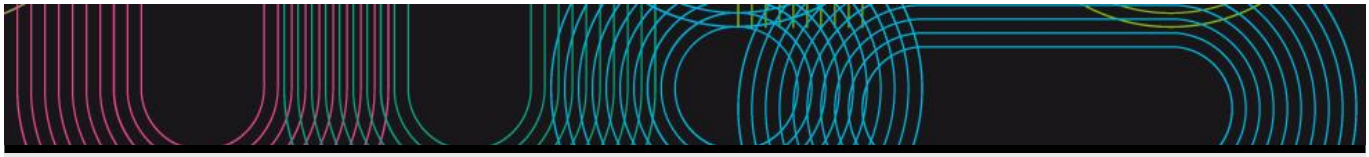

(*)Escola de Enxeñaría Industrial

Information
For additional information about the centre and its degres visit the centre's website https://eei.uvigo.es/

Máster Universitario en Ingeniería Biomédica

Subjects

Year 2nd

Code	Name	Quadmester	Total Cr.
V04M192V01301		1st	4.5
V04M192V01302		1st	6
V04M192V01303		1st	6
V04M192V01304		1st	4.5
V04M192V01305		1st	4.5
V04M192V01306		1st	4.5
V04M192V01307		1st	4.5
V04M192V01308		1st	4.5
V04M192V01401		2nd	6
V04M192V01402	Master Thesis	2nd	24

IDENTIFYING DATA				
(*)Tecnoloxías de imaxe médica				
Subject	(*)Tecnoloxías de imaxe médica			
Code	V04M192V01301			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Mandatory	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Martín Rodríguez, Fernando			
Lecturers	Martín Rodríguez, Fernando			
E-mail	fmartin@uvigo.es			
Web	http://https://moovi.uvigo.gal/			
General description				

Training and Learning Results	
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.
A5	Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.
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.
B6	Capacity for handling specifications, regulations and mandatory standards.
C7	Knowledge and ability to apply lead generation principles radiation, radiation-matter interaction and ultrasound.

Expected results from this subject	Training and Learning Results
Specify, compare, evaluate and operate commercial systems of acquisition, storage, exchange and processed of medical images.	A3 B13 B13 B6 C15 C15 C7 C15 D4
Implement simple systems for medical image processing.	A3 A5 B13 B13 B3 B13 B13 B13 B13 C15 C15 C7 C15 D4 D4 D4

Specify, direct and evaluate the development of complex systems of medical image processing.	A3 B6 C15 C15 C15 C15 C7 C15 C15 D4 D4 D4

Contents	
Topic	
Medical imaging fundamentals.	- Ultrasound (ultrasound), digital radiography, computed tomography, magnetic resonance, PET. - Medical image formats (and medical information standards): DICOM, HL7.
Medical images processing.	- Image transforms: 2D Fourier transform (application in MRI), Radon transform (application in CT). - Filtering and restoration of images. - Segmentation methods and application of unsupervised learning techniques (machine learning). - Other processing techniques.
Practical contents.	- Working with free tools for visualization (using real medical studies). Examples: MicroDicom, Invesalius, 3D-slicer. - Practical case 1: small image processing project using classical techniques. Examples: digitalization of scanned ECG's, compression of 3D medical studies using 3D-DCT... - Practical case 2: small image processing project using machine learning (ML) techniques. Examples: help in the diagnosis of breast cancer in mammograohies using CNN's (deep learning), detection of pneumonia in digital chest X-rays.

Planning	Class hours	Hours outside the classroom	Total hours
Lecturing	16	26	42
Problem solving	8	15	23
Practices through ICT	14	26	40
Report of practices, practicum and external practices	0.5	1	1.5
Report of practices, practicum and external practices	0.5	4	4.5
Essay questions exam	1.5	0	1.5

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

Methodologies	Description
Lecturing	Contents of the course are presented by lecturer, encouraging the critical discussion of the concepts. The theoretical bases of algorithms and procedures used in the practical part are established.
Problem solving	Working in practical cases. Discussion about decision making in real projects. Calculations.
Practices through ICT	Small projects are presented. The student must obtain the appropriate solution in a reasoned way, correctly choosing the applicable methods and reaching a valid solution.

Personalized assistance	
Methodologies	**Description**
Lecturing	Answering questions in class and tutorials, if necessary. https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez
Problem solving	Answering questions in class and tutorials, if necessary. https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez
Practices through ICT	
Tests	**Description**

Report of practices, practicum and external practices	On-site help and, if necessary, tutorial by appointment. Query and answer via e-mail. https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez
Report of practices, practicum and external practices	On-site help and, if necessary, tutorial by appointment. Query and answer via e-mail. https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez
Essay questions exam	Clarifications during the exam, if necessary.

Assessment

	Description	Qualification	Training and Learning Results		
Report of practices, practicum and external practices	Report of the first proposed project. Medical image processing problem of low-medium difficulty.	25	A3 A5	B3	C7
Report of practices, practicum and external practices	Report of the second proposed project. Medical image processing problem of medium-high difficulty.	35	A3 A5	B3	C7
Essay questions exam	Questions about theory and practical work done. Practical questions about the course. Practical case studies, decision making...	40	A5	B3 B6	C7

Other comments on the Evaluation

There is the option of global evaluation. The decision made the same day of the final exam by signing a resignation of the qualifications of the practical deliverables. In that case it is necessary to answer a set of extra questions of a practical nature.

The extraordinary call works equally as the ordinary one.

Sources of information

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Rafael C. González, **Digital image processing using MATLAB**, 9780982085400, 2, Gatesmark Publishing, 2009

Complementary Bibliography

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Arnulf Oppelt Ed., **Imaging Systems for Medical Diagnostics**, 9783895782268, 2, Wiley, 2006

R. Nick Bryan Ed., **Introduction to the Science of Medical Imaging**, 9780521747622, 1, CAMBRIDGE UNIVERSITY PRESS, 2010

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W.R. Hendee, E.R. Ritenour, **Medical Imaging Physics**, 9780471382263, 4, Wiley, 2002

N.A. Diakides, J.D. Bronzino, **Medical Infrared Imaging**, 9780849390272, 1, CRC Press, 2007

Xujing Yao et al., **A comprehensive survey on convolutional neural network in medical image analysis**, 10.1007/s11042-020-09634-7, Vol 81 (8), Springer-Nature, 2020

D.R. Sarvamangala, Raghavendra V. Kulkarni, **Convolutional neural networks in medical image understanding: a survey**, 10.1007/s12065-020-00540-3, PubMed, 2022

Fahad Shamshad et al., **Transformers in medical imaging: A survey**, 10.1016/j.media.2023.102802, Vol 88., Elsevier (Medical Image Analysis), 2023

Recommendations

IDENTIFYING DATA

(*)Certificación de productos sanitarios e innovación en tecnoloxía médica

Subject	(*)Certificación de productos sanitarios e innovación en tecnoloxía médica			
Code	V04M192V01302			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Comesaña Campos, Alberto			
Lecturers	Comesaña Campos, Alberto			
E-mail	acomesana@uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	This subject, which is part of the core module of the Master in Biomedical Engineering, focuses its objectives on the training related to the fulfilment of the necessary requirements for the professional use of a medical device. For this purpose, two main blocks of content are developed to cover the regulatory framework in which the medical device may be developed after its design. In the first block, the certification process of sanitary products will be studied, describing their classification, analysis and implementation. All the regulations involved in this process will be considered, from the implementation of a quality management system to compliance with the precise regulations. Then, in the second block, a generalized study of the industrial and intellectual protection process will be addressed, analyzing their respective characteristics and functions, reviewing the concepts, regulations and legislation in this regard, and also analyzing both the precise requirements for applying for a patent or utility model, as well as the procedure to be followed. Finally, and because of the processes described above, the process of innovation and entrepreneurship in biomedical engineering will be defined, contextualized and discussed. At the end of the course, the student should have sufficient skills and competences to understand the processes involved in the innovation of medical devices, to develop the procedure for the intellectual and industrial protection of these products and, in addition, to certify them appropriately and normatively for their end use.			

Training and Learning Results

Code	
A1	Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.
A2	That the students can apply their knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
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.
A4	Students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
A5	Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.
B4	Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of biomedical engineering.
B7	Ability to analyze and assess the social and environmental impact of the technical solutions.
B8	Ability to apply the principles and methods of quality.
B10	Knowledge, understanding and ability to apply legislation related to the field of Biomedical Engineering.
B12	To operate effectively in a multidisciplinary team whose members, together, exercise leadership, create a collaborative and inclusive environment, set goals, plan tasks and meet goals.
C12	Ability to manage and audit development, production and quality of medical devices and creative ability to develop ideas and new and original methods in the biomedical area.
D1	Ability to understand the meaning and application of the gender perspective in the different fields of knowledge and in professional practice with the aim of achieving a more just and equal society.
D3	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources.

Expected results from this subject

Expected results from this subject	Training and Learning Results
Knowledge about the certification of health and biomedical products.	A1 A3 B13 B13 B7 B8 B10 C15 C15 C15 D1 D4 D3
Know the regulations and the procedures on protection of the copyright and intellectual property.	A1 A4 A5 B13 B13 B13 B13 B10 C15 C15 C15 C12 D4 D4 D4
Apply knowledges about the certification, innovation and protection of the copyright, in the field of biomedical engineering.	A2 A3 A5 B4 B13 C15 D1 D3 D4
Develop and execute projects of innovation in medical technology.	A2 A4 B4 B13 B13 B12 C15 C15 C15 C15 D4 D4 D4

Contents	
Topic	
1. Certification of medical products. Legislative framework and national and international regulations.	1.1. Current regulations at the national and international level. 1.2. Main definitions according to current regulations. 1.2. Essential requirements. Sanitary guarantees of the products. 1.3. Precise facilities and licenses for the development of sanitary products. 1.4. Classification and risk analysis of medical devices. 1.5. Labeling of medical devices and CE marking. 1.5.1. CE declaration. 1.5.2. CE exam. 1.5.3. CE verification.

