



**Universidad de Jaén**

School of Engineering of Linares

## Digital Transmission

2024-2025

Grado en Ingeniería Telemática

Grado en Ingeniería de Tecnologías de Telecomunicación

Doble Grado en Ingeniería de Tecnologías de Telecomunicación e Ingeniería de Telemática



CREA



Acceso Mayores 40

Guías docentes UJA

Horarios de tutorías

Llamamientos PAU

Movilidad (Coordinador)

P.O.D.

Solicitud bilingüismo

## Syllabus 2024-25 - 14312026 - Digital Transmission (Transmisión digital)

### Caption

- Level 1: Tutorial support sessions, materials and exams in this language
- Level 2: Tutorial support sessions, materials, exams and seminars in this language
- Level 3: Tutorial support sessions, materials, exams, seminars and regular lectures in this language

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Full version (Spanish)

English

DEGREE:

Grado en Ingeniería de telecomunicación (14312026)

FACULTY:

SCHOOL OF ENGINEERING OF LINARES

DEGREE:

Doble Grado Ing. de tecnologías de la telecomunicación e Ing. telemática (15212010)

FACULTY:

SCHOOL OF ENGINEERING OF LINARES

DEGREE:

Grado en Ingeniería telemática (14512022)

FACULTY:

SCHOOL OF ENGINEERING OF LINARES

ACADEMIC YEAR:

2024-25

COURSE:

Digital Transmission

### SYLLABUS

#### 1. COURSE BASIC INFORMATION

NAME: Digital Transmission

CODE: 14312026 (\*)

ACADEMIC YEAR: 2024-25

LANGUAGE: English

LEVEL: 2

ECTS CREDITS: 6.0

YEAR: 2

SEMESTER: SC

#### 2. LECTURER BASIC INFORMATION

NAME: DE LA TORRE CRUZ, JUAN

DEPARTMENT: U134 - INGENIERÍA DE TELECOMUNICACIÓN

FIELD OF STUDY: 800 - TEORÍA DE LA SEÑAL Y COMUNICACIONES

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LANGUAGE: English

LEVEL: 2

NAME: MARTÍNEZ MUÑOZ, DAMIÁN

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LANGUAGE: English

LEVEL: 2

#### 3. CONTENT DESCRIPTION

The theoretical contents are structured in three thematic blocks with the following topics: introduction to digital transmission systems, quantization, waveform channel coding, structured sequence channel coding, linear block codes, convolutional codes, multiplexing and multiple access and spread spectrum techniques. Besides, students will develop skills in communicating information, ideas, problems and solutions in the field of engineering and society in general through documentation delivery processes or oral presentations.

The practical contents are structured in the following activities: laboratory practices, problem resolution and seminars. Additionally, students develop skills in communicating information, ideas, problems and solutions in the field of engineering and society in general through the process of delivering documentation or oral presentations. With respect to the organisation of work, collaboration and teamwork will be encouraged.

The theoretical and practical contents provide students with the knowledge and understanding necessary to address the competences and learning outcomes in this subject, as well as the necessary level to acquire the rest of the competences of the degree where it is necessary to apply the knowledge acquired in this subject.

Note that the contents taught in this subject will provide students with the ability to be updated in relation to the latest developments in science and technology, especially in this kind of issues, so closely linked to such a dynamic environment as telecommunications, and specifically in digital communications. Indicate that this subject will be focused on promoting quality teaching (Quality Education) with a focus on activities that promote inclusive and equitable learning (Sustainable Development Goals, SDG-4).

Next, the Units of the subject are detailed in the following sections:

## **THEORY AND PROBLEM LECTURES:**

### **THEMATIC BLOCK I: INTRODUCTION TO DIGITAL TRANSMISSION SYSTEMS AND FORMATTING**

#### **UNIT 1: INTRODUCTION TO DIGITAL TRANSMISSION SYSTEMS**

- 1.1 Signal classification.
- 1.2 Spectral Density.
- 1.3 Autocorrelation.
- 1.4 Random signals.
- 1.5 Signal Transmission through Linear Systems.
- 1.6 Bandwidth
- 1.7 The Digital Transmission System.
- 1.8 Classification of Digital Transmission Systems.

#### **UNIT 2: QUANTIZATION**

- 2.1 Introduction to quantization.
- 2.2 Classification quantizers.
- 2.3 Quantization error.
- 2.4 Uniform quantization.
- 2.5 Non-uniform quantization.
- 2.6 Adaptive Quantization.
- 2.7 Vector quantization.

