Universidad Rey Juan Carlos

TEACHING GUIDE

BIOMEDICAL INFORMATION TRANSMISSION AND CODING SYSTEMS

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, 1Q semester
Nº of credits	6
Language in wich the subject is taught	English

II.-Presentation

The goal of the course is that the student understands the main concepts of current communications systems in the hospital environment and sanitary, as well as the usual quantification and coding techniques in voice, audio, image and video processing.

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
CE07. Know and understand the principles of signals and biomedical systems in discrete time.
CE08. Know and understand the principles of analysis and treatment of biomedical images.
CE11. Identify, use and adapt telecommunication technologies that offer reasonable solutions to biomedical engineering problems
CE13 .Build, operate and manage telecommunication services and applications in biomedical engineering, understood them as systems for capturing, coding, transporting, representing, processing, storing, reproducing, managing and presenting multimedia information.
CE19. Use the fundamentals of programming for the development of computer programs in modern programming languages, as well as to understand and use different operating systems, databases and hospital information systems. To apply them in networks, systems and telematic services for hospital management.

- 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

PART 1 - Transmission of Biomedical Information

1. Introduction to biomedical data.
- Generation and processing of the transmitted signals
- Examples of applications to biomedical data

2. Transmission lines and propagation.
- Guided transmission media waves guided along a physical path)
- Antennas and propagation
- Examples of applications to biomedical data

3. Modulations and quality of service (QoS).
- Digital Modulations
- Quality of service
- Binary regime and channel capacity
- Probability of bit error and channel coding
- Delay in communications
- Quality in biomedical datasets

4. Communications networks.
- MAC access
- Multiplexing, Switching and Routed
- Examples of applications to biomedical data

PART 2 - Coding and Compression of Biomedical Information

1. Introduction to Coding and Compression.
- Generation and capture of sounds and images
- Digitization of audio and video signals
- Elements of channel coding and source coding: basic theory, algorithms and differences.
- Examples and applications

2. Signal compression.
- Introduction to the compression theory with and without loss.
- Compression algorithms: Huffman coding (and its variants), arithmetic coding and other entropic algorithms
- An example compression wih loss: methods for clustering and segmentation.
- Examples and different applications

3. Brief introduction to voice, audio (MPEG-audio and Dolby systems) and video (H26x and MPEGx).
- Waveform encoder
- Parametric encoder
- Hybrid encoder

IV.B.-Training activities

Type	Title
Resolution of exercises, problems, case studies	Laboratory/practice related to the theory
Theoretical sessions	Masterclasses

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V.-Student workload	
Theoretical sessions	24
Resolution of exercises, problems, case studies, etc.	16
Practical sessions in experimental, technological and clinical laboratories, fieldwork, etc.	14
Tests and/or exams	6
Academic tutorials	18
Related activities: conferences, seminars, etc.	30
Preparation of theoretical sessions and self-study	14
Preparation of practical tasks, exercises, case studies, projects, etc.	30
Preparation for tests and/or exams	28
Total student workload	180

VI.-Methodology and academic programme

Type	Period	Content
Theoretical sessions	Week 1 to Week 35	Teaching classes
Academic tutorials	Week 1 to Week 35	Solving questions
Experimental and/or technological laboratories	Week 1 to Week 35	Labaratories/Practices (classes)
Theoretical sessions	Week 1 to Week 35	Lectures are provided to the students, in the classroom, time is used for activities to discuss and analyze the content among the students, while the teacher guides and provides support
Tests and/or exams	Week 1 to Week 35	Exams

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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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Ordinary Evaluation:
- PE1 = Partial Exam 1
Minimum Mark = 5.0 over 10
Weight = 35%
- PE2 = Partial Exam 2
Minimum Mark = 5.0 over 10
Weight = 35%
- D1 = Deliveries Part 1
Weight = 10%
Minimum Mark = 3.0 over 10
- D2 = Deliveries Part 2
Weight = 10%
Minimum Mark = 3.0 over 10
- D3 = Deliveries Part 3
Weight = 10%
Minimum Mark = 3.0 over 10

FINAL MARK = 0,35 * PE1 + 0,35 * PE2 + 0,10 * D1 + 0,10 * D2 + 0,10 * D3

REQUIREMENTS in order to approve the course:
- Mark EP1 bigger or equal to 5
- Mark EP2 bigger or equal to 5
- Mark D1 bigger or equal to 3
- Mark D2 bigger or equal to 3
- Mark D3 bigger or equal to 3
- The FINAL MARK must be bigger or equal to 5

In all the period of evaluation (including the revision of the exams and/or the deliveries), The Professors can require an additional oral exam that can vary the final mark.

Re-Evaluation (extrordinary examination call):

The re-evaluation will follow the same structure. An exam with two blocks that cover the Partial Exam 1 and the Partial Exam 2 and three deliveries that can be re-evaluated.
- PE1 = Partial Exam 1
Minimum Mark = 5.0 over 10
Weight = 40%
- PE2 = Partial Exam 2
Minimum Mark = 5.0 over 10
Weight = 40%
- D1 = Deliveries Part 1
Weight = 10%
- D2 = Deliveries Part 2
Weight = 10%

FINAL MARK = 0,35 * PE1 + 0,35 * PE2 + 0,10 * D1 + 0,10 * D2 + 0,10 * D3

REQUIREMENTS in order to approve the course:
- Mark EP1 bigger or equal to 5
- Mark EP2 bigger or equal to 5
- The FINAL MARK must be bigger or equal to 5

Advance Exam Call:

If an early exam call for this subject is requested and granted, the evaluation will follow the same rules as the regular exam call.

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

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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.

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
Multimedia Signal Coding and Transmission", (Jens-Rainer Ohm, Springer-Verlag Berlin Heidelberg). Digital Communications (John G. Proakis y Masoud Salehi, McGraw-Hill Higher Education, 5.ª edición, 2008). Communication Systems Engineering (John G. Proakis y Masoud Salehi, Prentice Hall, 2.ª edición, 2002). Digital Communications: Fundamentals and Applications (Bernard Sklar y Fred Harris, Pearson, 3.ª edición). Communication Systems: An Introduction to Signals and Noise in Electrical Communication (A. Bruce Carlson, Paul B. Crilly y Janet C. Rutledge, McGraw-Hill, 4.ª edición, 2002). Elements of Information Theory (Thomas M. Cover y Joy A. Thomas, John Wiley & Sons, 2.ª edición, 2006).
Consultation bibliography

IX.-Professors	
Name and surname	ANTONIO FERNÁNDEZ CABALLERO
E-mail address	antonio.fcaballero@urjc.es
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	0
Name and surname	LEOPOLDO CARRO CALVO
E-mail address	leopoldo.carro@urjc.es
Department	Teoría de la Señal y Comunicaciones y Sistemas Telemáticos y Computación
Campus	Fuenlabrada
Category	Titular de Universidad
Academic degree	Doctor
Person responsible for the subject	Yes

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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	1
Number of sexennia	2
No. of positive evaluations by Docentia	2

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