2. Request and maintenance of the certification of sanitary products.	2.1. Application to a notified body. 2.2. Marketing and commissioning. 23. Process and regulations related to clinical investigations. 2.4. Surveillance and inspection system. 2.5. Quality system. 2.5.1. Application regulations. 2.5.2. Implementation. 2.5.3. Audits.
3. Industrial and intellectual property: concepts, regulations and legislation.	3.1. Current regulations at the national and international level. 3.2. Legislation relating to the protection of industrial and intellectual property. 3.3. Concepts and definitions according to current regulations. 3.3. The Spanish Patent and Trademark Office (SPTO) 3.3. Intellectual property. 3.4. Industrial property. 3.5. National and international patent databases.
4. Characteristics and requirements of invention patents, utility models and industrial designs.	4.1. Patentability. 4.2. The invention patent. 4.3. The European invention patent. 4.3. The utility model. 4.4. Industrial design. 4.5. The distinctive signs. 4.6. Requirements to apply for a patent. 4.6.1. Novelty. 4.6.2. inventive activity 4.6.3. industrial application. 4.6.4. Executable 4.7. Patent right.
5. Application procedure for patents and utility models.	5.1. Invention patent application procedure. 5.1.1. Application requirements. 5.1.2. Presentation of the application. 5.1.3. Designation of the inventor. 5.1.4. unit of invention 5.1.5. Description of the invention. 5.1.6. Claims. 5.2. Invention patent grant procedure. 5.2.1. Reception at the SPTO 5.2.2. Trade exam. 5.2.3. Issuance of the report on the state of the art. 5.2.3. Publication of the application and the report. 5.2.4. Substantive exam. 5.2.5. Processing, resolution and announcement of concession. 5.3. Application procedure and granting of utility models. 5.4. European invention patent application and grant procedure.
6. Innovation in biomedical technology.	6.1. Innovation and entrepreneurship in medical technologies. 6.2. Innovation tools: innovation management methods. 6.3. Technology transfer environments in biomedicine.
Practices. Certification and industrial protection of a biomedical product. R&D&i management in the health sector. In these practical exercises, the students will have to document the process that allows, on the one hand, the complete and correct certification of a medical device and, on the other hand, its intellectual and industrial protection in the field of biomedical engineering. There will also be an exercise on the integral management of healthcare R&D&i.	1. Choice of product. 2. Analysis of preliminary steps and previous conditions. 3. Documentation and review of the health certification process. 4. Comprehensive management of healthcare R&D&i. 5. Documentation and review of the intellectual and industrial protection process. 6. Submission and presentation of the process.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	20	18	38
Problem solving	8	0	8
Laboratory practical	12	5	17
Practices through ICT	6	2	8
Objective questions exam	1	10	11

Essay questions exam	1	15	16
Problem and/or exercise solving	0	7	7
Laboratory practice	0	20	20
Report of practices, practicum and external practices	0	25	25

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

Methodologies

	Description
Lecturing	The theoretical content will be presented by the lecturer during the classes, complemented by discussion and interpretation of the same. They will be coordinated with the planned practical activities.
Problem solving	In a complementary way to the presentation of the theoretical contents, different application exercises will be proposed and developed, which the students will have to solve in a comprehensive and reasoned way.
Laboratory practical	From a practical point of view, the course covers two large blocks of action, which are procedurally different but related by their application example and their objectives. On the one hand, the process of sanitary certification of the product and, on the other hand, its industrial protection. In addition, there is the study and practice of the integral management of healthcare R&D&i. Thus, once a biomedical product has been selected, the practices will cover these blocks as follows. Product certification: Working in groups and under the guidance and supervision of the lecturer, the students must define and develop the documentary process necessary for the certification of a medical device. The implementation of the quality system must be specified and all the steps necessary to achieve the correct and complete certification of the product must be detailed. It will also be possible to review the process of integral management of research, development and innovation in the health sector. Intellectual and industrial protection of the product: Using the same groups and the same product as in the previous block and in the same circumstances, the students will have to document the intellectual and industrial protection procedure, as the case may be, describing and writing the protection process followed and analyzing each of its stages in detail. Although the sanitary product that will be used as a vehicle example should preferably be the same, if necessary and after acceptance and supervision of the lecturer, the two blocks of exercises could use different products.
Practices through ICT	In the development of the practices of the subject, the students must actively use different information and communication technologies, even implementing some of them.

Personalized assistance

Methodologies	Description
Laboratory practical	Proposition and review of the outcomes of the course activities, aiming to support individually the learning process in small groups of students. An appropriate follow-up will be performed on student's work to verify that the best practices shown in theory classes are applied, and that the procedimental recommendations provided by the lecturer are followed. The tutorial sessions can be carried out using IT tools (email, video-call, Moovi forums, etc.) according to the modality of prior concertation of the virtual place, date and time.

Assessment

	Description	Qualification	Training and Learning Results
Objective questions exam	During the course, a series of objective and short-answer evaluation questionnaires will be carried out on the theoretical topics, either considering all the topics as a whole or individualizing each of them.	20	A1 B10 C12 A2 A3
Essay questions exam	At the end of the course there is an examination which includes development questions relating to the theoretical and practical content of the course.	25	A1 B4 C12 A2 B10 A3
Problem and/or exercise solving	The problems solved in class, after being checked and corrected, can be collected and supplemented with new ones. All of them will have to be commented on and justified before they are finally handed in. Their understanding, explanation and detailed justification will be assessed.	5	A1 B4 C12 A2 B10 A3

Laboratory practice	The practices of the subject will be carried out in consideration of two coherent and and complementary blocks: First block - Certification: Students must define and develop the documentary and regulatory process that will allow the certification of a health product previously defined in the classes. Each step of the process must be detailed, defining the implementation of the precise quality system and compliance with current regulations. It will also be possible to review the process of integral management of research, development and innovation (R&D&i) in the health sector. Second Block - Intellectual and Industrial Protection: In this block, the students will have to define the process of intellectual and industrial protection, as the case may be, describing and finally writing the protection process related to a medical device, which could be the one used in the first block, preferably, or another one. The objective will be to explain in detail each of the steps of the said protection process, describing and analyzing the different stages followed. In both blocks, the precision and adequacy of the proposals in relation to the stated objectives, the development of the practical work, the degree of autonomy of the students, as well as the choice and monitoring of compliance with the regulations will be assessed. During the practical work, compulsory periodical deliveries and individual and/or group meetings could be considered.	20	A3 B7 A4 B8 A5 B12	D1 D3
Report of practices, practicum and external practices	At the end of the course, a complete technical report of the results obtained during the practical sessions of each block of the subject must be prepared. In this report, which may be joint or divided into each block, the processes carried out in each block of exercises must be described and the technical documentation procedure followed must be highlighted. Among other aspects, the compliance of the proposal with the regulations, the technical writing, and the clarity of the explanation of the stages to be followed will be assessed. Other aspects that will be taken into consideration are the technical and content-related presentation, the student's participation in class and in the work, the adaptation to the deadlines and the presentation and defence of the solution obtained, which is compulsory.	30	A3 B7 A4 B8 A5 B10	D1 D3

Other comments on the Evaluation

The assessment of the subject will include the lecturer's assessment of the student's work, both individual and group, whether face-to-face or remote, weighted as indicated in the Assessment section.

To determine the grade for all the assessment tests, a numerical grading system will be used, with values ranging from 0.0 to 10.0 points, in accordance with current legislation (R.D. 1125/2003, of 5 September, BOE. No. 224, of 18 September). In any case, the subject is considered passed if the grade obtained is at least 5.0 out of 10.

The subject offers two different evaluation modalities in its first evaluation period: continuous evaluation and non-continuous or global evaluation. In the second period, the evaluation is carried out exclusively by means of the corresponding global examination.

Comments for the First Assessment Period / Ordinary Exam Period

The student may follow the above modalities:

- Continuous evaluation modality

In this modality, the student will pass the subject if he/she obtains a minimum of five points (5.0) out of 10 without having to take the corresponding ordinary period examination. Each assessment test is worth 10 points. It is necessary to obtain a minimum of 5.0 points out of 10 in each of the assessment tests and in each part or subpart of those tests in order to pass the subject. Students who do not pass the continuous assessment, i.e. who do not pass each and every one of the assessment tests set, will be required to take the corresponding additional tests and, if applicable, to take the second period examination. This is subject to the considerations and clarifications deemed appropriate by the teacher.

- Non-continuous or global evaluation modality

At the beginning of the course, enrolled students have a deadline set by the School of Industrial Engineering to explicitly opt

out of continuous evaluation. In this case, the enrolled student must inform the professor as soon as this has been requested and confirmed.

A student who opts out of continuous evaluation in order to pass the subject must take a single final examination on the date set by the School for the first assessment period, covering all the theoretical and practical content of the subject, including short answer questions, long answer questions, problem solving and the development of practical scenarios. Additionally, it will be necessary to demonstrate sufficient applied knowledge of the certification process and the intellectual and industrial protection of medical products, as well as the integral management of R&D&i in the healthcare sector. In order to pass the subject, students must achieve an overall mark of at least 5.0 out of 10 in each of these tests.