### **THEMATIC BLOCK II: CHANNEL CODING**

#### **UNIT 3: WAVEFORM CHANNEL CODING**

- 3.1 Antipodal signals.
- 3.2 Orthogonal signals
- 3.3 Waveform coding system.
- 3.4 Orthogonal codes.
- 3.5 Biorthogonal codes.
- 3.6 Simplex codes.
- 3.7 Conclusions

#### **UNIT 4: STRUCTURED SEQUENCE CHANNEL CODING**

- 4.1 Introduction.
- 4.2 Types of error control.
- 4.3 Structured sequence.
- 4.4 Coding rate and redundancy.
- 4.5 Channel models
- 4.6 Basic examples of codes with parity check.
- 4.7 Coding gain

#### **UNIT 5: LINEAR BLOCK CODES.**

- 5.1 Introduction.
- 5.2 Algebraic approximation to the block codes.
- 5.3 Generator matrix.
- 5.4 Parity check matrix and syndrome concept.
- 5.5 Error detection and correction.
- 5.6 Well-known linear codes
- 5.7 Cyclic Codes
- 5.8 Burst Error Detection and Correction

#### **UNIT 6: CONVOLUTIONAL CODES**

- 6.1 Introduction.
- 6.2 Convolutional Coding.
- 6.3 Representation of a convolutional encoder.
- 6.4 Convolutional decoding algorithms and Viterbi Algorithm.
- 6.5 Error detection and correction with convolutional codes.
- 6.6 Concatenated and interleaved codes.

### **THEMATIC BLOCK III: MULTIPLE ACCESS TECHNIQUES AND INTERFERENCE PROTECTION**

#### **UNIT 7: MULTIPLEXING AND MULTIPLE ACCESS**

- 7.1 Introduction.
- 7.2 Frequency Division Multiplexing/Frequency Division Multiple Access (FDM/FDMA).
- 7.3 Time Division Multiplexing/Time Division Multiple Access (TDM/TDMA).
- 7.4 Comparison between FDM/FDMA and TDM/TDMA.
- 7.5 Code Division Multiplexing/Code Division Multiple Access (CDM/CDMA).

#### **UNIT 8: SPREAD SPECTRUM TECHNIQUES**

- 8.1 Introduction.

- 8.2 Characteristics of Spread Spectrum techniques.
- 8.3 Pseudo-random sequences.
- 8.4 Direct Sequence Spread Spectrum (DSSS) Systems.
- 8.5 Frequency Hopping Spread Spectrum (FHSS) System.
- 8.6 Synchronisation
- 8.7 Applications of Spread Spectrum Techniques.

#### **PRACTICE LECTURES:**

The practical part of the course consists of laboratory sessions, which are obligatory.

The goal of the proposed practices is the acquisition of the established competences. Additionally, students will develop skills in communicating information, ideas, problems and solutions in the field of engineering and society in general through the process of delivering documentation or oral presentations.

With regard to the organisation of work, collaboration and teamwork will be encouraged.

The practical contents are described below:

##### **Practice 1. Basic functions with MATLAB.**

- Generation of signals typically used in communication systems.
- Calculation and representation of the autocorrelation function, power or energy spectrum.
- Signal parameters.
- Vector product.

##### **Practice 2. Quantization.**

- Implementation of a uniform quantizer.
- Characterisation of the performance of the uniform quantizer according to its parameters (dynamic range, number of bits).
- Granular and overload error.
- Dependence of the signal-to-noise ratio according to the input signal.

##### **Practice 3. Channel Coding**

- Simulation of a digital transmission system with channel encoder.
- Assessment of the error rate in noisy channels.
- Use of interleaver/de-interleaver.

##### **Practice 4. Simulation of a complete digital transmission system**

- This last practice will combine the different practices that have been performed throughout the course, in order to provide a global view of the functionality of a digital transmission system.

#### **SEMINARS:**

##### **Seminar I. MATLAB programming review**

- Review and consolidate concepts related to the MATLAB programming language and its programming environment necessary to perform the practical sessions of the course.

##### **Seminar II. Entropic coding**

- Basic concepts information theory.
- Discrete memoryless source coding.
- Statistical redundancy reduction codes.

## **4. COURSE DESCRIPTION AND TEACHING METHODOLOGY**

The development of large group and small group lectures will be focused on promoting quality teaching by giving priority to activities that foster inclusive and equitable learning (Quality education, SDG-4). This subject also contributes to the sustainable development objectives (SDG-9) industry, innovation and infrastructure.

### **A1 - Lectures with large group of students**

The methodology to be followed in large group lectures will be a mixture of introductory activities, lectures and the presentation of theory and general examples in the classroom assigned for the subject by the University. Additionally to the exposition of the theoretical contents of the subject, the ability to collect and interpret data and handle complex concepts within Telecommunication Technologies Engineering and Telematics Engineering will be developed and strengthened, in order to emit judgements that imply reflection on ethical and social issues.

