectors in medicine  
**Cycle:** Master's Degree  
**ECTS Credits:** 5  
**Academic year:** 2026-27

**STUDY (S)**

Degree	Center	Acad. year	Period
2140 - Master's Degree in Medical Physics	Facultat de Física	1	Annual

**SUBJECT-MATTER**

Degree	Subject-matter	Character
2140 - Master's Degree in Medical Physics	Dosimetry and radiation protection	COMPULSORY

**COORDINATION**

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**SUMMARY**

This subject consists of 5 ECTS which are devoted 50% to theory and problems and another 50% to practical work at the laboratory of Nuclear Instrumentation. Theory lectures imply the study of most common detectors in nuclear and medicine physics: proportional and scintillating detectors, solid state detectors etc, together with a detailed study of a statistical treatment of data.

Practical works at the laboratory include: X rays fluorescence studies, Compton experiment, study of gamma-gamma coincidences, measurement of mean life for nuclear states, electron and alpha spectroscopy, cosmic radiation determination and muon mean life measurement etc.

We have to point out that the normal development of this subject also requires good knowledge on electronics as the NIM standard, electronic logic for experiments, timing measurements etc. which are studied in other course of this master.

**PREVIOUS KNOWLEDGE****RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE**



There are no specified enrollment restrictions with other subjects of the curriculum.

## OTHER REQUIREMENTS

We recommend that the students which are going to follow this subject should have got knowledge on the items usually explained in the docent laboratories in physics faculties such as General Physics and Nuclear Physics laboratory etc.

It's therefore convenient that they have got knowledge on error propagation, lineal fitting methods statistics and treatment of experimental data.

Theoretical knowledge on nuclear physics, solid state physics and quantum physics are also recommendable.

## COMPETENCES / LEARNING OUTCOMES

### 2140 - Master's Degree in Medical Physics

Acceder a herramientas en el área de Física que puedan ser susceptibles de aplicación a la Medicina y valorar su aplicabilidad e interés.

Be able to access the information required (databases, scientific articles, etc.) and to interpret and use it sensibly.

Critically analyze both his/her work and that of the colleagues.

Elaborar una memoria clara y concisa de los resultados de su trabajo y de las conclusiones obtenidas.

Saber redactar y preparar presentaciones para posteriormente exponerlas y defenderlas en público.

Seleccionar la instrumentación apropiada para el estudio a realizar y aplicar sus conocimientos para utilizarla de manera correcta.

Students should demonstrate self-directed learning skills for continued academic growth.

Students should possess and understand foundational knowledge that enables original thinking and research in the field.

To acquire a critical attitude that allows you to make reasoned judgments and defend them with rigor and tolerance.

Utilizar la tecnología implicada en la producción y posterior detección de las radiaciones ionizantes.

## DESCRIPTION OF CONTENTS

### 1. Radiation sources

More common radiation sources are introduced, generally used in the laboratory



## **2. Spectroscopy of radiations**

We describe the characteristics of radiations observed in the detectors

## **3. Basic concepts in statistics**

Basic concepts in statistics applied to laboratory.

## **4. Probability distributions**

Most common probability distributions are presented.

## **5. Curve fitting**

We describe the methods in order to make fittings of most common curves.

## **6. General characteristics of detectors**

Simplified model of a general detector  
Detector response.  
Energy resolution. The Fano factor.  
Linearity  
Response time.  
Dead time

## **7. General properties of gas detectors**

The global characteristics of detectors using gases are described

## **8. Gaseous ionization detectors**

Avalanche formation and properties  
Ionization counters  
Proportional counters  
Drift chambers

General characteristics



## 9. Scintillating detectors

General characteristics  
Organic scintillators.  
Inorganic crystals  
Gaseous scintillators.  
Luminous response.  
Mounting and operation of scintillators

## 10. Photomultipliers (PMs)

Basic Elements of a PM  
Time resolution and response  
Gain

## 11. Semiconductor detectors

Energy band structure of semiconductors  
The p-n union  
Surface barrier detectors  
Microstrips and pixel detectors.

## 12. Introduccion to basic electronics

We describe some of the NIM moduls more commonly used in laboratories and basic techniques.

## 13. Laboratory experiences

X rays fluorescence  
Compton experiment  
Gamma-gamma coincidences and mean life of nuclear excited states  
Electron decay spectroscopy  
Alfa decay spectroscopy  
Cosmic radiation study  
Mean life determination for cosmic muons.

## WORKLOAD

### PRESENCIAL ACTIVITIES

Activity	Hours
Theory	26,00
Other activities	2,00



Laboratory	22,00
<b>Total hours</b>	<b>50,00</b>

## NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	1,00
Individual or group project	8,00
Independent study and work	30,00
Preparation of lessons	20,00
Preparation for assessment activities	15,00
Resolution of case studies	5,00
<b>Total hours</b>	<b>79,00</b>

## TEACHING METHODOLOGY

The theory of this subject is explained following the traditional method of exposing the matters in "magistral" form with the help of multimedia presentations selected by the professor, even if these classes are given using the videoconference format. In a complementary way tutorial classes are programmed, which again are performed by video and are specially devoted to the main points of this subject and try to clarify weak items and solve doubts.

The matter implies also that the student should get ability to solve blackboard problems. We regularly propose problems to the students, which once solved by them are explained again by video.

Practical work is done at the Nuclear Instrumentation laboratory with the professors being always present to explain and help in developing the proposed work.

## EVALUATION

### First and second session

Attendance at face-to-face practices is mandatory to pass the subject.

- Written exam on the content covered in the course's theoretical and problem-solving classes. 60%

- Theory exam (questions and questions) 30%
- Problem-solving exam 30%
- - Evaluation of the practical exercises and active participation in the theoretical and practical classes 40%

- The minimum grade for the written exam to average with the practical classes is 3 out of 6

- The minimum grade to pass the course is 5.



Evidence of copying or plagiarism will result in failure to pass the subject and in appropriate disciplinary action being taken. Please note that, in accordance with article 13. d) of the Statute of the University Student (RD 1791/2010, of 30 December), it is the duty of students to refrain from using or participating in dishonest means in assessment tests, assignments or university official documents.

In the event of fraudulent practices, the **¿Action Protocol for fraudulent practices at the University of Valencia¿** will be applied (ACGUV 123/2020):

<https://www.uv.es/sgeneral/Protocols/C83sp.pdf>

## REFERENCES

- W.R. Leo. Techniques for nuclear and particle physics experiments. Springer Verlag.
- G.F Knoll. Radiation Detection and Measurement. John Wiley and Sons.
- N. Tsoulfanidis and L. landsberger. Measurement and detection of radiation. CRC Press.
- R. Guardiola, E. Higón, J. Ros. Mètodes Numèrics per a la Física. Universitat de València
- A. Ferrer. Física Nuclear y de Partículas. Universitat de València
- K. S. Krane. Introductory nuclar Physics. John Wiley and Sons.