Universidad Rey Juan Carlos

TEACHING GUIDE

MEDICAL IMAGE ANALYSIS

GRADO EN INGENIERÍA BIOMÉDICA (INGLÉS) (3º y 4º curso) (2374)

ACADEMIC YEAR 2026-27

Q2803011B UNIVERSIDAD REY JUAN CARLOS
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I.-Subject Identification	
Type	OBLIGATORIA
Teaching period	4 course, 1Q semester
Nº of credits	6
Language in wich the subject is taught	English

II.-Presentation

Medical image analysis enables obtaining quantitative information from multimodal medical imaging studies, and has become a basic tool for diagnosis, therapy planning and patient follow-up.
In this course we will start by learning the features of the digital images that are obtained from each medical imaging modality, as well as the storage formats used in medicine.
From here, we will learn the different techniques for image processing and analysis, to be able to choose the optimal technique for each clinical problem.

III.-Learning outcomes

CG01 . Analyze and synthesize problems related to biomedical engineering, solve them and communicate them efficiently.
CG02. Use computational and experimental tools for the analysis and quantification of biomedical engineering problems
CE08. Know and understand the principles of analysis and treatment of biomedical images.
CE09. Use state-of-the-art methods in digital signal processing, especially of medical signals, and perform the necessary mathematical and statistical calculations to propose and make the required modifications in the signal processing techniques
CE10. Use state-of-the-art methods in digital image processing, especially of medical images, and perform the necessary mathematical and statistical calculations to propose and make the required modifications in image processing.

- Key for degrees not adapted to RD 822/21: **CB** - basic competences, **CG** - generic competences, **CE** - specific competences, **CT** - transversal competences.
- Key for degrees adapted to RD 822/21: **CON** - knowledge, **COM** - competences, **HAB** - skills.

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IV.-Contents

IV.A.-Syllabus

Chapter 1. Introduction to medical images: Modalities and image formats.
Chapter 2. Medical imaging formats and medical image analysis software .
Chapter 3. Techniques for medical image filtering and enhancement.
Chapter 4. Medical image segmentation.
Chapter 5. Image registration.
Chapter 6. Deep Learning in medical imaging.
Chapter 7. Image analysis methods assessment.

IV.B.-Training activities

Type	Title
Oral presentations	Project Presentations
Group work	Final group: Complete medical imaging project
Theoretical sessions	Theoretical lectures on the fundamentals of medical image analysis
Experimental and/or technological laboratories	Lab sessions on practical medical image analysis projects
Resolution of exercises, problems, case studies	Solving practical exercises in the class

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V.-Student workload	
Theoretical sessions	28
Resolution of exercises, problems, case studies, etc.	12
Practical sessions in experimental, technological and clinical laboratories, fieldwork, etc.	16
Tests and/or exams	4
Academic tutorials	30
Related activities: conferences, seminars, etc.	18
Preparation of theoretical sessions and self-study	28
Preparation of practical tasks, exercises, case studies, projects, etc.	28
Preparation for tests and/or exams	16
Total student workload	180

VI.-Methodology and academic programme		
Type	**Period**	**Content**
Theoretical sessions	Week 1 to Week 15	In-depth explanation of every topic.
Practical sessions	Week 1 to Week 15	Development of 4 practical assignments associated with Topics 3, 4, 6 and 7. A report of each of them will have to be uploaded to the Virtual Classroom. All these activities will take place in the laboratories, in which the activities to be performed will be explained and developed.
Academic tutorials	Week 1 to Week 15	Analysis, resolution and in-depth analysis of selected topics.
Group work	Week 1 to Week 15	Design and implementation of medical image analysis solutions. This activity will be done in groups of several students throughout the course, having to deliver a final written report through Virtual Classroom and a final on-site presentation. This activity will be explained and followed by teaching staff through several on-site sessions.

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VII.-Assessment methods

The general assessment method is continuous as established in the *Regulation for the Assessment of Learning Outcomes* of Rey Juan Carlos University.
All the assessment systems established in the degree report must be employed, except for those that have a minimum weight of 0%, which can be used by professors in the academic years they consider relevant. Each assessment system may be applied through one or more assessment activities, consistent with the system. No assessment activity can exceed individually 60% of the overall grade for the subject.
The sum of non re-evaluable activities cannot exceed 40% of the overall grade for the subject and, in general, should not have an established minimum grade (except for practical activities in which, strictly speaking, the conditions of the ordinary call cannot be reproduced in the extraordinary call).
Those students who do not manage to pass the subject in the ordinary call, or do not attend this first call, may attend the extraordinary call only for failed re-evaluable assessment activities.
The distribution and characteristics of the assessment activities are described below.