Comments for the Second Assessment Period / Extraordinary Exam Period

Students who have not passed the subject in the ordinary period by any of the above modalities will have a second opportunity to pass the subject by taking the second period examination on the date set by the School of Industrial Engineering.

The second period examination will cover all the theoretical and practical content of the subject, including short answer questions, long answer questions, problem solving and the development of practical cases. Additionally, it will be necessary to demonstrate sufficient applied knowledge of the certification process and the intellectual and industrial protection of medical products, as well as the integral management of R&D&i in the healthcare sector. In order to pass the subject, students must achieve an overall mark of at least 5.0 out of 10 in each of these tests.

Ethical Behavior

Students are expected to demonstrate appropriate ethical behaviour. In the event of unethical behaviour (cheating, plagiarism, use of unauthorized electronic devices, etc...) it will be assumed that the student does not meet the necessary requirements to pass the subject. In this case, the overall grade for the current academic year will be a fail (0.0). The use of teaching aids or electronic devices during examinations is not permitted unless specifically authorized. Bringing unauthorized materials or electronic devices into the examination room will be considered grounds for failing the subject for the current academic year and the overall grade will be a fail (0.0).

Sources of information

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Ministerio de Sanidad y Política Social, **Real Decreto 1591/2009, de 16 de octubre, por el que se regulan los productos sanitarios.**, 2009

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Ministerio de Sanidad y Consumo, **Real Decreto 437/2002, de 10 de mayo, por el que se establecen los criterios para la concesión de licencias de funcionamiento a los fabricantes de productos sanitarios a medida.**, 2002

Ministerio de Sanidad y Consumo, **Real Decreto 1662/2000, de 29 de septiembre, sobre productos sanitarios para diagnóstico in vitro**, 2000

Parlamento Europeo, **REGLAMENTO (UE) 2017/746 DEL PARLAMENTO EUROPEO Y DEL CONSEJO de 5 de abril de 2017 sobre los productos sanitarios para diagnóstico in vitro**, 2017

AENOR - UNE Normalización Española, **UNE-EN ISO 13485:2018/A11:2022 - Productos sanitarios. Sistemas de gestión de la calidad. Requisitos para fines reglamentarios.**, 2022

AENOR - UNE Normalización Española, **UNE-EN ISO 15223-1:2022 - Productos sanitarios. Símbolos a utilizar con la información a suministrar por el fabricante. Parte 1: Requisitos generales.**, 2022

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Comisión Europea, **Ficha informativa de la Comisión Europea para fabricantes de productos sanitarios.**, 2019

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Ministerio de Sanidad y Consumo, **Orden SCO/3603/2003, de 18 de diciembre, por la que se crean los Registros Nacionales de Implantes.**, 2003

Oficina Española de Patentes y Marcas, **Normativa**, https://www.oepm.es/es/propiedad_industrial/, 2023

Organización Mundial de la Propiedad Intelectual (OMPI), **Tratado sobre el Derecho de Patentes**, 2000

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Consoli, Davide y Mina, Andrea, **An evolutionary perspective on health innovation systems**, 19(297-319), Journal of evolutionary economics, 2009

Owen, R., Bessant, J.R. y Heintz, M., **Responsible innovation: managing the responsible emergence of science and innovation in society**, John Wiley & Sons, 2013

Gonzalez-Pifiero, M., Cano, E., Mafianas, M., Villanueva, J., y Magrans, P., **Knowledge Management and Open Innovation in a Bioengineering Research Case**, 1 (158), Case Studies in Innovation, 2012

Stroetmann B. et al., **Innovation management and technology assessment in medical industry**, IEEE, 1998

Recommendations

Subjects that are recommended to be taken simultaneously

(*)Organización do sistema sanitario e enxeñaría de procesos nos servizos sanitarios/V04M192V01303

Other comments

A review of the regulations contained in the bibliography is recommended to students as well as practice in information search methods.

IDENTIFYING DATA				
(*)Organización do sistema sanitario e enxeñaría de procesos nos servizos sanitarios				
Subject	(*)Organización do sistema sanitario e enxeñaría de procesos nos servizos sanitarios			
Code	V04M192V01303			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Galician			
Department				
Coordinator	Sartal Rodríguez, Antonio			
Lecturers	Nóvoa Conde, Xavier Rodríguez Vázquez, María Holanda Sartal Rodríguez, Antonio			
E-mail	antoniosartal@uvigo.es			
Web				
General description	(*)Coñecer o funcionamento os servizos clínicos dentro da organización hospitalaria, así como identificar os servizos sanitarios en cada un deles. Identificar a estrutura e organización da empresa, relacionándoa co tipo de servizo que presta. Planificar accións informativas destinadas tanto a persoal clínico como técnico, comprobando o desenvolvemento e resultado das mesmas. Recoñecer as capacidades asociadas á iniciativa emprendedora, analizando os requirimentos derivados dos postos de traballo e das actividades empresariais. Seleccionar oportunidades de emprego, identificando as diferentes posibilidades de inserción e as alternativas de aprendizaxe ao longo da vida. Aplicar as estratexias do traballo en equipo, valorando a súa eficacia e eficiencia para a consecución dos obxectivos da organización. Exercer os dereitos e cumprir as obrigacións que se derivan das súas funcións Aplicar hábitos éticos e laborais no desenvolvemento da súa actividade profesional, de acordo coas características do posto de traballo e cos procedementos establecidos na empresa.			

Training and Learning Results	
Code	
A1	Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.
A2	That the students can apply their knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
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.
A4	Students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
A5	Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.
B4	Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of biomedical engineering.
B5	Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
B7	Ability to analyze and assess the social and environmental impact of the technical solutions.
B9	Ability to organize and plan within the sphere of a company, and other institutions and organizations.
B10	Knowledge, understanding and ability to apply legislation related to the field of Biomedical Engineering.
B11	To recognize ethical and professional responsibilities in biomedical engineering situations and to make informed judgements, which must consider the impact of biomedical engineering solutions in global, economic, environmental and social contexts.
C13	Ability to identify needs in the organization and management of clinical engineering services in health centers.
D1	Ability to understand the meaning and application of the gender perspective in the different fields of knowledge and in professional practice with the aim of achieving a more just and equal society.
D3	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Know the functioning of the clinical services within the hospital organization, as well as identify the health services in each one of them. Identify the structure and organization of the company, relating it to the type of service it provides.	A1 B7 B9 B10 C13 D1 D3
Plan informative actions aimed at both clinical and technical personnel, checking their development and results.	A3 A4 A5 B7 C13
Recognize the capabilities associated with the initiative entrepreneurial, analyzing the requirements derived from jobs and business activities. Select opportunities from employment, identifying the different possibilities of insertion and the alternatives of learning throughout life.	A5 B9 B11
Apply work strategies as a team, valuing its effectiveness and efficiency to achieve the objectives of the organization.	A2 B4 D1
Exercise rights and fulfill obligations derived from their functions. Apply ethical and work habits in the development of their professional activity, in accordance with the characteristics of the job position and with the procedures established in the company.	B4 B5 B7 B10 B11 D1 D3

Contents	
Topic	
1. Process engineering and management of hospital services	-Principles of the approach oriented towards business processes. - Process-based management. Interaction of resources and processes: matrix of resources-processes. - Application of continuous improvement programs for the design and optimization of processes in a health institution. - Dashboards and indicators
2. Organization and management in the health system. General aspects	- Organizational structure of the health system. Care levels of a hospital center. - Study of different models of hospital management, public and private. - Management and organization of the health system and hospital services. - Efficient management of resources, both human and technical, and of service management. - Auxiliary services and agreement/contracting of health services
3. HR Management	- The importance of personnel - Hiring processes - Staff training plans - Motivation
4. Purchasing and logistics management	- Planning, financing, purchases and supplies. - Auxiliary services of a non-sanitary nature: supply and logistics.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	32	64	96
Problem and/or exercise solving	16	32	48
Essay questions exam	3	3	6
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Presentation by the teacher of the contents on the subject matter under study, theoretical bases and/or guidelines of a work, exercise or project to be developed by the student.

Personalized assistance	
Methodologies	**Description**
Lecturing	Resolution of doubts about the concepts developed in the classroom classes.
Tests	**Description**
Problem and/or exercise solving	Resolution of doubts about the concepts developed in the classroom classes.

Assessment

	Description	Qualification	Training and Learning Results
Problem and/or exercise solving	Continuous evaluation tests that will be carried out in the practical classes of each one of the parts of the subject consisting of the resolution of some case or situation similar to those developed in the classes.	40	
Essay questions exam	Continuous assessment tests that will be carried out throughout the course in theory classes, properly distributed at the end of each of the parts to be evaluated and programmed so that they do not interfere with the rest of the subjects. The tests will consist of solving questions/exercises related to the contents developed in the blocks of the subject and none of them may have a weight greater than 40%.	60	

Other comments on the Evaluation

Sources of information

Basic Bibliography

Fumadó, C. M., & Castellsagués, O. C., **Sanidad lean**, Elsevier Health Sciences., 2015

Kaplan, R. S., & Norton, D. P., **The balanced scorecard: translating strategy into action**, Harvard Buiness press, 1996

PMBOK, **Project management body of knowledge (pmbok® guide).**, 2001

Cabo Salvador, J., **Gestión de la calidad en las organizaciones sanitarias**, Diaz de Santos, 2014

Complementary Bibliography

Recommendations

IDENTIFYING DATA				
(*)Nanomateriais para biomedicina				
Subject	(*)Nanomateriais para biomedicina			
Code	V04M192V01304			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Optional	2nd	1st
Teaching language	Galician			
Department				
Coordinator	Pérez Juste, Jorge Pérez Lorenzo, Moisés			
Lecturers	Pérez Juste, Jorge Pérez Lorenzo, Moisés			
E-mail	juste@uvigo.es moisespl@uvigo.es			
Web				
General description				

Training and Learning Results	
Code	
A1	Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.
A5	Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.
B1	Ability to design, develop, implement, manage and improve products and processes in the different areas of the biomedical engineering, by means of appropriate analytical, computational or experimental techniques.
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.
D3	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources.

