COURSE DATA

Data Subject	
Code	43074
Name	Radiation detectors in medicine
Cycle	Master's degree
ECTS Credits	5.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
2140 - M.D. in Medical Physics	Faculty of Physics	1	Annual

Subject-matter

Degree	Subject-matter	Character
2140 - M.D. in Medical Physics	2 - Dosimetry and radiation protection	Obligatory

Coordination

Name	Department
HIGON RODRIGUEZ, EMILIO	180 - Atomic, Molecular and Nuclear Physics

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 estate 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 estates, electron and alfa 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.

OUTCOMES

2140 - M.D. in Medical Physics

- Students should demonstrate self-directed learning skills for continued academic growth.
- Be able to access the information required (databases, scientific articles, etc.) and to interpret and use it sensibly.
- 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.
- Critically analyze both his/her work and that of the colleagues.
- Acceder a herramientas en el área de Física que puedan ser susceptibles de aplicación a la Medicina y valorar su aplicabilidad e interés.
- Seleccionar la instrumentación apropiada para el estudio a realizar y aplicar sus conocimientos para utilizarla de manera correcta.
- Utilizar la tecnología implicada en la producción y posterior detección de las radiaciones ionizantes.
- 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.

LEARNING OUTCOMES

- The student should get basic knowledge on the techniques and methods more widely used to detect radiation in nuclear and medicine physics.

-The student has to obtain the necessary agility and enough knowledge to publicly present a scientific research in oral form or in the usual scientific format of research publications.

- The student should get enough experience to be able to work in collaboration with other students or researchers as to be able to work in a team.

DESCRIPTION OF CONTENTS

1. Radiation sources

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

2. Spectroscopy of radiations

We describe the charactersitics of radiations observes in the detectors

3. Basic concepts in statistics

Basic concepts in statistics applied to laboratory.

4. Probability distributions

Most common probabilty 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

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 tecniques.

13. Loboratory 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

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	16,00	100
Attendance at events and external activities	1,00	0
Development of group work	4,00	0
Development of individual work	4,00	0
Study and independent work	25,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	10,00	0
Preparation of practical classes and problem	10,00	0
Resolution of case studies	5,00	0
Resolution of online questionnaires	5,00	0
TOTAL	**125,00**	

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

The evaluation of this subject corresponds 50% to theory and blackboard problems, whose evaluation is performed by means of the usual tests. This percentage is divided to 70% to theory and 30% to problems.

The remaining 50% of the evaluation is devoted to the memory and presentation of the practical work done in the laboratory.

REFERENCES

Basic

- 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.

Additional

- 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.