

**COURSE DATA****Data Subject**

Code	43076
Name	Information and communication technology
Cycle	Master's degree
ECTS Credits	5.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
2140 - Master's Degree in Medical Physics	Faculty of Physics	1	First term

Subject-matter

Degree	Subject-matter	Character
2140 - Master's Degree in Medical Physics	3 - The physics of diagnosis and therapy	Obligatory

Coordination

Name	Department
GONZALEZ MILLAN, VICENTE	242 - Electronic Engineering
SANCHIS PERIS, ENRIQUE J	242 - Electronic Engineering
VILA FRANCES, JOAN	242 - Electronic Engineering

SUMMARY

This subject is divided into two sections: the first one deals with the electronic technology for radiation detectors, and the second one describes the digital image processing applied to medical imaging.

In the first section, we examine the signal conditioning for the transducers most commonly used in radiation detectors. Afterwards, we present the basic elements of the electronic conditioning: charge preamplifiers, RC-CR filters operating as shapers and 1-bit and multilevel digitalization stages (leading-edge discriminators and constant fraction discriminators). Finally, we analyse the temporal reference circuits, mean-timers and TDCs. This block has a practical part showing the propagation of high frequency signals and some of the signal conditioning circuits.



The second part of the subject introduces the digital image processing techniques. These techniques are essential to interpret and check the quality of the images obtained by the different medical imaging modalities. The first part introduces the concept of digital imaging and its use in medical imaging. Then, we present the analysis software MATLAB and its library Image Processing Toolbox (IPT). Afterwards, we describe the most common analysis and digital image processing, techniques, from the intensity processing to the spatial and frequency domain processing.

This block introduces the basic concepts that students must understand to successfully address the subject of Imaging Systems for Medical Diagnosis, which explains in detail the acquisition and characteristics of each medical imaging modality.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

No existen requisitos previos

COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

2140 - Master's Degree in Medical Physics

- 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.
- 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.
- Be able to access to information tools in other areas of knowledge and use them properly.
- Use the different exhibition techniques oral, written, presentations, panels, etc., to communicate the knowledge, proposals and positions.
- Project the knowledge on specific problems and know how to summarize and extract the most relevant arguments and conclusions for their resolution.



- 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.
- Manejar los métodos matemáticos de procesamiento de señales para la obtención de las diferentes modalidades de imágenes.
- Distinguir las diferencias y similitudes de los métodos de procesamiento y análisis de imágenes de ayuda al diagnóstico.
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- Manejar las técnicas básicas de control de calidad de las diferentes modalidades de obtención de imágenes.
- Manejar la instrumentación básica en un laboratorio de electrónica de comunicaciones.
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- Utilizar generadores de pulsos y analizadores de espectros y aplicarlos a la visualización de señales.
- Realizar medidas de señales en el dominio frecuencial con el analizador de espectros.
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- Realizar la simulación de un sistema de comunicación de datos.
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- Utilizar los aspectos teóricos y prácticos del procesado de señales eléctricas para su uso en señales e imágenes biológicas.
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- 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 (RD 1393/2007) // NO CONTENT (RD 822/2021)

After studying the subject, the student should be able to:

Translate signals between the time or space domain and its equivalent frequency domain.

Explain the principles analogue and digital electronics and the use of signal conditioning circuits.



Design basic digital filters in one and two dimensions, and predict their effects.

Know the basics of Digital Image Processing and its application to data interpretation.

Manage digital tools for advanced image processing

Apply image filter in the spatial and frequency domain.

DESCRIPTION OF CONTENTS

0. 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.

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. Systems of medical image

Digital images
Getting and displaying medical images

3. Introduction to image processing

Introduction to MATLAB.
Introduction to the Image Processing Toolbox.
Introduction to digital image processing.

4. Image processing techniques

Intensity processing
Spatial domain processing
Frequency domain processing

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Development of individual work	15,00	0
Study and independent work	10,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	125,00	

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 image processing techniques will be introduced with lectures supported by slideshows and online computer demonstrations using MATLAB. The lectures will be complemented by a practical part, consisting of the realization of a series of guided exercises using the MATLAB mathematical analysis software.

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

REFERENCES**Basic**

- Leo, Techniques for Nuclear and Particle Experiments. Springer-Verlag
- Knoll, Radiation Detection and Measurements. Wiley
- Horowitz. The art of Electronics. Cambridge



- González, Woods. Digital Image Processing. Gatesmark Publishing.
- González, Woods, Eddins. Digital Image Processing using MATLAB. Prentice-Hall.
- Dougherty. Digital Image Processing for Medical Applications. Cambridge University Press

Additional

- Suetens. Fundamentals of Medical Imaging. Cambridge University Press
- Birkfellner. Applied Medical Image Processing. CRC Press

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

English version is not available