Expected results from this subject	Training and Learning Results
I handle of basic terminology in the field of the *nanobiomedicina, understanding of the different concepts and capacity to relate them	A1 B1 B3
Acquisition of basic knowledge on the applications of the *nanociencia in the biomedicine, from the synthesis of nanomaterials to his characterisation and finally, his application in therapy and diagnosis	A1 B1 B3
Perception, inside the global context of the applications *biomédicas, of the fundamental paper played by the *nanociencia and the nanotechnology.	A1 A5 B3 D3

Contents	
Topic	
1. Introduction to nanomaterials and their importance in biomedicine.	In this section, we will address the fundamental concepts of nanomaterials and their significance in the field of biomedicine. We will delve into the ways in which nanomaterials present novel opportunities for research and their application in the diagnosis and treatment of various conditions.
2. Synthesis and properties of nanomaterials.	We will examine the unique properties of nanomaterials, such as size and structure, that give them distinct characteristics. Additionally, we will analyze various synthesis methods used to create nanomaterials with specific properties.
3. Characterization of nanomaterials for biomedical applications.	We will explore the characterization techniques employed to analyze the physical and chemical properties of nanomaterials used in biomedicine. We will delve into the analytical tools that enable the evaluation of their structure, morphology, and interaction with biological systems.

4. Interaction of nanomaterials with biological systems.	We will investigate the interaction between nanomaterials and cells, as well as biological tissues. We will analyze the mechanisms through which nanomaterials interact with biological components and how this interaction can impact their applications in the diagnosis and treatment of various conditions.
5. Applications of nanomaterials in biomedical diagnostics.	We will explore the applications of nanomaterials in the field of diagnostics. We will analyze their use in imaging techniques and the detection of biomarkers, as well as their role in the development of highly sensitive biosensors.
6. Applications of nanomateriais in therapy and treatment of different conditions.	We will study the various applications of nanomaterials in therapy and the treatment of different conditions. We will analyze their utilization in drug delivery, gene therapy, and the treatment of cancer and other medical conditions.
7. Recent advances and future perspectives in nanomaterials for biomedicine.	We will explore the recent advances in the field of nanomaterials for biomedicine and examine the future perspectives of this technology. We will analyze the current trends and the remaining challenges in the development of novel nanomaterials and their applications in diagnostics and the treatment of various conditions.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	16	20	36
Laboratory practical	6	20	26
Presentation	4	20	24
Case studies	4	20.5	24.5
Essay questions exam	2	0	2

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

Methodologies

	Description
Lecturing	In the lecture sessions, the professors will present and explain the theoretical contents of the subject. Through oral presentations and the use of audiovisual resources, students will gain knowledge about nanomaterials and their applications in biomedicine. These sessions serve as a strong foundation for understanding the fundamental concepts related to the topics covered.
Laboratory practical	The lab sessions provide students with the opportunity to conduct experiments related to nanomaterials in biomedicine. During these activities, students will have the chance to apply their theoretical knowledge, perform synthesis and characterization of nanomaterials, and analyze their results. The lab sessions promote a more practical and experimental understanding of the concepts covered in the subject.
Presentation	Presentations serve as a means to assess students' understanding of specific subjects related to nanomaterials for biomedicine. Students will be required to prepare oral or audiovisual presentations to share their knowledge, explore recent advances, or present works related to the topics covered in the subject. These presentations enhance communication skills and encourage students to delve deeper into the subject matter through research and effective presentation techniques.
Case studies	In the case studies, students will analyze real or hypothetical scenarios where nanomaterials are applied in biomedicine. Through this methodology, students can apply their theoretical knowledge to practical contexts and make informed decisions. This approach fosters critical analysis, teamwork, and problem-solving skills by applying the knowledge acquired in the subject.

Personalized assistance

Methodologies	Description
Case studies	In the case studies, students will analyze real or hypothetical situations where nanomaterials are applied in biomedicine. This methodology allows students to apply their theoretical knowledge to practical contexts and make informed decisions. It provides an opportunity for students to develop critical thinking skills and gain experience in applying their knowledge to real-world scenarios.

Assessment

	Description	Qualification	Training and Learning Results

Laboratory practical	During the lab sessions, the evaluation will primarily assess the students' ability to apply their theoretical knowledge to practical situations. Students will be evaluated based on their proficiency in performing lab tasks accurately and safely, interpreting and analyzing the obtained results, and preparing appropriate technical reports. The evaluation aims to gauge the students' practical skills, understanding of experimental procedures, data analysis capabilities, and their ability to effectively communicate their findings.	20	A1 B1 D3
Presentation	The evaluation of the presentations will primarily focus on the students' ability to effectively communicate their acquired knowledge on nanomaterials for biomedicine. Students will be evaluated based on the clarity and structure of their presentations, their ability to summarize and explain key concepts, the quality of the discussions presented, and their skills in responding to questions and actively participating in the discussion. The evaluation aims to assess the students' communication skills, their grasp of the subject matter, their ability to engage in critical thinking, and their proficiency in engaging with the audience.	20	A5 B3 D3
Case studies	In the case studies, the evaluation will primarily focus on the students' ability to apply theoretical knowledge to real or hypothetical situations related to nanomaterials for biomedicine. Students will be evaluated based on their skills in analyzing and solving problems, making informed decisions, and engaging in discussions from their acquired knowledge. The evaluation aims to assess the students' ability to think critically, apply their theoretical understanding to practical scenarios, demonstrate problem-solving skills, and effectively communicate their perspectives and reasoning.	20	A5 B3 D3
Essay questions exam	The exam will assess the overall understanding of the theoretical content covered in the subject. Students will be required to answer open-ended questions, where they must provide clear and precise responses, applying their theoretical knowledge and using appropriate terminology. The evaluation will focus on the comprehension of key concepts, the ability to analyze information, and the coherence of the discussion. The exam aims to gauge the students' depth of understanding, critical thinking skills, and their ability to articulate and support their ideas effectively.	40	A1 B3 D3

Other comments on the Evaluation

Sources of information

Basic Bibliography

Hossein Hosseinkhani, **Nanomaterials in Advanced Medicine**, Wiley-VCH Verlag GmbH & Co. KGaA, 2019

Sourav Bhattacharjee, **Principles of Nanomedicine**, Wiley-VCH Verlag GmbH & Co. KGaA, 2019

Ajay Kumar Mishra, **Nanomedicine for Drug Delivery and Therapeutics**, Wiley-VCH Verlag GmbH & Co. KGaA, 2013

Complementary Bibliography

Recommendations

IDENTIFYING DATA				
(*)Bioinstrumentación. Sistemas de monitorización				
Subject	(*)Bioinstrumentación. Sistemas de monitorización			
Code	V04M192V01305			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Optional	2nd	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Fariña Rodríguez, José Machado Domínguez, Fernando			
Lecturers	Fariña Rodríguez, José Machado Domínguez, Fernando			
E-mail	fmachado@uvigo.es jfarina@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	(*)Neste curso analízase a estrutura e especificacións de dispositivos de monitorización de sinais fisiolóxicas. Abórdase o estudo das características básicas deste tipo de equipos electrónicos, afóndase na utilización de microcontroladores, dispositivos lóxicos programables e dispositivos embebidos, e refórzanse os coñecementos sobre a transmisión de sinal a través de diferentes medios. Durante o curso, o alumnado fará un conxunto de prácticas orientadas ao desenvolvemento e proba dun equipo de medida e monitorización completo de sinais biomédicos.			

Training and Learning Results	
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.
B6	Capacity for handling specifications, regulations and mandatory standards.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Knowledge of the methods and current techniques in bioinstrumentación for the diagnostic, therapy and monitoring of patients.	B6
Knowledge of the methods and techniques of wireless transmission in the corporal surroundings	B6
Knowledge of the procedures and strategies for the implementation in embedded systems of measurement algorithms and processing of biomedical signals.	B6
Create biomedical systems using specific sensors and mobile devices, with application to monitoring, diagnostic, treatment or therapy systems.	A3 B6

Contents	
Topic	
Topic 1. Introduction to advanced instrumentation in Medicine.	Structure of a measurement equipment. Processor technologies. Monitoring of biomedical signals. Practical case: Box UCI.
Topic. 2 Evaluation of the uncertainty of the measure.	Static characteristics of a measuring equipment. Specifications and comparison criteria of biomedical instruments.
Topic 3. Wireless transmission in the body environment.	Characteristics of a wireless transmission. Technologies: Wi-Fi, Bluetooth.
Topic 4. Sensor networks.	Technology and communication protocols. Measurement synchronization. Examples.
Topic 5 Embedded systems. Application in biomedical equipment.	Concept and structure of an embedded system. Programmable Logic Devices and system-on-chip. Examples of application in biomedical equipment.
Topic 6. Technologies and portable health devices.	Wearable device concept. basic structure. examples

Planning			
	Class hours	Hours outside the classroom	Total hours

Lecturing	10	10	20
Problem solving	7	14.5	21.5
Laboratory practical	12	18	30
Project based learning	6	24	30
Objective questions exam	1	10	11

