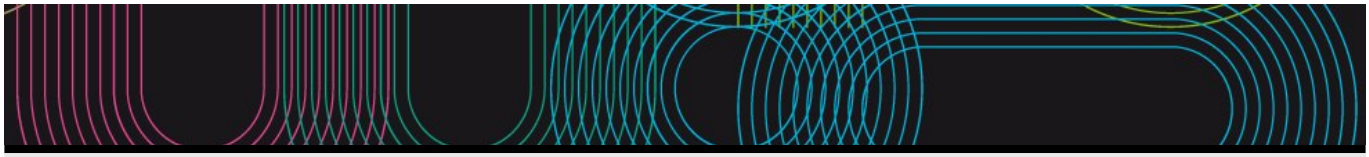

IDENTIFYING DATA				
(*)Sistemas de diagnóstico e terapia				
Subject	(*)Sistemas de diagnóstico e terapia			
Code	V04M192V01104			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Mandatory	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Quintáns Graña, Camilo Pastoriza Santos, Vicente			
Lecturers	Pastoriza Santos, Vicente Quintáns Graña, Camilo			
E-mail	quintans@uvigo.es vpastoriza@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	(*)O propósito principal desta materia é que os estudantes adquiran os coñecementos acerca dos fundamentos físicos e das tecnoloxías utilizadas nos equipos médicos que integran os sistemas de diagnóstico e terapia empregados no ámbito hospitalario. O temario complétase cunha introdución á protección, calidade e lexislación aplicable. Estes contidos compleméntanse e reforzan coa realización de prácticas orientadas ao estudo do funcionamento e das especificacións dos equipos nos servizos existentes nos hospitais participantes na titulación.			

Skills	
Code	
A3	That students are able to integrate knowledge and handle complexity and formulate judgments based on information that was incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments.
B3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B5	Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
B6	Capacity for handling specifications, regulations and mandatory standards.
C4	Knowledge and ability to design and analyze systems, sensors and techniques for diagnosis, therapy and monitoring.

Learning outcomes	
Expected results from this subject	Training and Learning Results
To know and understand the physical principles of operation of the medical equipment that make up the diagnosis and therapy used in the hospital setting.	B3 B5 C4
To know and understand the operating principles of the main medical equipment used in the hospital environment.	A3 B3 C4
Knowledge to supervise the use and maintenance of medical equipment.	A3 B3 B5 B6 C4

Capability to analyze the management of facilities associated with medical equipment and apply the knowledge acquired for its improvement.	A3 B5 B6 C4
To know the fundamentals for working in multidisciplinary teams typical of biomedical engineering	B3 C4

Contents	
Topic	
Topic 1: Introduction.	General description of the subject. Introduction to diagnostic techniques and therapy.
Topic 2: Physical fundamentals of the diagnostic and therapy equipment.	Electromagnetic waves. Interaction of the electromagnetic radiation with matter. Radioactive transitions. Nuclear structure. Nuclear processes.
Topic 3: Technologies for diagnostics with X-rays.	The X-ray apparatus. Generation of X-rays. Emission of X-rays. X-ray interaction with matter. Detection and formation of image. Intensifying screens, beam restrictor devices and grid.
Topic 4: Characterization and operation of computed tomography equipment.	Introduction. Tomographic image. Conventional, helical and multislice computed tomography. Components. Diagnostic and therapeutic uses. Safety. Representation of the image. Image quality.
Topic 5: Characterization and operation of magnetic resonance equipment	Introduction. Behavior of nuclear spin in a magnetic field. Generation of the magnetic resonance signal. Examination room. Open and closed resonance equipment. Emitters and receptors. Control console. Diagnostic and therapeutic uses. Security. Signal capture: Fourier transform, K-space and data matrix. Repeat time, echo time, inversion time. Classic acquisition sequences: spin-echo, and gradient echo. Reconstruction in 2D and 3D. Artifacts in magnetic resonance. emerging techniques.
Topic 6: Technologies for Nuclear Medicine Diagnostics.	Introduction. Radiopharmaceuticals for imaging diagnostics. Techniques for the production of radiopharmaceuticals. Particle accelerator. Obtaining the flat image. The gamma camera. Positron emission tomography (PET, SPECT).
Topic 7: Technologies for radiotherapy.	Introduction. Types of radiotherapies. Brachytherapy. External beam radiotherapy. Electron beam. X-ray photon beam. The linear accelerator. Proton therapy.
Subject 8: Protection, quality and legislation.	Basic safety standards for protection against exposure to ionizing radiation. Quality criteria in radiotherapy. Safety concepts in nuclear installations. Regulations on medical uses of X-rays. Justification for the use of ionizing radiation in medicine. Quality criteria in radiodiagnostics.
Practices.	Practice 1: Radiology. Practice 2: Nuclear Medicine. Practice 3: Radiotherapy.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	1	2
Lecturing	13	13	26
Case studies	4	8	12
Seminars	2	4	6
Previous studies	0	12	12
Laboratory practical	12	0	12
Objective questions exam	0.5	6.5	7
Problem and/or exercise solving	0.5	7	7.5