VII.A.-Description and weight of the assessment activities

During the course there will be 4 laboratory assignments and a final project in which the student will solve a specific medical imaging problem.
The evaluation will include **a midterm and a final exam covering the material of the course**, as well as the evaluation of of **practical assignments** and final **project**, **taking place on the dates indicated in the Official Call**. The contribution of each of these parts to the total grade will be as follows:
Ordinary and Extraordinary Calls: Midterm: 30%. To be carried out on the date indicated at the beginning of the course. It will cover the first part of the syllabus and could be retaken in the extraordinary call.
Final: 30%. To be carried out on the date indicated in the Official Call. It will cover the second part of the syllabus and could be retaken in the extraordinary call.
Lab assignments: 20%. There will 4 lab assignments, each contributing 5% of the total grade. They will be graded directly on the submissions uploaded to the Virtual Classroom. Labs cannot be resubmitted in the extraordinary call.
Final project (presentation + written report): 20%. They will be graded jointly on the final presentation and on the written delivery uploaded to the Virtual Classroom. Projects cannot be resubmitted in the extraordinary call.
In both calls, to pass the course, the weighted sum or the grades obtained for each item must be higher or equal to 5 points. Also, in both cases, **it is required that the grades obtained for the midterm and final exams are, at least 5 points each. In both calls, the exams will take place on the dates indicated in the Ordinary/Extraordinary calls, and the midterm date will be anounced at the beginning of the course.**
Call for Advanced Assessment (Convocatoria Adelantada): It will be ruled by Article 19 of the Regulations for the Reglamento de Evaluación de los Resultados de Aprendizaje de la Universidad Rey Juan Carlos , approved on June 12, 2024. The evaluation method that will be used in this call will be the same as that described for the Ordinary and Extraoordinary Calls.
Artificial intelligence-based tools can enhance the learning experience, but they must be used in an ethical, legal, honest, and transparent manner. For this reason, the recommendations for appropriate use provided by the course instructors must be followed.
The use of generative AI (Gen-AI) in an evaluation activity can lead to a reduction in the grade of that activity.

VII.B. Assessment of students with academic exemption from class attendance

Having Academic Exemption from Class Attendance (DAAC) does not imply that students are automatically exempt from participating in the continuous assessment activities or in the training activities of compulsory attendance as established in the teaching guide. Once the exemption has been granted, students must contact the subject's teaching staff, who will propose the adaptations he/she may consider relevant, as long as they guarantee the acquisition and adequate assessment of the learning goals established. Students must maintain adequate communication with the teaching staff so that they may provide information on the dates for training and assessment activities, if these are not established in the programme and available for students at the time of achieving the exemption.
Subject with possibility of academic exemption: Yes.

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VII.C. Review of assessment activities

In accordance with the Regulation for the Assessment of Learning Outcomes of Rey Juan Carlos University.

VII.D.-Students with a disability or special educational needs

In order to guarantee equal opportunities, non-discrimination, universal accessibility and academic success, students with disabilities or especial education needs may request curricular adaptations to follow their studies. These adaptations will be provided by the Unit of Attention to People with Disabilities of Rey Juan Carlos University, in accordance with the regulation which regulates the service for the Attention of People with Disabilities at the University. This Unit will issue a report for curricular adaptations, so that students with disabilities or special education needs must contact the service (at e-mail discapacidad.programa@urjc.es) in order to provide relevant information for different educational alternatives.

VII.E.-Academic behaviour, academic integrity and honesty

Rey Juan Carlos University is fully committed to the highest standards of academic integrity and honesty, so studying at the URJC means assuming and subscribing to the values of integrity and academic honesty set out in the University's Ethical Code. To support this process, the University has Rey Juan Carlos University's Academic Conduct Regulation as well as different tools (anti-plagiarism, supervision...) that offer a collective guarantee for the full development of these essential values.

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VIII.-Teaching resources and materials
Basic bibliography
Medical Image Analysis. A volume in The MICCAI Society. Editors: Alejandro Frangi, Jerry Prince, Milan Sonka. 2023, Elsevier. ISBN: 9780128136577. eBook ISBN: 9780128136584 Medical Image Analysis. Special issue on the 20th anniversary of the Medical Image Analysis journal. Vol. 33, Elsevier, 2016. Image Processing and Acquisition using Python. Chityala R., Pudipeddi S. Chapmand and Hall, 2014. Image Processing, Analysis and Machine Vision. Sonka M., Hlavac V., Boyle R. Cengage Learning, 2014.
Consultation bibliography

IX.-Professors	
Name and surname	ÁNGEL TORRADO CARVAJAL
E-mail address	angel.torrado@urjc.es
Department	Matemática Aplicada, Ciencia e Ingeniería de los Materiales y Tecnología Electrónica
Campus	Fuenlabrada
Category	Titular de Universidad
Academic degree	Doctor
Person responsible for the subject	No
Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico
Number of quinquennia	1
Number of sexennia	2
No. of positive evaluations by Docentia	2
Name and surname	LAURA MARTÍNEZ MATEU
E-mail address	laura.martinez.mateu@urjc.es
Department	Teoría de la Señal y Comunicaciones y Sistemas Telemáticos y Computación
Campus	Fuenlabrada
Category	Profesor/a Permanente Laboral
Academic degree	Doctor
Person responsible for the subject	No
Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico

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Number of quinquennia	1
Number of sexennia	1
No. of positive evaluations by Docentia	2
Name and surname	NORBERTO ANTONIO MALPICA GONZÁLEZ
E-mail address	norberto.malpica@urjc.es
Department	Matemática Aplicada, Ciencia e Ingeniería de los Materiales y Tecnología Electrónica
Campus	Fuenlabrada
Category	Catedrático/a de Universidad
Academic degree	Doctor
Person responsible for the subject	Yes
Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico
Number of quinquennia	4
Number of sexennia	4
No. of positive evaluations by Docentia	5

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