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

Methodologies	
	Description
Lecturing	Presentation by the teaching staff of the relevant aspects of the contents labeled with the heading of Theory. For a better understanding of the contents and an active participation in the session, the students must carry out a previous personal work on the proposed bibliography. In this way, the students will be able to ask questions, request clarifications or raise doubts, which can be resolved in the session or in personalized tutorials. The students will have to carry out subsequent personal work to assimilate the concepts and acquire the skills corresponding to each session. These sessions will take place at the times and in classrooms indicated by the Center's Management.
Problem solving	This activity aims to reinforce the knowledge acquired in the master sessions with the analysis of biomedical signal monitoring problems. Statements and specifications of equipment for the measurement and processing of biomedical signals are presented to the students and they are resolved by applying the concepts and methodologies developed in the master sessions.
Laboratory practical	Application activities of the theoretical knowledge acquired. They are intended for students to acquire abilities and skills related to the design, simulation, debugging, testing of digital electronic circuits based on microcontrollers or FPGAs for the measurement of biomedical signals. In these sessions, students use electronic instrumentation to analyze the behavior of digital electronic circuits, tools for design, simulation, and debugging of digital electronic circuits based on reconfigurable devices, and tools for programming, simulation, and debugging of digital electronic circuits based on microcontrollers. For each practice there is a statement that indicates the previous personal work that the students must carry out and the tasks that they must carry out in the practical session. The practices are developed in the laboratory and the schedules indicated by the Management of the Center. The students are organized into groups. Assistance control is carried out.
Project based learning	In this activity, students acquire abilities and skills related to the design, simulation, debugging, testing, and maintenance of electronic equipment for monitoring biomedical signals. In work groups, students must face the design, assembly and start-up of a digital electronic system for the measurement and monitoring of physiological signals. Each working group will be assigned a project with a detailed description of the specifications and the milestones that must be met. Students must organize and plan their activity to comply, in due time and form, with said project specifications. The face-to-face part of this activity takes place in the laboratory under the tutorship of the professor.

Personalized assistance	
Methodologies	**Description**
Lecturing	The students have at their disposal personalized tutorials with the teaching staff of the subject. The tutorials can be face-to-face, in the corresponding office, or online, through Remote Campus. The tutorial schedule is established at the beginning of the course and is published on the subject's website in Moovi (https://moovi.uvigo.gal). In these tutorials, the students can solve the doubts that arise about the contents taught in the master sessions and they will be guided on how to approach their study.
Problem solving	Students have personalized tutorials with the subject's teachers at their disposal. The tutorials can be face-to-face, in the corresponding office, or online, through Remote Campus. The tutorial schedule is established at the beginning of the course and is published on the subject's website in Moovi (https://moovi.uvigo.gal). In these tutorials, students can resolve doubts about the resolution of the problems raised and assess alternative solutions.
Laboratory practical	The students have at their disposal personalized tutorials with the teaching staff of the subject. The tutorials can be face-to-face, in the corresponding office, or online, through Remote Campus. The tutorial schedule is established at the beginning of the course and is published on the subject's website in Moovi (https://moovi.uvigo.gal). In addition to the attention of the practical teacher during the realization of the same, the students will be able to attend personalized tutorials to raise and solve the difficulties derived from the preparation and realization of the laboratory practices.
Project based learning	Students have personalized tutorials with the subject's teachers at their disposal. The tutorials can be face-to-face, in the corresponding office, or online, through Remote Campus. The tutorial schedule is established at the beginning of the course and is published on the subject's website in Moovi (https://moovi.uvigo.gal). The student body has personalized tutorials to clarify and resolve all the doubts that arise about the planning and execution of the tasks necessary to finish the entrusted project.

Assessment				
	Description	Qualification	Training and Learning Results	
Laboratory practical	Each laboratory practice is evaluated individually. In order to pass it, it is necessary to achieve a minimum grade of 40% of the maximum possible grade. To assess each practice, the previous work for the preparation of each practice session and the content of the document results of the practice will be taken into account. The total practical mark is calculated with the arithmetic mean of the practical mark. To pass the practices it is necessary to obtain at least 50% of the maximum possible mark.	30	A3	B6
Project based learning	In the documentation delivered to the students, in addition to the design and operation specifications of the electronic equipment for the measurement and monitoring of biomedical signals, 3 task evaluation milestones are established. For these evaluations, students must submit a report justifying the solution applied to the evaluated task. Each of these evaluations will have a weight of 20% in the final grade of this evaluation. In addition, an evaluation of the final solution is carried out with a weight of 40% in the final grade. For this, the students must demonstrate the operation of the equipment according to the specifications received and submit a report justifying the applied solution. The temporal planning of these evaluations will be published at the beginning of the teaching activity of the subject. To pass this part it is necessary to obtain 50% of the maximum possible grade.	40	A3	B6
Objective questions exam	With this type of tests the knowledge acquired in the master sessions will be evaluated. A single test will be carried out at the end of said sessions on the date and time established by the School Management. To pass this part it is necessary to obtain 50% of the maximum grade.	30	A3	B6

Other comments on the Evaluation

1. Continuous evaluation

1.1. ordinary opportunity

The final grade for the course will be obtained as a weighted average of the laboratory practice grade (A), the project-based learning grade (B) and the objective questions exam grade (C). To pass the subject it is necessary to obtain a minimum of 50% of the maximum grade. To be able to do the average it is necessary to obtain a minimum of 40% of the maximum grade in each part.

If the minimum threshold (40%) is not reached in any of the parts, the final grade for the subject will be failed and the numerical value will be calculated by multiplying the grade obtained with the weighted average by 0.64.

Clarification on the coefficient: This coefficient is obtained by dividing 4.99 (maximum fail grade) by 7.56 (maximum grade of the arithmetic mean that can be obtained by failing the subject: grade A=3; grade B=3 .9x0.4=1.56; grade of C=3; total=7.56).

1.2. extraordinary opportunity

In the extraordinary opportunity it will not be necessary to appear before the approved parties.

The evaluation of students who have to take the extraordinary opportunity of the academic year will be carried out with:

Final exam: Test with short answer questions. Theoretical concepts and case studies will be evaluated.

Practice exam: Test of completion of any of the tasks indicated in the practical statements.

Project presentation: The assigned project will be evaluated, according to the criteria described for the ordinary opportunity.

The final grade will be obtained with the same criteria specified for the calculation of the ordinary opportunity grade.

2. Global evaluation and call for the end of the degree

The students of global evaluation and end of degree call will be qualified by means of a final exam of theoretical knowledge (C) and a laboratory exam: practices (A) and project (B). The weight and evaluation criteria are the same as in continuous evaluation.

3. Ethical commitment

Students are expected to present appropriate ethical behavior. In case of detecting unethical behavior (copying, plagiarism, use of unauthorized electronic devices, and others), it will be considered that the student does not meet the necessary requirements to pass the subject. In this case, the overall grade for this academic year will be fail (0.0).

Sources of information
Basic Bibliography
Saeid Sanei, Delaram Jarchi, Anthony G. Constantinides, **Body Sensor Networking, Design and Algorithms**, 1119390028, 1st, Wiley, 2020
John G. Webster, **Medical instrumentation: application and design**, 9781119457336, 5th, John Wiley, 2020
Complementary Bibliography
Haider Raad, **Fundamentals of IoT and Wearable Technology Design**, 9781119617549, 1st, IEEE Press, 2021
Myer Kutz, **Biomedical Enineerind and Design Handbook**, 978-0-07-170472-4, 2nd, Mc Graw Hill, 2009
Khandpur, Raghbir Singh, **Compendium of Biomedical Instrumentation**, 9781119288121, 1st, Wiley, 2020

Recommendations

IDENTIFYING DATA				
(*)Análise cronobiolóxico de sinais biomédicas				
Subject	(*)Análise cronobiolóxico de sinais biomédicas			
Code	V04M192V01306			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Optional	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Hermida Domínguez, Ramón Carmelo Mojón Ojea, Artemio			
Lecturers	Hermida Domínguez, Ramón Carmelo Mojón Ojea, Artemio			
E-mail	rhermida@uvigo.es amojon@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This course intends: - Provide knowledge on other frequency/temporal scales that are common in clinical practice. - Provide knowledge on methods for analysis of noisy biomedical signals, with short duration, and/or with non-equidistant sampling, evaluating individuals as well as specific groups of patients or populations. - Contribute to the understanding of the clinical, diagnostic and prognostic importance of specific parameters extracted from biomedical signals. - Train in the use of computer tools to solve problems of the contents of the course.			