Report of practices, practicum and external practices	0	18	18
Presentation	2	6	8
Systematic observation	1	1	2

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Introductory activities	Activities directed to take contact and gather information on the students, as well as to present the matter.
Lecturing	Exposition by the lecturer of the contents on the matter object of study, theoretical bases and/or guidelines of a work, exercise that the/the student has to develop. The the skills to be worked on are: CB3, CG3, CG5, CG6 and CE4.
Case studies	Analysis of a fact, problem or real event with the purpose to know it, interpret it, resolve it, generate hypothesis, contrast data, to reason, complete knowledge, diagnose it and train alternative procedures for solution. The skills to be worked on are: CB3, CG3, CG5, CG6 and CE4.
Seminars	Activity focused on the work on a specific topic, that allows to deepen or complement the contents of the course. The skills to be worked on are: CB3, CG3, CG5, CG6 and CE4.
Previous studies	Research, reading and work of documentation, previous to the classes or practical of laboratory, that makes the students of autonomous form. The skills to be worked on are: CB3, CG3, CG5, CG6 and CE4.
Laboratory practical	Activities of application of the knowledge to concrete situations, and for acquisition of basic skills and procedures, related with the course. These practices will be developed at hospital facilities. The skills to be worked on are: CB3, CG3, CG5, CG6 and CE4.

Personalized assistance

Methodologies	Description
Introductory activities	The students can attend to personalised or in groups office hours in the schedule displayed in the course teaching support application. Doubts and queries of the students on the organisation of the course will be clarified.
Lecturing	The students can attend to personalised or in groups office hours in the schedule displayed in the course teaching support application. Doubts and queries of the students on the lecture contents of the course will be clarified.
Previous studies	The students can attend to personalised or in groups office hours in the schedule displayed in the course teaching support application. Doubts and queries of the students on the previous work to the classes or practical of laboratory will be clarified.
Seminars	The students can attend to personalised or in groups office hours in the schedule displayed in the course teaching support application. Doubts and queries of the students on the concrete topics will be clarified.
Case studies	The students can attend to personalised or in groups office hours in the schedule displayed in the course teaching support application. Doubts and queries of the students on previously presented cases will be clarified.
Laboratory practical	The students can attend to personalised or in groups office hours in the schedule displayed in the course teaching support application. Doubts and queries of the students on laboratory practices will be clarified.
Tests	**Description**
Report of practices, practicum and external practices	The students can attend to personalised or in groups office hours in the schedule displayed in the course teaching support application. Doubts and queries of the students on the practice reports will be clarified.
Presentation	The students can attend to personalised or in groups office hours in the schedule displayed in the course teaching support application. Doubts and queries of the students about the presentation preparation will be clarified.

