Universidad Rey Juan Carlos

TEACHING GUIDE

Mathematical Methods in Biomedical Engineering

GRADO EN INGENIERÍA BIOMÉDICA (INGLÉS) (1º y 2º curso) (2384)

ACADEMIC YEAR 2026-27

Q2803011B UNIVERSIDAD REY JUAN CARLOS
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I.-Subject Identification	
Type	FORMACIÓN BÁSICA
Teaching period	2 course, 2Q semester
Nº of credits	6
Language in wich the subject is taught	English

II.-Presentation

Circuit Theory is fundamental knowledge for biomedical engineers. Understanding circuit theory allows biomedical engineers to analyze biological signals, and work collaboratively with many other disciplines such as electronics and communications. This subject introduces the theory of circuits, presenting the active and passive components of electrical circuits, along with techniques for analyzing circuits under direct current (DC) and sinusoidal steady state conditions.
Previous knowledge: To take this subject it is necessary to have completed the subjects Mathematics I and Mathematics II. Especially, it is necessary for the student to master the algebra of complex numbers, linear systems and basic concepts of trigonometry.

III.-Learning outcomes

COM16. Ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical ¿societal, health and safety, environmental, economic and industrial ¿ constraints. (EURACE 2.2)
COM19. Laboratory
CON18. Understand the basic concepts of: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differen-tial equations, numerical methods, numerical algorithms, statistics, and optimization.
CON20. Knowledge and understanding of the mathematics, computation and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes. (EURACE 1.1)
CON23. Understanding of applicable techniques and methods of analysis, design and investigation and of their limitations in their field of study. (EURACE 5.1)
HAB03. Ability to solve mathematical problems that may arise in engineering. Proficiency in applying knowledge of linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differential equations, numerical methods, numerical algorithms, statistics, and optimization.
HAB17. Ability to analyse complex engineering products, processes and systems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to correctly interpret the outcomes of such analyses. (EU-RACE 2.1)

- 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

Topic 1. "Fundamentals of sequential logic. Bistable devices".
1.1- Concept of sequential circuit. Synchronous and asynchronous systems.
1.2- Asynchronous bistables.
1.3- Synchronous bistables.
1.4- Conversions between bistables.

Topic 2. Registers and counters. Registers and counters.
2.1- Concept of registers and types of registers.
2.2- Synchronous and asynchronous counters. Design and implementation.

Topic 3. Finite state automata. State machines (Mealy and Moore).
3.1- Concept of state machine or automaton. Classification: Moore machines and Mealy machines.
3.2- Design of Moore and Mealy machines.

Topic 4. Design of practical applications with Microcontrollers and FPGAs.
4.1- Introduction to Microprocessors and Microcontrollers. Architecture, core, input and output ports.
4.2- Introduction to FPGAs. Architecture, core, input and output ports.
4.3- Programming languages for programmable logic devices, Basic design of combinational and sequential circuits with Arduino and VHDL.
4.4- Design of basic electronic applications with Arduino, Sensors and FPGAs.

IV.B.-Training activities

Type	Title
Experimental and/or technological laboratories	AF7. Laboratory practices. The scripts of the programming practices of applications on microcontrollers (Arduino) and on FPGA (using VHDL language) will be available in the Virtual Campus of the course. They are intended to introduce the basics of microcontroller management, as well as VHDL through the realization of applications that take advantage of the peripherals of the development boards, through projects that will be carried out through the laboratory sessions.
Lectures	AF1. Theoretical classes on blackboard or with presentation, encouraging active participation.
Academic tutorials	AF2. Problem solving by the students under the supervision of the teacher. Exercises of analysis/design of digital circuits proposed by the teacher and to be solved autonomously by the student.
Realización de Pruebas	AF9. Individual or group completion of a laboratory project for each topic studied.

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V.-Student workload	
Theoretical sessions	0
Resolution of exercises, problems, case studies, etc.	0
Practical sessions in experimental, technological and clinical laboratories, fieldwork, etc.	230
Tests and/or exams	0
Academic tutorials	2
Related activities: conferences, seminars, etc.	0
Preparation of theoretical sessions and self-study	13
Preparation of practical tasks, exercises, case studies, projects, etc.	25
Preparation for tests and/or exams	0
Total student workload	270

VI.-Methodology and academic programme		
Type	**Period**	**Content**
Week 1 to Week 15	Seminarios de orientación de las rotaciones básicas	Week 1 to Week 15

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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

In the evaluation of Exteran Practices I (Clinical Practices), the following items will be considered:
- General aspects. Assiduity and punctuality in attending the service will be assessed, as well as the interest shown by the student during the internship.
- Interpersonal communication. Effective and clear communication with health professionals will be assessed.

- **Clinical/technical skills**. The acquisition of clinical and technical knowledge will be assessed. The evaluation will be made using the following system:
- Attendance to rotations in different medical areas/services: 5 %.
- Test with questions related to the concepts shown in the areas visited during the basic clinical practice: 30%.
- **Assessment of a report and a presentation of the work carried out in the specialized clinical practice**: 65%.

Attendance is mandatory. Up to a maximum of 20% absence will be accepted, provided that it is duly justified and as determined by the teacher in charge. If the number of absences exceeds 20%, they must be made up at another time of the year (evenings, weekends, holidays) after agreeing with those responsible for the subject and the clinical staff in charge of the clinical practice. If the rotation cannot be completed before the end of the course, due to good reasons (e.g., illness), if the teacher/tutor agrees, it can be rotated during the summer

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: No.

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
Those indicated as supportive material on each clinical practice
Consultation bibliography

IX.-Professors	
Name and surname	ANA MARÍA DE PABLO HERMIDA
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Department	Especialidades Médicas y Salud Pública
Campus	Fuenlabrada
Category	Profesor/a Asociado/a CC Salud (Vinc.)
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	0
No. of positive evaluations by Docentia	0
Name and surname	ÁNGELA SANTANA VALENCIANO
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Campus	Fuenlabrada
Category	Professional
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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Campus	Fuenlabrada
Category	Profesor/a Asociado/a CC Salud (Vinc.)
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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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 sexennia	1
No. of positive evaluations by Docentia	0
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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	2
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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	0
No. of positive evaluations by Docentia	0
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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	0

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No. of positive evaluations by Docentia	0
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Tutorial timetable	Para consultar las tutorias póngase en contacto con el/la profesor/a a través de correo electrónico
Number of quinquennia	3
Number of sexennia	3
No. of positive evaluations by Docentia	1
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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	1
No. of positive evaluations by Docentia	1
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Category	Catedrático/a 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
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Number of sexennia	4
No. of positive evaluations by Docentia	6
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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 sexennia	0
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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	0
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No. of positive evaluations by Docentia	0
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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	5
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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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No. of positive evaluations by Docentia	0
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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 sexennia	1
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Number of quinquennia	0
Number of sexennia	0
No. of positive evaluations by Docentia	0
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Number of sexennia	0
No. of positive evaluations by Docentia	0
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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 sexennia	0
No. of positive evaluations by Docentia	0
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Person responsible for the subject	No
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Number of quinquennia	0
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No. of positive evaluations by Docentia	0
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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 sexennia	2
No. of positive evaluations by Docentia	3
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Number of quinquennia	2
Number of sexennia	2
No. of positive evaluations by Docentia	3
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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	2
Number of sexennia	2
No. of positive evaluations by Docentia	2

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