Training and Learning Results	
Code	
A5	Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.
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.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Know other espectral/temporal scales that appear in the clinical practice. Knowledge of analysis methods for noisy biomedical signals, short biomedical signals and/or with non-equidistant sampling.	B3
Being able to apply techniques to model biomedical signals of individuals and/or populations. Understand the clinical, diagnostic or prognostic importance of parameters extracted from biomedical signals.	A5 B3
Use computer tools to solve problems of the course contents.	A5

Contents	
Topic	
Topic 1	Presentation and work environment
Topic 2	Introduction to biological rhythms
Topic 3	Review of linear regression concepts
Topic 4	Rhythmometry of individual (longitudinal) time series: single cosinor, multiple components rhythmometry, model comparison
Topic 5	Rhythmometry of population (hybrid) time series: mean population cosinor, population multiple components rhythmometry, model comparison
Topic 6	Chronobiological serial section
Topic 7	Reference limits

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	14	14	28
Problem solving	5.5	11	16.5
Practices through ICT	12	18	30

Problem and/or exercise solving	2	4	6
Laboratory practice	1.5	9	10.5
Presentation	1	9	10
Essay questions exam	1.5	10	11.5

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

Methodologies

	Description
Lecturing	The course is structured in seven blocks. Each one will have a theoretical part that will be presented by the teaching staff trying to illustrate the concepts with real practical example
Problem solving	Although most of the practical work requires the use of a computer, we have considered it appropriate to include in this block the design of the analytical approach and the analysis of results. Students will be required to work previously on these problems.
Practices through ICT	Each topic is complemented with one or more computer practices. The work environment will be R (multipurpose free software, although with a marked statistical orientation), and will be complemented with some developments of the teaching staff for a faster progress

Personalized assistance

Methodologies	Description
Lecturing	Students will have the opportunity to attend personalized tutorials in the modality that each teacher will establish for this purpose at the beginning of the course. Tutorials may be carried out in person or by telematic means. On the page of the course in MooVi, within the section "Teachers and tutorials" (https://moovi.uvigo.gal) the contact details of the teaching staff will be specified.
Problem solving	Students will have the opportunity to attend personalized tutorials in the modality that each teacher will establish for this purpose at the beginning of the course. Tutorials may be carried out in person or by telematic means. On the page of the couse in MooVi, within the section "Teachers and tutorials" (https://moovi.uvigo.gal) the contact details of the teaching staff will be specified.
Practices through ICT	Students will have the opportunity to attend personalized tutorials in the modality that each teacher will establish for this purpose at the beginning of the course. Tutorials may be carried out in person or by telematic means. On the page of the couse in MooVi, within the section "Teachers and tutorials" (https://moovi.uvigo.gal) the contact details of the teaching staff will be specified.

Assessment

	Description	Qualification	Training and Learning Results	
Problem and/or exercise solving	Questions about the problems solved in the practices in relation to the contents of the lectures	30	A5	B3
Laboratory practice	Resolution of exercises with computer.	30	A5	B3
Presentation	Presentation of a tutored written assignment and its discussion with the teaching staff and the rest of the students.	20	A5	
Essay questions exam	This test will consist of questions and problems of short answer, with questions related to the master classes, laboratory and presentations of the supervised written assignment.	20		B3

Other comments on the Evaluation

Two assessment systems will be offered to the students taking this course: continuous assessment (CA) and global assessment (GA). Students who wish to renounce the continuous evaluation (choice by default), must notify the teaching staff within a period not exceeding two months from the beginning of classes.

The grades of the continuous assessment tests are only valid for the ordinary evaluation of the current academic year. The tests of continuous assessment are not recoverable, that is, if someone cannot perform them, teachers have no obligation to repeat them (except in duly documented cases). In the continuous evaluation the final grade cannot be "not presented".

Students who do not opt for continuous assessment must take a final, theoretical and practical, exam on all the contents of the course. This exam will be graded between 0 and 10 and this will be the final grade obtained.

The exam of the extraordinary opportunity, as well as the exam of the end-of-career opportunity, will have a structure similar to the final exam of students who do not opt for continuous evaluation.

The course is considered passed if the final obtained grade is equal to or greater than 5.

In case of detected plagiarism in any of the tests, the final grade will be FAIL (0) and the fact will be communicated to the

direction of the Center for the appropriate effects.

Sources of information

Basic Bibliography

Weisberg S, **Applied Linear Regression**, 9781118386088, 4, J Wiley & Sons, 2013

Yihui X, J J A, Garrett G, **R Markdown**, 9781138359338, 1, Chapman & Hall, 2018

Bingham C, Arbogast B, Guillaume GC, Lee JK, Halberg F, **Inferential statistical methods for estimating and comparing cosinor parameters**, Chronobiologia, 1982

Hermida RC, Fernández JR, Alonso I, Ayala DE, García L, **Computation of time-specified tolerance intervals for hybrid time series with nonequidistant sampling, illustrated for plasma growth hormone**, 10.3109/07420529709001461, Chronobiol Int, 1997

Fernández JR, Hermida RC, **Computation of model-dependent tolerance bands for ambulatorily moni- tored blood pressure**, 10.1081/cbi-100101064, Chronobiol Int, 2000

Fernández JR, Hermida RC, Mojón A, **Chronobiological analysis techniques. Application to blood pressure**, 10.1098/rsta.2008.0231, Philos Trans R Soc, A, 2009

Complementary Bibliography

Fernández JR, Hermida RC, **Inferential statistical method for analysis of nonsinusoidal hybrid time series with unequidistant observations**, 10.3109/07420529808998683, Chronobiol Int, 1998

Fernandez JR, Mojón A, Hermida RC, Alonso I, **Methods for comparison of parameters from longitudinal rhythmometric models with multiple components**, 10.1081/cbi-120021383, Chronobiol Int, 2003

Fernández JR, Mojón A, Hermida RC, **Comparison of parameters from rhythmometric models with multiple components on hybrid data**, 10.1081/cbi-120038630, Chronobiol Int, 2004

Hermida RC, Smolensky MH, Ayala DE, Portaluppi F, Crespo JJ, Fabbian F, et al., **2013 Ambulatory Blood Pressure Monitoring Recommendations for the Diagnosis of Adult Hypertension, Assessment of Cardiovascular and other Hypertension-associated Risk, and Attainment of Therapeutic**, 10.3109/07420528.2013.750490, Chronobiol Int, 2013

Recommendations

Subjects that it is recommended to have taken before

(*)Estatística avanzada para a enxeñaría biomédica/V04M192V01101

IDENTIFYING DATA				
(*)Tecnoloxías de fabricación aditiva e híbrida aplicada á enxeñaría biomédica				
Subject	(*)Tecnoloxías de fabricación aditiva e híbrida aplicada á enxeñaría biomédica			
Code	V04M192V01307			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Optional	2nd	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Pérez García, José Antonio Feijoó Vázquez, Iria Pena Uris, Gloria María			
Lecturers	Feijoó Vázquez, Iria Pena Uris, Gloria María Pérez García, José Antonio			
E-mail	japerez@uvigo.es gpena@uvigo.gal ifeijoo@uvigo.es			
Web	http://https://moovi.uvigo.gal/			
General description	In this optional subject, students will acquire the theoretical knowledge and basic practical training to begin modelling and manufacturing biomedical products (prostheses, orthoses, models, and tools for surgery, etc.). This subject is structured with an eminently practical orientation and an integral approach in which, starting from the functional design of a product, the selection of the material that guarantees the appropriate properties, biocompatibility and durability is addressed. Applicable additive and hybrid manufacturing technologies are analyzed, considering quality, safety and economic criteria, and this approach is completed with a review of the post-processing techniques necessary to achieve adequate biomechanical functionality and the best compatibility with physiological environments. Finally, the techniques for verifying the quality of the manufactured part (metrology, microstructural, mechanical and durability characterization) are addressed. English Friendly subject: International students will be able to ask the teaching staff for: a) materials and bibliographic references to follow the subject in English, b) tutorials in English, c) tests and evaluations in English.			

Training and Learning Results	
Code	
A1	Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.
A2	That the students can apply their knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
A4	Students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
A5	Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.
B1	Ability to design, develop, implement, manage and improve products and processes in the different areas of the biomedical engineering, by means of appropriate analytical, computational or experimental techniques.
B4	Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of biomedical engineering.
B10	Knowledge, understanding and ability to apply legislation related to the field of Biomedical Engineering.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Analyse the characteristics of the main materials used in biomedical implants: metallic, polymers, ceramic, composed and biological.	A1 B10

Knowledge of the design and modelling of implants used in orthopaedics, traumatology and rehabilitation, and dental implants.	A2 A4 B1 B4
Use CAD-CAM tools for the modelling and manufacture of a prosthesis or specific implants.	A2 A4 A5 B1

Contents	
Topic	
1. Introduction	- Historical evolution of additive manufacturing (AM) in the biomedical sector. - Benefits of AF: time and cost reduction, lightening, ergonomic improvements, personalised medicine. - Applications of AF to biomedical products: implants, orthoses, pre-operative models and tooling. - Ethical and legal aspects related to AF in the biomedical field.
2. Functional design of biomedical products	- CADCAM platforms for design and manufacturing - Stages in the design of biomedical products: Definition of functional requirements, preliminary design, optimisation, final design.
3. Biomaterials for additive manufacturing (AM).	- Ceramics: HA, tricalcium phosphate (TCP). Other calcium phosphates (CaPs). Bioglass. Ceramic composites. - Metallics: noble metals, Ti6Al4V, TiNi. 316L, Co-Cr, CoCrMo. Mg alloys. Metal matrix composites. - Polymers: natural biopolymers. Synthetic biopolymers. Polymer-ceramic composites. - Advanced biomaterials for AF.
4. Additive manufacturing technologies applied to biomedical products.	- Fused deposition modeling (FDM) - Tank or vat light curing (SLA) - Powder bed fusion (SLS) - Binder injection (BJ) - Localized energy deposition (DED) - Electron beam powder bed melting (EBM) - Bioprinting - Multi-material and hybrid manufacturing.
5. Product quality control	- Analysis of the effect of printing parameters on product properties. - Post-processing and surface treatments. - Structural, mechanical, thermal and chemical characterisation. Related regulations and standards.
6. Design and manufacturing project	- Study cases - Initial design: particular conditioning factors. Topological optimization - Initial printing tests: Influence of deposition parameters on properties. - Manufacture of parts. - Analysis of the results obtained. Lessons learned

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	23	46	69
Practices through ICT	4	2	6
Laboratory practical	4	5	9
Mentored work	4	20	24
Self-assessment	0.5	0	0.5
Report of practices, practicum and external practices	0.5	0	0.5
Presentation	0.5	0	0.5
Objective questions exam	2	0	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	The teaching staff present the course: contents, organisation, methodologies used, timetable and assessment system. Special attention is paid to the description of the projects to be developed by the students (tutored work) as well as the system of tutorials and support available to the students.