Assessment

	Description	Qualification	Training and Learning Results
Objective questions exam	Exam that evaluate the knowledge that include enclosed questions with different alternative of answer (true/false, multiple election, pairing of elements, etc.) The students select an answer between a number limited of possibilities.	25	A3 B3 C4 B5 B6

Problem and/or exercise solving	Test/exams in which the student has to solve a series of problems and/or exercises in a time/condition established by the lecturers. Of this way, the students has to apply the acquired knowledge.	25	A3	B3 B5 B6	C4
Report of practices, practicum and external practices	Preparation of a report by part of the student in that they reflect the characteristics of the work carried out. The students have to describe the tasks and procedures developed, show the results obtained and/or observations made, as well as the analysis and treatment of data.	30	A3	B3 B5 B6	C4
Presentation	Presentation by part of a group of students of a subject on contents of the subject or of the results of a work, exercise, project, etc. Can make of individual way or in group.	10			
Systematic observation	Attentive perception, rational, scheduled and systematic to describe and register the demonstrations of the behaviour of the students. It is possible to value learnings and actions, and as they carry out valuing the order, precision, the skill, efficiency, the active participation, etc.	10	A3	B3 B5 B6	C4

Other comments on the Evaluation

1. Continuous assessment

Following the guidelines of the degree and the agreements of the academic committee,

presenting to the students who study this subject a system of continuous evaluation.

The qualifications of the evaluable tasks will be valid only for the academic course in which they are made.

perform Continuous assessment consists of the following four parts:

1.1 Practices (30%), which are divided into:

Development of the practices: realization of the practices of the matter. Missing is only allowed

a session for justified reasons and must be recovered in another shift to the extent of the

time possibilities. Your grade will be pass or fail.

Laboratory practices report (30%).

1.2 Classroom exams (50%), which are roughly divided into:

Objective questions (25%). Questions and exercises (25%).

1.3 Presentation (10%): the results on the work of a topic are completed orally

material concrete.

1.4 Systematic observation (10%). In addition to the aspects mentioned in the

description, the student's participation in carrying out the activities proposed for their

autonomous work and participation in tutorials.

The final grade, which is scored out of a maximum of 10 points, is the sum of the grades for each part.

if the following conditions are met:

Obtain a passing grade in laboratory practices.

Obtain a minimum score of 40% in the practice report, and in the classroom exams.

Make the presentation of the work.

If any of the above requirements is not met, the final grade will be the sum of the grades for each

part, but limited to 40% of the maximum mark (4 points). Students who did not achieve

minimum score of 40% in the evaluation of the practice report and in the exams, or that

have made the presentation in the continuous evaluation will be able to recover them in the tests of the

recovery call maintaining the percentages of the continuous evaluation.

To pass, students must obtain a total score equal to or greater than 50% of the grade.

maximum (5 points).

The tests of objective questions and exercises will be divided into two sessions distributed throughout the

throughout the school period. The first will coincide in the middle of the teaching period and the second

in the final exam.

2. Final exam

Students who do not opt for continuous assessment may take a final exam in which

They will take both parts of the exam (objective questions and exercises) and, in addition, they will have to

make an oral presentation on one of the topics of the subject to choose between two

options, if you have not previously requested the faculty to choose the topic.

To pass you must obtain a minimum of 40% in each part and add a total of at least 5

points.

Continuous assessment students who will have pending to exceed the minimum of some part may

do it in the final exam. If they did not reach the minimum in the practice report, they will have a date

limit to present the proposed improvements until the final exam. It is understood that carrying out the internship is mandatory regardless of the call to which it is applied.

present.

3. About the second call (July)

In this call the evaluation will be as in the final exam. It will be necessary to have passed the practices during the

academic course.

4. Ethical commitment

The student is expected to exhibit appropriate ethical behavior. In the case of detecting unethical behavior

(cheating, plagiarism, use of unauthorized electronic devices, or others) will be considered that the student does not meet the

requirements necessary to pass the subject. In this case, the overall grade in the current academic year will be

fail (0.0).

