Universidad Rey Juan Carlos

TEACHING GUIDE

DIGITAL SYSTEMS AND MICROPROCESSORS

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	3 course, 2Q semester
Nº of credits	3
Language in wich the subject is taught	English

II.-Presentation

This course expands on the skills previously acquired in the field of digital electronics, addressing sequential digital systems, which depend on time and a digital memory. Sequential digital circuits, including bistables, memories, registers and counters, are described and design techniques using state diagrams are presented. Digital design tools and programmable and configurable electronic devices are described and used, in particular microcontrollers using the Arduino platform, or FPGAs programmed using VHDL. The use of different types of sensors in the design of analog and digital electronic systems is described.
The course is oriented to practical activities, where the necessary theoretical concepts are used to help solve real design problems where different types of sensors and electronic devices can be used to achieve a solution according to the proposed objective.

Recommended previous knowledge: Analog and digital electronics, digital combinational circuits.

III.-Learning outcomes

CG01 . Analyze and synthesize problems related to biomedical engineering, solve them and communicate them efficiently.
CG07. Work in a multidisciplinary group of engineers and biomedical scientists.
CE01 . Understand or acquire the principles of bioelectrical fundamentals, anatomy, physiology or pathophysiology needed to identify the most appropriate processing technologies for a given problem in biomedical engineering
CE21 . Extract biomedical data from its environment, including knowledge of medical consultation systems, and information standards in medical equipment.

- 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

The external practices 1 (Clinical practice) are carried out in two sections:

- **Basic Clinical Practice in Biomedical Engineerin**g. In the internships for each service or unit, the clinical and technical staff of the service provide students with the necessary training to understand the equipment, technology, and information available in that service.
- **Specialized Clinical Practices in Biomedical Engineering.** The second phase of the clinical practice will consist of a specialized rotation, i.e., each student will develop a project in one of the areas they have visited. Its objective will be to define and carry out a project in one of the medical areas visited, which identifies a need that can be addressed from any of the knowledge subjects studied in the degree. The work methodology will be established by the teaching staff of the clinical practice and by the medical areas. This methodology will include interaction with the clinical staff, both for the definition of the problem to be solved and for the clinical evaluation of the results obtained, and with the hospital technical staff (service in question, information systems) to identify the sources of information available, when applicable.

A clear deliverable shall be defined to be evaluated at the end of the clinical practice, which may be, for example:

- A report including the results obtained after data analysis, signals or medical images; a study of need; or a feasibility study, among others.
- A prototype of code of some kind (toolbox, application, analysis tool; others).
- An electronic prototype.
- Any other that allows its evaluation as a contribution of biomedical engineering to the health system.

IV.B.-Training activities

Type	Title
Clínicos	Clinical practice
Other activities	Seminars

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V.-Student workload	
Theoretical sessions	30
Resolution of exercises, problems, case studies, etc.	26
Practical sessions in experimental, technological and clinical laboratories, fieldwork, etc.	0
Tests and/or exams	4
Academic tutorials	8
Related activities: conferences, seminars, etc.	40
Preparation of theoretical sessions and self-study	15
Preparation of practical tasks, exercises, case studies, projects, etc.	42
Preparation for tests and/or exams	15
Total student workload	180

VI.-Methodology and academic programme

Type	Period	Content
Theoretical sessions	Week 1 to Week 13	Master classes
Resolution of exercises, problems, case studies	Week 1 to Week 13	Presentation of case studies to illustrate the theory
Group work	Week 1 to Week 13	Students, working in groups of four, will develop a project throughout the Challenge-Based Learning course.
Academic tutorials	Week 1 to Week 13	Students may request tutorials as needed, both to resolve questions about the course content and to follow up on group work.
Tests and/or exams	Week 14 to Week 15	Oral presentation of work.

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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

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The course is assessed based on the following five activities:

1. **Assignment based on a proposed challenge.** In the first week of the course, a challenge will be presented on which a group of four students must work throughout the semester. As part of their work, they must produce a portfolio that, at a minimum, must include: a concept map developed in class during the last session of Block I, and an expanded version of this map completed at the end of the course; a document for which a template with instructions on structure, format, and scope will be provided, explaining the group's analyses and proposals; and a poster summarizing all of the above. The assessment of this assignment will account for 15% of the final grade. If the assignment does not reach the minimum score of 5 out of 10, the group will receive feedback to improve it and resubmit it during the resit period.
2. **Five submissions for each of the in-person practical activities**, accounting for 15% of the final grade (0.03% per submission). Attendance at 80% of the practical activities is mandatory. In the case of unjustified absence from more than 20% of the practical sessions, the student will be required to take a written exam related to the content of the course's case study during the extraordinary exam, which will account for 15% of the final grade.
3. **Oral presentation of the group assignment**, delivered during the final class sessions, in which each team member's participation will be assessed individually. This activity will account for 10% of the final grade, is non-recoverable, and has no minimum passing mark.
4. **Theoretical exam.** At the end of the course, a theoretical test will be held covering questions from the entire syllabus, including some that may arise during the final sessions in which groups present their work. This activity accounts for 50% of the final grade, but a minimum score of 4/10 must be obtained in order for it to be averaged with the rest. It is recoverable during the resit period under the same conditions.
5. **Individual written exam on the group assignment.** This test will account for 10% of the final grade and requires a minimum score of 5 out of 10. It will include questions related to the group assignment to assess whether students have acquired the expected competencies during its development. It is recoverable during the resit period under the same conditions.

The following table summarizes the above information:

Assessment Systems	Activity	Nature	Type	Minimum grade	Weighting	Period	Content
SE02	Written exam	Individual	Revaluable	4	50%	Regular and extraordinary assessment period	Written test related to the theoretical content of the course
SE02	Written exam	Individual	Revaluable	5	10%	Regular and extraordinary assessment period	Written test related to the contents of the practical case study for the course.
SE03	Oral test	Individual	Non revaluable	No	10%	Week 14 – Week 15	Oral presentation of the work on the practical case study for the course.
SE04	Preparation of scientific-technical document	Group	Revaluable	5	15%	Week 14 – Week 15 and extraordinary assessment period	Group work related to the practical case study for the course
SE04	Preparation of scientific-technical document	Group	Revaluable	5	15%	Week 1 – Week 15 and extraordinary assessment period	5 submissions in each of the in-person practical activities

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.

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.

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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
Oppenheim, A. V., Willsky, A. S., & Nawab, S. H. (1997). *Signals & systems*. Pearson Education.
Oppenheim, A. V., & Schafer, R. W. (2009). Discrete-time signal processing (3rd ed.). Pearson Education.
Consultation bibliography

IX.-Professors	
Name and surname	DAFNE LOZANO PAREDES
E-mail address	dafne.lozanop@urjc.es
Department	Teoría de la Señal y Comunicaciones y Sistemas Telemáticos y Computación
Campus	Fuenlabrada
Category	Investigador
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	0
Number of sexennia	0
No. of positive evaluations by Docentia	0
Name and surname	ENRIQUE FEITO CASARES
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Department	Teoría de la Señal y Comunicaciones y Sistemas Telemáticos y Computación
Campus	Fuenlabrada
Category	Investigador
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	0
Number of sexennia	0
No. of positive evaluations by Docentia	0

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Name and surname	SARA GARCÍA DE VILLA
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Department	Teoría de la Señal y Comunicaciones y Sistemas Telemáticos y Computación
Campus	Fuenlabrada
Category	Profesor/a Ayudante Doctor/a
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	0
Number of sexennia	1
No. of positive evaluations by Docentia	1

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