Lecturing	The teacher will present and explain the fundamental contents of the subject, encouraging the active participation of the students. The material used in the presentations will be available to students beforehand on the Moovi platform. Manipulative activities may be carried out in the classroom.
Practices through ICT	They will take place in a IT classroom. In these practical sessions teachers will guide students in the use of CADCAM platforms for the design of simple biomedical products, and also in the use of CESEDUPACK program for the adequate selection of materials.
Laboratory practical	Practical application activities of the knowledge acquired in the theoretical sessions. These are carried out in the laboratory with specialised equipment and in accordance with the applicable standards. In these activities, the teaching staff will guide the student in the use of the equipment and techniques to be used in the development of the project, such as AD technologies, machining and metrology, mechanical, thermal and microstructural characterisation equipment.
Mentored work	This project or supervised work involves the direct application of all the knowledge acquired during the course. The teaching staff will propose various biomedical products to the students so that each of the students (or in groups of two, depending on their number) can carry out the complete process of requirements analysis, design, material selection, manufacture and characterisation. The students will have access to the equipments of the centre and the support of the teaching staff to carry it out.

Personalized assistance

Methodologies	Description
Lecturing	The teacher will guide and solve any doubts that the student may have in relation to the contents explained in the Lectures. This attention will take place spontaneously in the classroom, and in tutorial sessions. The tutorials may be individual or small group, at the student's request, during the timetable defined by the teaching staff.
Practices through ICT	The laboratory teachers will guide the students in the development of the practical classes, clarifying doubts and guiding them to achieve the best understanding of the concepts and the acquisition of the necessary skills. This attention will be carried out spontaneously throughout the practical sessions, and also in personalized tutoring sessions, following the scheduled sessions defined by the teaching staff.
Mentored work	During the development of the project, which the students will have to carry out individually or in small groups, they will have the guidance and help of the teaching staff. This attention will be given when required, during the timetable established by the teaching staff. However, two group tutoring sessions will be proposed, one at the beginning of the project and the other before the defence, in order to be able to modify those aspects of the structure or content that need it.
Tests	**Description**
Self-assessment	The teacher will design the self-assessment questionnaires that students will have to answer at the end of each lesson or thematic unit. The self-assessment will take place in the classroom, on a day and at a time set sufficiently in advance. The teaching staff will help to resolve any technical questions that may arise.
Report of practices, practicum and external practices	Students will have the support of the laboratory lecturers to resolve any concerns that may arise in the writing of the practical reports or in the answers to the questions asked.

Assessment

	Description	Qualification	Training and Learning Results
Self-assessment	At the end of each topic or thematic unit, there will be a short self-assessment test that students will have to answer individually. The results of these tests will guide students on their understanding of the subject and their progress in learning. The tests will consist of the resolution of 10 multiple choice questions (single or multiple answer), online, through the Moovi platform. They will take place in the classroom itself, in the time allocated to the lectures. The dates and times of these tests will be communicated to students sufficiently in advance through the teaching platform and in the classroom itself. Students must have a laptop or mobile phone that allows connection to the platform.	20	A2 B4 A5
Report of practices, practicum and external practices	After each practical session (ICT and laboratory), the student must hand in a report including the results of the tests carried out as well as the answers to the questions posed.	10	A2 B4 A5

Presentation	Oral presentation in which each student (or small group, depending on the number of students) presents and defends the project carried out before the teacher and their classmates. The student must explain the steps followed in each of the stages of development of the project, demonstrating the knowledge and skills acquired. At the end of the presentation, the student must answer questions from the teacher and the rest of the students. This presentation and defence will be assessed according to a previously published rubric.	40	A1 A2 A4	B1 B4 B10
Objective questions exam	A written test will be held on the dates scheduled by the centre. This exam will assess the knowledge that students have acquired of the concepts presented in the theory classes, through short questions, exercises, etc.	30	A2 A5	B4 B10

Other comments on the Evaluation

Continuous assessment (this will be the preferred assessment system): Consists of various tests to be taken throughout the teaching period, and a written test to be taken on the official **1st Attempt** exam date, as indicated in the table above, in which the percentage of each test is included in the final mark. As a summary:

- Self-assessment: 20%.
- Practical work and report: 10%.
- Presentation of the project: 40%.
- Written exam: 30%.

- Students who follow the continuous assessment procedure **must compulsorily participate in all the activities** indicated above, and their final grade will be the sum of the marks obtained in each of the tests, with the weighting indicated in the table above. In order to pass the continuous assessment of the subject, a mark equal to or higher than 5 points out of 10 must be obtained.

- In **exceptional cases** in which a student is unable to participate in a specific session of the above activities, the teaching staff will agree with the student on an alternative activity or test, which will allow him/her to continue with the development of the subject without prejudice to the evaluation process.

- Students who must sit the **second assessment attempt** will keep the grade obtained in the Self-assessment and Practical Reports tests (30%), but must take a written exam of objective questions that will evaluate the theoretical contents of the course (30% of the final grade) and carry out the presentation of the project (40%). The exam will take place on the official date established by the centre.

Global or comprehensive assessment: Students who do not wish to take part in the continuous assessment procedure must follow the **procedure for waiving continuous assessment** established by the management of the IEE, complying with the deadlines set by the centre. In this case, **both in the first and in the second edition,** the assessment will be carried out by means of a written exam (50% of the final mark), and the defence of a comprehensive project selected from those proposed by the teaching staff including analysis, design, manufacturing and characterization of a medical product (50% of the final mark). The assessment will be carried out on the official dates established by the centre. In order to pass the overall assessment, the student must achieve a minimum mark of 5 out of 10.

Extraordinary Call: to be held according to the global assessment system described above, on the date previously set by the centre.

Ethical commitment: Students are expected to behave ethically in accordance with the code of ethics of the University of Vigo and the IEE. According to article 42.1 of the ***Regulation on the evaluation, grading and quality of teaching and the learning process of students at the University of Vigo***, (Approved in closing on 18 April 2023): "Fraudulent performance in any assessment test will result in a grade of zero (fail) in the minutes of the corresponding assessment opportunity, regardless of the value that the test in question has on the overall grade and without prejudice to the possible consequences of a disciplinary nature that may occur".

NOTE: In the event of discrepancies or inconsistencies in the information contained in the different language versions of this guide, the version published in Spanish will prevail.

Sources of information

Basic Bibliography

Sheku Kamara, K. S. Faggiani, Ed., **Fundamentals of Additive manufacturing for the pradtitioner**, Wiley, 2021

Kun Zhou, Ed., **Additive Manufacturing Technology**, WILEY-VCH, 2023

Venina dos Santos, Rosmary Nichele Brandalise, Michele Savaris, **Engineering of Biomaterials**, Springer, 2017

Roger Narayan, Ed., **Rapid prototyping of biomaterials : principles and applications**, Philadelphia, PA : Woodhead Pub, 2014

Atul Babbar, Ankit Sharma, Vivek Jain, and Dheeraj Gupta, Eds., **Additive manufacturing processes in biomedical engineering : advanced fabrication methods and rapid tooling techniques**, Boca Raton : CRC Press, 2023

Zafar Alam Faiz, Iqbal Dilshad, Ahmad Khan, Eds, **Post-processing Techniques for Additive Manufacturing**, CRC Press, 2024

Complementary Bibliography

William Murphy, Jonathan Black, Garth Hastings Eds., **Handbook of Biomaterial Properties**, 2ª Ed, Springer, 2016

Recommendations

Subjects that are recommended to be taken simultaneously

(*)Certificación de productos sanitarios e innovación en tecnoloxía médica/V04M192V01302
(*)Simulación biomecánica/V04M192V01308

Subjects that it is recommended to have taken before

(*)Análisis biomecánico de actividades e funcións humanas/V04M192V01105
(*)Deseño de produtos e servizos intelixentes no sector biomédico/V04M192V01209
(*)Enxeñaría de superficies para aplicacións biomédicas/V04M192V01205

IDENTIFYING DATA				
(*)Simulación biomecánica				
Subject	(*)Simulación biomecánica			
Code	V04M192V01308			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	4.5	Optional	2nd	1st
Teaching language				
Department				
Coordinator	Segade Robleda, Abraham González Baldonedo, Jacobo			
Lecturers	González Baldonedo, Jacobo Segade Robleda, Abraham			
E-mail	jacobo.gonzalez.baldonedo@uvigo.es asegade@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	(*)Introdución á simulación e cálculo mecánico de sistemas e dispositivos biomédicos.			

Training and Learning Results	
Code	
A5	Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.
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.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Capacity for the study of the mechanical behaviour of joints and prosthetic systems.	A5 B3
Apply knowledges of simulation and mechanical calculation to biomechanical systems	B3

Contents	
Topic	
Fundamentals of finite element simulation	- Pre-processing, solution and post-processing - Generalities of non-linear calculus - Non-linear problem solving methods - Equilibrium trajectories - Large deformations
Computational Dynamics	- Implicit Dynamics: Implicit Euler method, Newmark method. - Explicit Dynamics: Explicit Euler method, finite difference method.
Preparation of geometry for finite element analysis.	- Definition of the problem, establishment of adequate boundary conditions. - Material behavior models. - Analysis of results: tensions, deformations, evaluation of contacts, resistance evaluation. - Calculation of components.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	13	17	30
Problem solving	5	15	20
Practices through ICT	17	32	49
Objective questions exam	2	0	2
Report of practices, practicum and external practices	1	10.5	11.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies

	Description
Lecturing	Introduction and description of the different concepts and techniques related to the subject
Problem solving	Putting the knowledge acquired in the field into practice by applying it to solving common engineering problems
Practices through ICT	Practices with the support of ICT Troubleshooting simulation of devices and biomechanical cases using commercial software

Personalized assistance

Methodologies	Description
Lecturing	Personalized attention to all the doubts raised by the students
Problem solving	Group or individual tutorials will take place during tutoring hours, which will serve to reinforce the knowledge acquired and tutor the proposed work.
Practices through ICT	Group or individual tutorials will take place during tutoring hours, which will serve to reinforce the knowledge acquired and tutor the proposed work.

