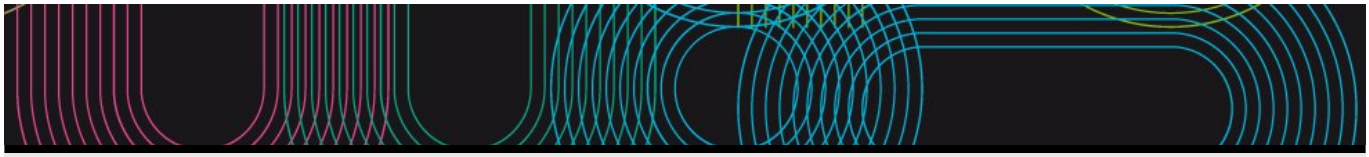
Universidade Vigo

Subject Guide 2021 / 2022



IDENTIFYING DATA				
Image generation and processing in biomedicine				
Subject	Image generation and processing in biomedicine			
Code	V12G420V01913			
Study programme	Grado en Ingeniería Biomédica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Martín Rodríguez, Fernando			
Lecturers	Martín Rodríguez, Fernando			
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General description	This course describes the fundamentals of medical imaging with different technologies (X-rays, ultrasound, magnetic resonance, PET...). Digital image processing is also introduced focusing on medical applications. English Friendly course: International students can ask for: a) Bibliographic references in English for following the course. b) Personal assistance in English. c) Being assessed in English.			

Skills	
Code	
C33	CE33 Resolve problems of Biomedical Engineering including those associated with the interaction between living systems and alive.
C35	CE35 Carry out measurements and interpret data from living systems.
D6	CT6 Application of computer science in the field of study.

Learning outcomes		
Expected results from this subject	Training and Learning Results	
Knowledge and understanding of image formation techniques applied in medicine.	C33 C35	
Knowledge of the parameters that affect image quality (contrast, resolution and signal to noise ratio).	C35	D6
Knowledge of the techniques and algorithms to extract quantitative information of the images and their interpretation.	C35	D6

Contents	
Topic	
Introduction to digital imaging.	Digital image concept. Image formats, specific medical image formats. Parameters of an image: resolution, dynamic range, contrast, signal to noise ratio. Practical work with images: introduction and first steps.

Medical imaging technologies.	X-ray, digital radiography. Ultrasound, Doppler ultrasound. CT (computerized axial tomography): capture system, Radon transform and inverse Radon. NMR (nuclear magnetic resonance): capture system, Fourier transform (FFT and inverse FFT). PET (positron emission tomography). Other techniques (thermography, endoscopy, infrared, microscopy).
Medical image processing.	2D Fourier transform, frequency analysis. 2D sampling and resolution. Image registration: control points, transformation calculation. Punctual and neighborhood filters. Linear and non-linear. Convolution. Morphological filters. Application to enhancement and restoration. Practical work: examples of the techniques studied.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	30	50	80
Practices through ICT	18	40	58
Essay questions exam	1	0	1
Problem and/or exercise solving	1.5	0	1.5
Report of practices, practicum and external practices	0	9.5	9.5

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

Methodologies

	Description
Lecturing	Exposition of course contents, promoting critical discussion of concepts. The theoretical bases of algorithms and procedures used in the practical part are studied.
Practices through ICT	Small projects are proposed. The student must obtain the appropriate solution in a reasoned way, correctly choosing the applicable methods and arriving at a valid "product".

Personalized assistance

Methodologies	Description
Lecturing	Answering questions in class and, if necessary, personalized tutoriang.
Practices through ICT	On-site help and, if necessary, tutoring by appointment. Consultations via e-mail.

Assessment

	Description	Qualification	Training and Learning Results	
Essay questions exam	Questions about the theory and the practical work carried out.	30	C33 C35	D6
Problem and/or exercise solving	Practical questions about the subject. Practical assumptions, decision making...	30	C33 C35	D6
Report of practices, practicum and external practices	Final result of the practical work. Based on deliverables with a deadline and specification of mandatory content.	40	C33 C35	D6

Other comments on the Evaluation

The essay question exam and problem solving take place on the same day at the date, time and place defined by the center in the exam calendar.

The student can decide whether he wants only a final exam (single evaluation) or continuous evaluation (according to the procedure described above). To do this, they must indicate their decision in writing in the statement of the final exam. If they opt for the final exam option (the final exam is 100% of the grade), they will have to complete extra questions and/or exercises (having more time).

On the second call, they can again choose between continuous assessment and the final exam. Take into account that:

- The continuous assessment mark is the same as that obtained in the first call.

- The continuous assessment mark is only valid for the current academic year.

EXTRAORDINARY CALL: in extraordinary call (end of degree) the same procedure is applied as in the case of students who

have not followed the continuous assessment process.

In the event of detection of plagiarism in any of the tests (short tests, midterms, final exam, practical reports), the final grade will be FAIL (0) and the fact will be communicated to the school governors for the appropriate purposes.

Sources of information

Basic Bibliography

Paul Suetens, **Fundamentals of Medical Imaging**, 978-0-521-51915-1, 2, CAMBRIDGE UNIVERSITY PRESS, 2009

Rafael C. González, **Digital image processing using MATLAB**, 978-0-982-0854-0-0, 2, Gatesmark Publishing, 2009

Complementary Bibliography

Oleg S. Pianykh, **Digital Imaging and Communications in Medicine (DICOM)**, 978-3-642-10849-5, 2, Springer-Verlag, 2012

Arnulf Oppelt Ed., **Imaging Systems for Medical Diagnostics**, 978-3-89678-669-3, 2, Publicis Publishing, 2005

R. Nick Bryan Ed., **Introduction to the Science of Medical Imaging**, 978-0-521-74762-2, 1, CAMBRIDGE UNIVERSITY PRESS, 2010

Krzysztof Iniewski Ed., **MEDICAL IMAGING Principles, Detectors, and Electronics**, 978-0-470-39164-8, 1, John Wiley & Sons, 2009

W.R. Hendee, E.R. Ritenour, **Medical Imaging Physics**, 0-471-38226-4, 4, John Wiley & Sons, 2002

N.A. Diakides, J.D. Bronzino, **Medical Infrared Imaging**, 978-0-8493-9027-2, 1, CRC Press, 2007

Recommendations

Subjects that it is recommended to have taken before

Computer Science: computer science for engineering/V12G420V01203
Processing techniques of biomedical signals/V12G420V01911

Contingency plan

Description

In the event that teaching cannot be in person, the activities would be carried out remotely:

GROUP A:
- Group A classes using the virtual campus.

GROUP B:
- Group B activities would focus on student work and tutoring meetings through the virtual campus.

ASSESSMENT:
- The submission of group B works is already done remotely (using moodle as a document delivery place).
- The final evaluation test is DESIRABLE to be done in person but it can be done online combining faitic and virtual campus.