Students must follow the lecturer's presentation with the material provided for this purpose, whether notes or slides, which must be completed with their own notes and with the subsequent review of the basic and/or recommended bibliography.

Attendance, as well as the active, respectful and responsible participation, either to raise doubts or to respond to the professor's requests or questions, may be evaluated positively in its corresponding factor as the professor deems appropriate.

The autonomous student work should focus on the revision of the concepts and theoretical aspects seen in class, doing exercises, as well as studying them with the material provided by the professor, the student's notes and bibliography.

Additionally, in the lecture sessions with large groups of students, controls will be performed to supervise the progression and assimilation of the concepts by the students.

The theoretical contents provide students with the knowledge and understanding necessary to address the competences and learning outcomes in this subject, as well as the necessary level to acquire the rest of the competences of the degree where it is necessary to apply the knowledge acquired in this subject.

## A2 - Lectures with small groups

The work in small group classes (small group) will be based primarily on practical activities in the laboratory. The work of the students will focus on the development of the applications or learning tasks designated by the lecturer, resulting in the achievement of the goals set for the practice. Secondly, the small group classes will consist of the resolution of exercises and practical questions of the subject. Finally, seminars will also be held to study relevant and complementary aspects of the subject in depth.

Attendance, as well as active, respectful and responsible participation, either to raise doubts or to respond to the professor's requests or questions, may be evaluated positively in its corresponding factor according to the professor.

With respect to autonomous work, this will focus on continuing the work started in the laboratory on the practicals, seminars and/or problem solving that could not be completed in the corresponding session.

Also, in the small group class sessions, controls will be performed to supervise the progression and assimilation of the concepts by the students.

The practical contents provide students with the necessary knowledge and understanding to address the competences and learning results in this subject, as well as the necessary level to acquire the rest of the competences of the degree where it is necessary to apply the knowledge learned in this subject.

Additionally, work in a collaborative environment will be encouraged, as well as the communication of results, with special emphasis on the need for continuous training in telecommunications-related activities throughout their independent professional life.

## A3 - Collective tutorials

The collective tutorials will be used in the resolution of doubts, monitoring and supervision of the works and exercises in a virtual way through forums or other digital means indicated by the teaching staff as well as in the attendance and participation in different seminars, talks, conferences, workshops and/or or conferences, designated by the teacher, in order to complete and update the training and obtain general, transversal and/or specific skills defined for this activity, such as the value of continuous training, entrepreneurship or the review of technological innovations in the subject.

Attendance in the case of face-to-face activity, as well as active, respectful and responsible participation in the aforementioned activities, will be evaluated according to the provisions of the evaluation system of this guide.

### IMPORTANT NOTE:

1. The use of electronic devices, e.g. smartphones, will not be allowed in class (large group lectures, small group classes and/or collective tutorials) or in global assessment tests or final exam of the subject unless expressly authorised by the professor responsible for the subject for the correct development of the planned activities.

2. Online access will only be allowed to those students who are entitled to it according to the regulations in force.

Students with special educational needs should contact the Student Attention Service (Servicio de Atención y Ayudas al Estudiante) in order to receive the appropriate academic support

## 5. ASSESSMENT METHODOLOGY

At the end of the term the students can choose between two assessment modalities: GLOBAL ASSESSMENT or FINAL EXAM. In both assessment modalities, the use of electronic devices in classes and exams is forbidden except that they are required for the right development of learning activities and always with the authorization of the lecturer.

### GLOBAL ASSESSMENT

The Global Assessment modality will be carried out according to the outcomes of the activities planned in the syllabus and described in the section "Methodology and activities", in addition to those described in the section "Detailed description of the Continuous Assessment" that will be weighted by considering the aspects and percentages detailed in the above table.

The Global assessment modality consists of two parts:

- The work assessment during the term, according to the tasks defined for this purpose.
- The completion of a FINAL EXAM on the day set for the exam during the evaluation period.

The distribution of the weights for each assessable aspect of the two aforementioned parts, and according to the activities described in the table above, is as follows:

Table 1. Weighting of the Global Assessment.

| Aspect                                              | Teaching term | Final exam | Total |
|-----------------------------------------------------|---------------|------------|-------|
| S1<br>Assistance and participation                  | 10%           | -          | 10%   |
| S2<br>Theoretical concepts                          | 15%           | 15%        | 30%   |
| S3<br>Completion of work, study cases and exercises | 15%           | 15%        | 30%   |
| S4<br>Laboratory/ computer practical work           | 30%           |            | 30%   |
| Course<br>Total                                     | 70%           | 30%        | 100%  |

Grades obtained in an aspect during the teaching term in the GLOBAL assessment will be maintained until the end of the academic year.

**Final Exam:** At the end of the term, on the day set for the course within the exam period, there will be a final exam of the theoretical part and exercises of the course (aspects S2 and S3), in which students must demonstrate that they have acquired the competences and learning outcomes established for these aspects. The weight of this exam in the final grade will be 30% of the total, as reflected in the table "Weighting of the Global Assessment", with 15% corresponding to aspect S2 and the other 15% to aspect S3. The specific conditions, as well as the material and/or documentation that may be used in the final exam will be established by the lecturer.

#### Final Assessment

In order to pass the course, students must obtain a grade equal to or higher than 5.0 out of 10 in the overall results considering all the assessed aspects, provided that they have obtained a grade equal to or higher than 4.0 in the final exam and in the laboratory/computer practical part (S4).

Students will have the option of resigning the GLOBAL evaluation, and it will not be possible to return to it once the resignation has been made.

## FINAL EXAM

In the FINAL EXAM modality, an exam will be held on the day set for the course within the exam period, which will cover all the course contents, ensuring that students have acquired the competences and learning outcomes established for the course. The two parts of this written exam are weighed as follows:

- Part 1: Attendance and participation, theoretical concepts and completion of study cases or exercises assignments (S1, S2, and S3): 70%.
- Part 2: Laboratory/ computer practical work (S4): 30%

The specific conditions, as well as the material and/or documentation that may be used in the Final Exam will be established by the lecturer.

In order to pass the course, students must obtain a grade equal to or higher than 5.0 out of 10 in each of the two parts.

Students who have passed the S4 aspect (laboratory/computer practical work) of the course, through GLOBAL ASSESSMENT, with a grade equal to or higher than 5.0 out of 10, will not have to take Part 2 corresponding to this aspect in the exam. The same grade obtained in the GLOBAL ASSESTMENT will be assigned to this part.

The parts passed at each exam attempt will be maintained until the end of the academic year.

## DETAILED DESCRIPTION OF THE GLOBAL ASSESSMENT

For those students whose evaluation is carried out globally, it will be based on monitoring and carrying out the activities included in the four categories presented in the Evaluation System, which make up the total of the evaluable elements of the subject:

- S1, Attendance and participation, 10%.
- S2, Theoretical concepts of matter, 30%.
- S3, Realization of works, cases or exercises, 30%.
- S4, Laboratory/computer practices, 30%.

Each of these blocks will be detailed in the following sections.

### **S1 - Attendance and participation (10%)**

In this section the following competences will be evaluated: CB4, CG9, C4.

The positive evaluation of this section will mean that the student has achieved the following competences or learning outcomes: R5, R14, R24, R25.

This aspect will be assessed considering the attendance to large group, small group and/or collective tutorials, as well as the attendance to other activities organised by the Department of Telecommunication Engineering of the University of Jaén and that are recommended by the professor responsible for the subject. The lack of collaboration in maintaining a good working environment in the classroom or hindering the work, either of the professor or of the students, in any session, will lead to a mark in this section equal to zero.

If there are activities organised by the Department of Telecommunication Engineering and they have been recommended by the professor responsible for the subject, then 75% of the S1 mark will be due to the attendance to large group classes, small group classes and collective tutorials but the remaining 25% will be due to the attendance to all the above mentioned activities organised by the Department of Telecommunication Engineering and previously recommended by the professor responsible for the subject. If there is more than one activity organised and recommended, then each activity will have an equal weight within the 25% of the S1 element.

### **S2 - Theoretical concepts of the subject (30%)**

In this section the following competences will be evaluated: CB4, CG3, CG9, C1, C4, C5.

The positive evaluation of this section will mean that the student has achieved the following competences or learning outcomes: R1, R3, R6, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R25.

The evaluation of the theoretical concepts will be carried out through evaluation tests or controls raised in class by the teacher. These tests will be individual. Its format and content will be communicated to the students before it is carried out, and it may be adapted to the course of the subject, syllabus, availability of classrooms, etc. Each test will be evaluated separately and the student will be able to obtain a grade between 0 and 10 points. The weight of each test in the final evaluation is equal. The score to be obtained will be between 0 and 10, correspondingly extrapolated to the range between 0% and 30%, this resulting value coinciding with the total of the assessment of the section on theoretical concepts of the subject.

### **S3 - Realization of works, cases or exercises (30%)**

In this section the following competences will be evaluated: CB4, CG3, CG9, C1, C4, C5.

The positive evaluation of this section will mean that the student has achieved the following competences or learning outcomes: R1, R3, R6, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R25.