Assessment

	Description	Qualification	Training and Learning	Results
Practices through ICT	Once the internships have been completed, reports of internships and other tasks carried out IN GROUP will be delivered	40	A5	B3
Objective questions exam	There will be a multiple choice exam on the contents developed in the subject	10		B3
Report of practices, practicum and external practices	Reports or work carried out INDIVIDUALLY will be delivered on assumptions proposed in the subject	50	A5	B3

Other comments on the Evaluation

To pass the subject, students must obtain at least a score of 40% in the Report on practicals, practicum and external practices (work done individually) section.

By default, the evaluation will be in Continuous Evaluation mode for all students. Anyone who wishes and requests it in the time and manner specified by the School may waive this modality of evaluation.

For students who take the subject in the Continuous Assessment modality and do not pass the subject in the First Chance call (May), to pass the subject in the Second Chance call (July), the subject teachers will They will indicate the deliveries or work that will have to be carried out in order to be evaluated in that call.

Students who renounce the Continuous Evaluation modality will be evaluated with 100% of the subject's score in a single test. In this case, the student must notify the subject teachers sufficiently in advance, who will indicate the recovery methodology.

Sources of information

Basic Bibliography

J. Bonet, R. D. Wood, **Nonlinear Continuum Mechanics for Finite Element Analysis**, Cambridge, 2008

R. R. Cray, A. J. Kurdila, **Fundamentals of Structural Dynamics**, Wiley, 2006

Complementary Bibliography

G. A. Holzapfel, **Nonlinear Solid Mechanics: A Continuum Approach for Engineering**, Wiley, 2000

Ted Belytschko, Wing Kam Liu, Brian Moran, Khalil Elkhodary, **onlinear Finite Elements for Continua and Structures**, Wiley, 2014

O. C. Zienkiewicz R. L. Taylor J.Z. Zhu, **The Finite Element Method: Its Basis and Fundamentals**, Elsevier, 2013

Recommendations

Subjects that it is recommended to have taken before

(*)Biomateriales avanzados e enxeñaría tisular/V04M192V01106
(*)Mecánica de materiais e tecidos blandos/V04M192V01207
(*)Métodos matemáticos aplicados á enxeñaria biomédica/V04M192V01102

IDENTIFYING DATA				
(*)Prácticas externas				
Subject	(*)Prácticas externas			
Code	V04M192V01401			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language				
Department				
Coordinator	Eguizábal Gándara, Luis Eduardo Pardo Froján, Juan Enrique Comesaña Piñeiro, Rafael			
Lecturers	Comesaña Piñeiro, Rafael Eguizábal Gándara, Luis Eduardo Pardo Froján, Juan Enrique			
E-mail	jpardo@uvigo.es eguizaba@uvigo.es racomesana@uvigo.es			
Web				
General description	External internships in Companies, Hospitals or Research Centers in the biomedical field			

Training and Learning Results	
Code	
A1	Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.
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.
A4	Students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
B2	Ability to direct activities related to the CG1 competence
B4	Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of biomedical engineering.
B9	Ability to organize and plan within the sphere of a company, and other institutions and organizations.
B11	To recognize ethical and professional responsibilities in biomedical engineering situations and to make informed judgements, which must consider the impact of biomedical engineering solutions in global, economic, environmental and social contexts.
B12	To operate effectively in a multidisciplinary team whose members, together, exercise leadership, create a collaborative and inclusive environment, set goals, plan tasks and meet goals.
D1	Ability to understand the meaning and application of the gender perspective in the different fields of knowledge and in professional practice with the aim of achieving a more just and equal society.
D2	Ability to communicate orally and in writing in the Galician language.
D3	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Capacity to adapt to the real situations of the profession.	A1 A3 B2 B4 B11 D1 D2

Integration in groups of multidisciplinary work.	A4 B2 B4 B12 D1 D2
Responsibility and autonomous work	A1 A3 B9 B11 D1 D3

Contents

Topic	
Integration in a group of work in a company.	The student will integrate in the organisational context of a company, hospitable centre or centre of investigation, having to coordinate with the different members of the group of work to what was assigned.
Realisation of activities tied to the exert of the profession.	The student will carry out a series of tasks related with the knowledge and with the learning outcomes of the program

Planning

	Class hours	Hours outside the classroom	Total hours
Practicum, External practices and clinical practices	150	0	150

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

Methodologies

	Description
Practicum, External practices and clinical practices	The student will integrate in a group of work in a company, hospital or research centre, where will have the opportunity to put in practice the knowledge and the skills acquired, in order to complement the program learning outcomes.

Personalized assistance

Methodologies	Description
Practicum, External practices and clinical practices	The student will have of a tutor in the company where will make his practices and an academic tutor.

Assessment

	Description	Qualification	Training and Learning Results		
Practicum, External practices and clinical practices	The students in practical will have to keep a contact continued no only with his tutor in the company/ hospital/centre of investigation, but also with his academic tutor. When concluding the practices, will have to deliver to the academic tutor a final memory and the pertinent documentation associated to the practices. In the evaluation will take into account to assessment made by the tutor in the company, the follow-up made by the academic tutor and the reports delivered.	100	A1 A3 A4	B2 B4 B9 B11 B12	D1 D2 D3

Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Other comments

The subject will be able to give indistinctly in Galician or Spanish, as both are official languages of the autonomous

community. If the subject adds to the plan of internationalisation, will be given in English.
The students has to be enrolled of all the pending matters for the acquisition of the title to exception, if it was the case, of the Master's thesis (TFM)

IDENTIFYING DATA				
Master Thesis				
Subject	Master Thesis			
Code	V04M192V01402			
Study programme	Máster Universitario en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	24	Mandatory	2nd	2nd
Teaching language				
Department				
Coordinator	Izquierdo Belmonte, Pablo Eguizábal Gándara, Luis Eduardo Pardo Froján, Juan Enrique Comesaña Piñeiro, Rafael			
Lecturers	Comesaña Piñeiro, Rafael Eguizábal Gándara, Luis Eduardo Izquierdo Belmonte, Pablo Pardo Froján, Juan Enrique			
E-mail	pabloizquierdob@uvigo.es jpardo@uvigo.es eguizaba@uvigo.es racomesana@uvigo.es			
Web				
General description	Master Thesis (TFM) in Companies, Hospitals and Research Centers of the biomedical field			

Training and Learning Results	
Code	
A1	Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.
A2	That the students can apply their knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
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.
A4	Students can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.
B1	Ability to design, develop, implement, manage and improve products and processes in the different areas of the biomedical engineering, by means of appropriate analytical, computational or experimental techniques.
B2	Ability to direct activities related to the CG1 competence
B4	Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of biomedical engineering.
B9	Ability to organize and plan within the sphere of a company, and other institutions and organizations.
B11	To recognize ethical and professional responsibilities in biomedical engineering situations and to make informed judgements, which must consider the impact of biomedical engineering solutions in global, economic, environmental and social contexts.
B12	To operate effectively in a multidisciplinary team whose members, together, exercise leadership, create a collaborative and inclusive environment, set goals, plan tasks and meet goals.
C14	Ability to apply biomedical engineering design to produce solutions that meet specific needs taking into account the public health, safety and welfare, as well as global, cultural, social, environmental and economic factors
D1	Ability to understand the meaning and application of the gender perspective in the different fields of knowledge and in professional practice with the aim of achieving a more just and equal society.
D2	Ability to communicate orally and in writing in the Galician language.
D3	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources.

Expected results from this subject	
Expected results from this subject	Training and Learning Results

Research, classification and structuring of information on any topic inside the biomedical engineering field.	A1 B2 B9 B11
Preparation of a memory in which they collect , among others, the following appearances: antecedents, problematic or state of the art, aims, phases of the project, development of the project, conclusions and future lines.	A3 A4 B2 B9 D2
Design of equipment, prototypes, programs of simulation, etc, according to specifications.	A2 B1 B2 B4 B9 B11 B12 C14 D1 D2 D3

Contents

Topic

Planning

	Class hours	Hours outside the classroom	Total hours
Mentored work	600	0	600

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

Methodologies

	Description
Mentored work	Research, ordination and structuring of information on any thematic inside the biomedical engineering field. Preparation of a report in which they collect , among others, the following appearances: antecedents, problematic or state of the art, aims, phases of the project, development of the project, conclusions and future lines. Design of teams, prototypes, programs of simulation, etc, according to specifications. Classical projects of engineering technical Studies, organisational and economic theoretical Works-experimental

Personalized assistance

Methodologies	Description
Mentored work	The tutor in the centre and the academic tutor will attend personally the doubts and queries so much of theoretical character like practical.

Assessment

	Description	Qualification	Training and Learning Results			
Mentored work	The student will have to make a Master's Thesis report (project) and a public presentation of the same (presentation).	100	A1 A2 A3 A4	B1 B2 B4 B9 B11 B12	C14	D1 D2 D3

Other comments on the Evaluation

Students must be enrolled in all the program subjects necessary for the acquisition of the title

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations