COURSE DATA

DATA SUBJECT

Code: 43076
Name: Information and communication technology
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	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
2140 - Master's Degree in Medical Physics	The physics of diagnosis and therapy	COMPULSORY

COORDINATION

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SUMMARY

This subject is divided into two blocks: the first deals with electronic technology for radiation detectors, and the second describes the principles of scientific programming.

In the first block, basic analog and digital circuits are studied, as well as signal conditioning for the most used transducers in radiation detectors. The basic conditioning elements are presented: load preamplifiers, RC-CR filters operating as shapers and the 1-bit digitization stages (leading-edge discriminators and constant fraction discriminators) and multilevel.

Finally, time reference circuits, mean-timers and TDCs are analyzed. This block has a practical part in which some of the circuits studied are shown.

The second block of the course introduces the principles of scientific programming using the Python language. With this programming language it is possible to perform statistical analysis on a set of data obtained in a scientific experiment, to represent graphs or to process medical images to extract the most relevant information, among others. First, the basics of Python programming (semantics, data types, control statements) are introduced. Next, the handling of advanced data structures is described, and then

applied to the creation of graphics, statistical analysis, and digital image processing, introducing the necessary packages.

This block introduces the basic concepts that the student must understand to satisfactorily approach the subject of Medical Diagnostic Imaging Systems, where the acquisition and characteristics of each medical imaging modality are explained in depth.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

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.

Be able to access to information tools in other areas of knowledge and use them properly.

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

Distinguir las diferencias y similitudes de los métodos de procesamiento y análisis de imágenes de ayuda al diagnóstico.

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

Manejar la instrumentación básica en un laboratorio de electrónica de comunicaciones.

Manejar las técnicas básicas de control de calidad de las diferentes modalidades de obtención de imágenes.

Manejar los métodos matemáticos de procesamiento de señales para la obtención de las diferentes modalidades de imágenes.

Project the knowledge on specific problems and know how to summarize and extract the most relevant arguments and conclusions for their resolution.

Realizar la simulación de un sistema de comunicación de datos.

Realizar medidas de señales en el dominio frecuencial con el analizador de espectros.

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

Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.

Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.

Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.

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.

Use the different exhibition techniques oral, written, presentations, panels, etc., to communicate the knowledge, proposals and positions.

Utilizar generadores de pulsos y analizadores de espectros y aplicarlos a la visualización de señales.

Utilizar los aspectos teóricos y prácticos del procesado de señales eléctricas para su uso en señales e imágenes biológicas.

DESCRIPTION OF CONTENTS

1. Radiation detection electronics

Time and frequency domain signals. Signals in Nuclear Physics
Electronics for analogue signal processing: pulse selection, matching techniques and methods for measurement of time intervals

2. Basic electronics

This subject describes the basic circuits of analog and digital electronics, including semiconductor components, operational amplifiers, oscillators, logic gates, combinational circuits, sequences and timing.

3. Fundamentals of Python programming

Introduction to object-oriented programming. Python language: semantics, data types, control sequencies, functions

4. Data structures

NumPy and Pandas libraries. Arrays and matrix operations with numPy. Use of Series and DataFrames with Pandas.

5. Graphics

Graphic libraries. Generation of univariable and multivariable graphs.

6. Statistical analysis

Introduction to probability. Estimation of statistics. Hypothesis testing.

7. Digital image processing

Image processing libraries. Load and visualization of images. Intensity processing. Spatial processing.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Computer classroom practice	20,00
Total hours	**50,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	15,00
Independent study and work	15,00
Preparation of lessons	30,00
Preparation for assessment activities	15,00
Resolution of case studies	0,00
Total hours	**75,00**

TEACHING METHODOLOGY

In the first part of the subject, we will introduce the radiation detectors technology with theoretical lectures with the support of media materials. This part will be completed by the realization of two practical sessions in an electronics laboratory.

The scientific programming techniques will be introduced with lectures supported by slideshows and online computer demonstrations using Python. The lectures will be complemented by a practical part, consisting of the realization of a series of guided exercises using the Python programming language.

EVALUATION

Students' knowledge will be assessed by conducting a written exam regarding the concepts explained in the lectures (75% of the final mark) and an evaluation of the laboratory sessions (25% of the final mark). It will be necessary to achieve a minimum value of 4 over 10 in each one of the parts for averaging.

It will be necessary to obtain a minimum grade of 4 out of 10 in each part of each of the tests in order to average.In the second call, the grade of each part (exam or laboratory) passed in the first call (grade equal or higher than 5) will be maintained.

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

- Leo, Techniques for Nuclear and Particle Experiments. Springer-Verlag
- Knoll, Radiation Detection and Measurements. Wiley
- Horowitz. The art of Electronics. Cambridge
- Suetens. Fundamentals of Medical Imaging. Cambridge University Press

- Birkfellner. Applied Medical Image Processing. CRC Press
- Jake VanderPlas, Python Data Science Handbook. O'Reilly Media, Inc. ISBN: 9781491912058
- Wes McKinney, Python for Data Analysis, 2nd Edition. O'Reilly Media, Inc. ISBN: 9781491957660
- Ravishankar Chityala and Sridevi Pudipeddi, Image Processing And Acquisition Using Python. Chapman & Hall/CRC Press. ISBN: 9780367198084