The evaluation of exercises will be carried out through evaluation tests or controls raised in class by the teacher. These tests will be individual. Its format and content will be communicated to the students before it is carried out, and it may be adapted to the course of the subject, syllabus, availability of classrooms, etc. Each test will be evaluated separately and the student will be able to obtain a grade between 0 and 10 points. The weight of each test in the final evaluation is equal. The score to be obtained will be between 0 and 10, correspondingly extrapolated to the range between 0% and 30%, this resulting value coinciding with the total of the assessment of the section on theoretical concepts of the subject. Each test will be evaluated from 0 to 10 and the total grade will be the arithmetic mean of all of them, which will be extrapolated to the range between 0% and 30%.

### **S4 - Laboratory/computer practices (30%)**

In this section the following competences will be evaluated: CB4, CG3, CG9, C1, C4, C5.

The positive evaluation of this section will mean that the student has achieved the following competences or learning outcomes: R1, R3, R4, R5, R6, R14, R15, R16, R17, R18, R19, R20, R21, R22, R23, R24, R25.

The evaluation of the practical concepts will be carried out through evaluation tests or controls raised in class by the teacher. These tests will be individual and/or collective. Its format and content will be communicated to the students before it is carried out, and it may be adapted to the course of the subject, syllabus, availability of classrooms, etc. Each test will be evaluated separately and the student will be able to obtain a grade between 0 and 10 points. The weight of each test in the final evaluation is equal. The score to be obtained will be between 0 and 10, correspondingly extrapolated to the range between 0% and 30%.

## **6. BOOKLIST ([Access the bibliography in the Library catalog](#))**

### **MAIN BOOKLIST:**

- Digital communications: fundamentals and applications. Edition: 2nd ed. Author: Sklar, Bernard. Publisher: Upper Saddle River (New Jersey): Prentice Hall, cop. 2001.
  - **Notes:** Unit 1, 3, 4, 6, 7  
(Library)
- Vector quantization and signal compression. Edition: 8th imp.. Author: Gersho, Allen. Publisher: Boston [etc.]: Kluwer Academic, 2001.

- **Notes:** Unit 2  
(Library)
- Digital transmission theory. Edition: -. Author: Benedetto, Sergio. Publisher: Englewood Cliffs: Prentice Hall International, cop. 1987.
  - **Notes:** Unit 5 y 6  
(Library)
- Error control coding: fundamentals and applications. Edition: -. Author: Lin, Shu. Publisher: Englewood Cliffs: Prentice-Hall, cop. 1983.
  - **Notes:** Unit 3, 4, 5, 6  
(Library)
- Introduction to Digital Audio Coding and Standards. Edition: 1. Author: Bosi, Marina, Goldberg, Richard E. . Publisher: Springer US.
  - **Notes:** Unit 2  
(Library)
- Digital communications . Edition: 2nd ed. Author: Proakis, John G.. Publisher: McGraw-Hill.
  - **Notes:** Unit 1, 5, 6, 7 y 8  
(Library)
- Fundamentals of convolutional coding . Edition: Second edition.. Author: Johannesson, Rolf, 1946-. Publisher: Institute of Electrical and Electronics Engineers.
  - **Notes:** Unit 6  
(Library)

#### ADDITIONAL BOOKLIST:

- Digital transmission of information. Edition: -. Author: Blahut, Richard E.. Publisher: Addison-Wesley.
  - **Notes:** Unit 1, 3, 4, 5, 6  
(Library)
- Modern digital and analog communication systems . Edition: 5ª ed.. Author: Lathi, B.. Publisher: Oxford University Press.
  - **Notes:** Unit 1, 5, 6, 7 y 8  
(Library)
- Channel coding : theory, algorithms, and applications . Edition: 1st ed.. Author: Declercq, David, author.. Publisher: Academic Press.
  - **Notes:** Unit 3, 4, 5, 6  
(Library)
- Introduction to data compression . Edition: -. Author: Sayood, Khalid. Publisher: Morgan Kaufmann.
  - **Notes:** Unit 2  
(Library)
- CDMA: principles of spread spectrum communication . Edition: -. Author: Viterbi, Andrew J.. Publisher: Addison-Wesley.
  - **Notes:** Unit 8  
(Library)

## 7. SUSTAINABLE DEVELOPMENT GOALS

Educación de calidad

Industria, innovación e infraestructura

#### DETAILED INFORMATION

Sustainable Development Goal (SDG) of Quality Education with the subject of Digital Transmission:

Quality Education is a fundamental right and essential for the development of individuals and societies. In the context of Digital Transmission, leveraging modern technologies and innovative educational approaches can significantly improve educational outcomes. This proposal outlines strategies to integrate advancements in digital transmission systems to enhance quality education.

Expected actions:

- Increased enrollment and retention rates in schools due to improved access and quality of education.
- Enhanced learning outcomes through interactive, personalized, and inclusive educational experiences.
- Empowered teachers with access to continuous professional development and collaborative resources.
- Sustainable and scalable educational models leveraging communication technologies.