Sources of information

Basic Bibliography

Ignacio López Moranchel, Patricia irene Maurelos Castell, **Fundamentos físicos y equipos**, 978-84-9077-368-0, 3º edición, Editorial Síntesis, 2019

X. Pifarré, M. A. Rivas, J. Valverde, P. Ruiz, J. Molero, M.F. Rodríguez, **Fundamentos de Física Médica. Volumen 2: Radiodiagnóstico: bases físicas, equipos y control de calidad.**, 978-84-938016-6-3, Aula Documendal de Investigación (A.D.I), 2012

Araceli Hernández Vitoria, María Cruz Lizuain Arroyo, Cristina Picón Olmos, **Fundamentos de Física Médica. Volumen 3: Radioterapia externa I. Bases físicas, equipos, determinación de la dosis absorbida y programa de garantía de calidad**, 978-84-938016-7-0, Aula Documendal de Investigación (A.D.I), 2012

Carlos Vallejo Carrascal, **Técnicas de imagen en medicina nuclear**, 978-84-9171-369-2, Editorial Síntesis, 2019

C. Álvarez, C. Escalada, P. Fernández, N. Ferrer, L. Carlos Martínez, M.C. Paredes, **Fundamentos de Física Médica. Volumen 7: Protección radiológica hospitalaria**, 978-84-944186-2-4, Aula Documendal de Investigación (A.D.I), 2016

Ángel Alberich-Bayarri, Gracián García Martí, Eduardo Guibelalde del Castillo, Roberto Sanz Requena, **Fundamentos de Física Médica. Volumen 10: Radiaciones no ionizantes II. Resonancia magnética. Bases físicas, equipos y control de calidad.**, 978-84-944186-5-5, Aula Documendal de Investigación (A.D.I), 2018

Ignacio López Moranchel, **Protección radiológica**, 978-84-9077-495-3, 2ª, Editorial Síntesis, 2019

Complementary Bibliography

M. alonso, E.J.Finh, **Física**, 968-444-426-5, Pearson Education, 2000

Stewart C. Bushong, **Manual de radiología para técnicos**, 84-8086-031-6, 5ª edicicón, Mosby, 1993

J.M Fernández-Varea, A. Brosed, A.M. González Leitón, A. Gracia Ezpeleta, **Fundamentos de Física Médica. Volumen 1: Medida de la radiación.**, 978-84-938016-1-8, Aula Documendal de Investigación (A.D.I), 2011

Patricia Irene Maurelos Castell, Ignacio López Moranchel, **Técnicas de radiología simple**, 978-84-9077-390-1, 2ª, Editorial Síntesis, 2020

Juan Montero Reyes, María Carmen Prieto, Daniela de Araujo, **Técnicas de radiología especial**, 978-84-9171-026-4, Editorial Síntesis, 2017

J.M. Delgado Rodríguez, A. García Romero, F. García Vicente, E. Millán Cebrián, **Fundamentos de Física Médica. Volumen 4: Radioterapia externa II. Dosimetría clínica, algoritmos de cálculo, sistemas de planificación y control de calidad.**, 978-84-940849-7-3, Aula Documendal de Investigación (A.D.I), 2013

F. Ballester, A. Brosed, V. Carmona, V. Crispín, et al, **Fundamentos de Física Médica. Volumen 5: Braquiterapia: bases físicas, equipos y control de calidad**, 978-84-940849-0-4, Aula Documendal de Investigación (A.D.I), 2014

R. Barquero, N. Ferrer, J.M. Martí, J. Pavía, R. Puchal, X. Setoain, **Fundamentos de Física Médica. Volumen 6: Medicina nuclear: bases físicas, equipos y control de calidad**, 978-84-940849-2-8, Aula Documendal de Investigación (A.D.I), 2014

vicente Juan Magías Moreno, **Técnicas de imagen por resonancia magnética**, 978-84-9077-496-0, Editorial Síntesis, 2017

Julia Vallés Pascual, **Técnicas de radiofarmacia**, 978-84-9077-338-3, Editorial Síntesis, 2019

Harold Elford Johns, John Robert Cunningham, **The Physics of Radiology**, 0-398-04669-7, 4ª, Charles C Thomas, 1983

Álvaro Ruibal Morell, **La biología en la medicina nuclear e imagen molecular oncológica**, 978-84-09-23551-3, 2020

CONSEJO DE LA UNIÓN EUROPEA de 5 de diciembre de 2013, **DIRECTIVA 2013/59/EURATOM**, Diario Oficial de la Unión Europea, 2013

Centro de documentación: Normativa, **Consejo de Seguridad Nuclear (CSN)**,

Recommendations