Integrating advancements in digital transmission systems into the educational framework can significantly contribute to achieving the Sustainable Development Goal of Quality Education. By improving accessibility, content delivery, inclusiveness, and teacher training, we can create a more equitable and effective educational environment for all learners. This proposal not only addresses the immediate needs of quality education but also sets a foundation for continuous improvement and innovation in the education sector through the application of advanced communication technologies.

Sustainable Development Goal (SDG) of Industry, Innovation, and Infrastructure with the subject of Digital Transmission:

The Sustainable Development Goal of Industry, Innovation, and Infrastructure aims to build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation. Digital Transmission plays a pivotal role in achieving these objectives by enabling advanced industrial processes,

supporting innovation, and developing robust infrastructure. This proposal outlines strategies to leverage knowledge on digital transmission systems to enhance industry, innovation, and infrastructure.

#### Expected Actions:

- Improved industrial efficiency and productivity through advanced communication technologies.
- Innovation and research capabilities, leading to the development of new products and processes.
- Sustainable and resilient infrastructure capable of supporting modern industrial needs.
- Inclusive growth of industries, with equitable access to communication technologies for all enterprises.

Leveraging advancements in digital transmission systems is essential for achieving the Sustainable Development Goal of Industry, Innovation, and Infrastructure. By enhancing industrial automation, fostering innovation, developing sustainable infrastructure, and promoting inclusive growth, we can create a robust industrial ecosystem that drives economic development and societal progress.

This proposal outlines a comprehensive approach to integrate communication technologies into industrial practices, ensuring that industries are prepared for the challenges of the future while contributing to sustainable and inclusive development.

## 8. VIRTUAL / CLASSROOM TEACHING SCENARIO

### 1. Teaching methodology and learning activities

| Activities                                 | Format (on-site/online)*                                                                                                                     | Teaching methodology description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A1 - Lectures with large group of students | On-site at 50%                                                                                                                               | <p>Sessions of participative master classes, lasting one or two hours each, held in the classroom and broadcast by videoconference to the rest of the group* (if the technical resources of the classroom allow it).</p> <p>If the technical means of the classroom do not allow it, the large group lectures will be conducted online and broadcast* from the professor's office. Periodic rotation of students.</p> <p>* Only for those students who are not required to attend classes in person.</p>                                                                                                                                                              |
| A2 - Lectures with small groups            | On-site at 50%<br><br>Or, in the case of being able to use a laboratory or classroom that allows full capacity - 20 students -, 100% on-site | <p>Development of practical sessions, lasting two hours each, in the laboratory or classroom.</p> <p>The content taught may be retransmitted by videoconference* if the technical means of the classroom allow it and if the professor considers it appropriate. If the technical means of the classroom or laboratory do not allow it, the small group classes will be conducted online and retransmitted* from the teacher's office.</p> <p>Attendance will depend on the capacity of the laboratory assigned by the Department or the classroom assigned by the University.</p> <p>* Only for those students who are not required to attend classes in person.</p> |

|                          |                    |                                                                                                                                                                                                                                                        |
|--------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A3 - Collective Tutoring | On-site and online | Tutorial sessions, both collective and individual, will be carried out preferably online (synchronous and/or asynchronous). The face-to-face tutoring sessions will be agreed between the person responsible for the subject / group and the students. |
|--------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### Schedule

The schedule can vary mainly due to the change from multi-modal scenario to the online one.

## 2. Evaluation system

There are no changes in the evaluation format (weights of each section) or in what is specified in the detailed evaluation.

As a summary, the following tables are added, detailing the weight and format of the final exam in the modalities of Global Assessment and Single Test:

| Evaluation text              | Format  | Description                                                                                                                                                                                                                                                                                                                                                                                                                       | Percentage                  |
|------------------------------|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Global assessment - End exam | On-site | At the end of the semester there will be a final test of the theoretical part of the subject (S2 and S3), in which the student must demonstrate that they have acquired the skills and learning results established for these aspects. The weight of this test in the final grade will be 50% of each aspect evaluated. The material and / or documentation that can be used in the final test will be authorized by the teacher. | 30%<br>(15% S2 y 15% S3)    |
| Single Test                  | On-site | In the SINGLE TEST modality, there will be an exam that will cover all the contents of the subject, ensuring that the student has acquired the skills and learning results established for it.<br><br>In order to pass the subject, students must obtain a mark equal to or higher than 5.0 out of 10 in each of the two parts of this test.                                                                                      | S1, S2 y S3: 70%<br>S4: 30% |

## 3. Resources

Expository classes in large groups or practice groups at 50%:

### Technical means in the classroom:

- Videoconference infrastructure in the classroom or laboratory consisting of a video and audio capture system for use in a videoconference system or virtual classroom such as Google Meet or BigBlueButton.

### Individual media (students in non-face-to-face format):

- PC or similar equipment and internet connection with sufficient bandwidth to correctly receive both audio and video streamed from the classroom or laboratory.
- Videoconferencing system or virtual classroom: e.g. Google Meet or BigBlueButton.

- Remote access to the assigned laboratory equipment in order to be able to use the practical software if necessary.

#### Common means (teachers and students):

- Use of interactive tools: screen sharing for the use of comments as a virtual blackboard in PDF presentations.
- Use of the teaching platform of the University of Jaén: messaging, forums, tasks, activities and means of evaluation.

Practice groups at 100%:

Given that the attendance in the Classes in practice groups is 100%, no exceptional resources are foreseen for them.

## 9. VIRTUAL TEACHING SCENARIO

### 1. Teaching methodology and learning activities

| Activities                                                                                                                                           | Format (on-site/online)* | Teaching methodology description                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>A1 - Lectures in large group.</p> <p>- Asynchronous lectures based on videos and / or audiovisual content, forums, interactive material, etc.</p> | online                   | <p>The sessions of participative face-to-face classes, of one or two hours each, are replaced by other activities carried out through the Internet such as:</p> <ul style="list-style-type: none"> <li>- Lectures by videoconference or in a virtual classroom.</li> <li>- Visualization of videos with explanation of the theoretical contents.</li> <li>- Review of interactive material on the subject.</li> <li>- Review of content on the Internet (forums, - specialized websites)</li> </ul> |
| A2 - Practical lectures                                                                                                                              | online                   | <p>Practical sessions are replaced by online training activities, lasting two hours each, by other activities carried out through the Internet such as:</p> <ul style="list-style-type: none"> <li>- Virtualized or simulation activities.</li> <li>- Visualization of videos with explanation of the practical contents.</li> <li>- Review of interactive material about practices.</li> <li>- Online content review (forums, specialized websites, etc.)</li> </ul>                               |
| A3 - Collective tutoring                                                                                                                             | online                   | <p>The tutoring sessions, both collective and individual, will be carried out completely in person through online media synchronously and / or asynchronously.</p>                                                                                                                                                                                                                                                                                                                                  |

#### Schedule

The schedule can vary mainly due to the change from multi-modal scenario to the online one.

### 2. Evaluation system

There are no changes in the evaluation format (weights of each section) or in what is specified in the detailed evaluation.

As a summary, the following tables are added, detailing the weight and format of the final exam in the modalities of Global Assessment and Single Test:

| Evaluation text              | Format             | Description                                                                                                                                                                                                                                                                                                                                                                                                                       | Percentage                  |
|------------------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Global assessment - End exam | Synchronous online | At the end of the semester there will be a final test of the theoretical part of the subject (S2 and S3), in which the student must demonstrate that they have acquired the skills and learning results established for these aspects. The weight of this test in the final grade will be 50% of each aspect evaluated. The material and / or documentation that can be used in the final test will be authorized by the teacher. | 30%<br>(15% S2 y 15% S3)    |
| Single Test                  | Synchronous online | In the SINGLE TEST modality, there will be an exam that will cover all the contents of the subject, ensuring that the student has acquired the skills and learning results established for it.<br><br>In order to pass the subject, students must obtain a mark equal to or higher than 5.0 out of 10 in each of the two parts of this test.                                                                                      | S1, S2 y S3: 70%<br>S4: 30% |

The synchronous online exam, both theory-problem (S2-S3) and practical (S4), will be organised in a written evaluation via videoconference. The synchronous online exam will be conducted through the following actions ordered, below, in time:

- One week before the date of the synchronous online exam, at the latest, and following the instructions of the subject responsible, students will communicate to the professor their intention to sit the synchronous online exam in order to facilitate the scheduling of the online assessment.
- Before the day of the exam, the subject responsible will inform each student of the exact time of the oral part of the exam and the link to access the videoconference for both the part related to the theory-problem exam (S2-S3) and the practical exam (S4). Those students who do not give advance notice may receive an appointment for the interview for the days following the date of the exam.
- On the exam date and time established in the academic calendar, the first part of the exam will begin via videoconference. At that time, the person in charge of the subject will distribute the exam paper electronically to each student. The exam sent to each student may be different in content (questions or data) but with similar requirements. The aim is to randomise the distribution of exams among the students whenever possible. This videoconference will be recorded to check the identity of the students. Unless approved by the person in charge of the subject, each student will have an active camera and microphone during the videoconference. The camera must be oriented to check the performance of the exam with the required means. If the student is absent from the videoconference, this may be a reason for expulsion, which will not happen due to mere technical problems.
- Before the maximum time stipulated in the statement, each student will send the photographs, compressed in .zip format or using .pdf, of the solutions he/she has made in relation to the exam received. The student is solely responsible for ensuring the quality of the photos of the solutions. If a photo with the solutions is not of sufficient quality to know perfectly what the student has answered in his/her answer, this question will not be corrected in the evaluation.
- The second part of the exam will consist of a videoconference interview with each student to validate the contents delivered, at the indicated time, with a maximum of 10 minutes. The purpose of these interviews is to corroborate the authorship of the answers given in the first part by means of complementary questions on the assessment test. The final mark for each exercise will depend on both the written test and the interview. This videoconference will be recorded to ensure the quality of the assessment. Unless approved by the person in charge of the subject, each student will have the camera and microphone active during the videoconference.

If, due to technical problems, a student's videoconference cannot be carried out normally, an incident exam will be held in the synchronous online mode.

### 3. Resources

Since all the teaching, either in the exposition lectures in large groups or in the lectures in practical groups, will be taught in a non-face-to-face way or on-site, the following resources will need to be used:

#### Common means (teachers and students):

- PC or similar equipment and internet connection with sufficient bandwidth to correctly receive both the audio and video streamed.

- Videoconferencing system or virtual classroom, such as Google Meet or BigBlueButton.
- Use of interactive tools: screen sharing for use of comments as a virtual whiteboard in PDF presentations.
- Use of the teaching platform of the University of Jaén: messaging, forums, assignments, activities and means of evaluation.
- Remote access to the assigned laboratory equipment in order to be able to use the practice software if necessary.

**IMPORTANT:** in the multimodal and/or virtual scenario, where appropriate, professors involved in teaching reserve the right to deny consent for the recording, publication, retransmission or reproduction of their speech, image, voice and lecture explanations, in the exercise of their educational functions, within the University of Jaén.

## DATA PROTECTION CLAUSE (on line exams)

**Institution in charge of data processing:** Universidad de Jaén, Campus Las Lagunillas, s/n, 23071 Jaén

**Data Protection Delegate:** dpo@ujaen.es

**Purpose:** In accordance with the Universities Law and other national and regional regulations in force, carrying out exams and assessment tests corresponding to the courses students are registered in. In order to avoid frauds while sitting the exam, the exam will be answered using a videoconference system, being able the academic staff of the University of Jaén to compare and contrast the image of the person who is answering the exam with the student's photographic files. Likewise, in order to provide the exam with evidential content for revisions or claims, in accordance with current regulation frameworks, the exam will be recorded and stored.

**Legitimacy:** compliance with legal obligations (Universities Law) and other national and regional regulations currently in force.

**Addressees:** service providers who are the owners of the platforms where the exams are carried out and with whom the University of Jaén has signed the corresponding data access contracts.

**Storage periods:** those established in current in force regulations. In the specific case of exam videoconference recordings, not before the examination records and transcripts are closed or the exam can still be reviewed or challenged.

**Rights:** you can exercise your right of access, amendment, cancellation, opposition, suppression, limitation and portability by sending a letter to the postal or electronic address indicated above. In the event that you consider that your rights have been violated, you may submit a complaint to the Andalusian Council for Transparency and Data Protection [www.ctpdandalucia.es](http://www.ctpdandalucia.es)

## CLASS RECORDING CLAUSE PERSONAL DATA PROTECTION

**Person in charge:** Universidad de Jaén, Paraje Las Lagunillas, s/n; Tel.953 212121; [www.ujaen.es](http://www.ujaen.es)

**Data protection delegate (DPO):** TELEFÓNICA, S.A.U. ; Email: dpo@ujaen.es

**Procedure aim:** To manage proper recordings of teaching sessions with the aim of facilitating learning process under a multimodal and/or online teaching

**Period for record storage:** Images will be kept during legal term according to regulations in force

**Legitimacy:** Data will be managed according to legal regulations (Organic Law 6/2001, December 21, on Universities) and given consent provided by selecting corresponding box in legal admission documents

**Data recipients (transfers or assignments):** Any person allowed to get access to every teaching modality

**Rights:** You may exercise your rights of access, rectification, cancellation, portability, limitation of processing, deletion or, where appropriate, opposition. To exercise these rights, you must submit a written request to the Information, Registration and Electronic Administration Service of the University of Jaén at the address above, or by e-mail to the address above. You must specify which of these rights you are requesting to be satisfied and, at the same time, you must attach a photocopy of your ID card or equivalent identification document. In case you act through a representative, legal or voluntary, you must also provide a document that proves this representation and identification. Likewise, if you consider that your right to personal data protection has been violated, you may file a complaint with the Andalusian Data Protection and Transparency Council [www.ctpdandalucia.es](http://www.ctpdandalucia.es)

