# COURSE DATA

| Data Subject | |
|---|---|
| **Code** | 34798 |
| **Name** | Fundamentals of communications |
| **Cycle** | Grade |
| **ECTS Credits** | 6.0 |
| **Academic year** | 2021 - 2022 |

**Study (s)**

| Degree | Center | Acad. year | Period |
|---|---|---|---|
| 1402 - Degree in Telecommunications Electronic Engineering | School of Engineering | 2 | Second term |

**Subject-matter**

| Degree | Subject-matter | Character |
|---|---|---|
| 1402 - Degree in Telecommunications Electronic Engineering | 10 - Telecommunication signals, systems and services | Obligatory |

**Coordination**

| Name | Department |
|---|---|
| GARCIA OLCINA, RAIMUNDO | 242 - Electronic Engineering |
| MARTOS TORRES, JULIO | 242 - Electronic Engineering |
| TORRES PAIS, JOSE GABRIEL | 242 - Electronic Engineering |

# SUMMARY

The course Fundamentals of Communications is a compulsory subject to be taught quarterly basis in the fourth quarter of the Degree in Electrical Engineering Degree in Telecommunications consisting of a total of 4 credits of classroom (theory and problems) and 2 laboratory credits. This course is intended for students to learn the foundations of electronic communications for later use in the field of telecommunications.

The purpose of this course is to describe the basic fundamentals and techniques used in signal transmission application in communications. It then lays out the basic circuits shown in the process of implementing these techniques, and various commonly used applications in communications.

The course contents are:

**Thematic block I. Introduction and basical concepts. Signals.**

- General considerations on the communication systems.
- Representation of signals in the frequency domain.

**Thematic block II. Modulation of analog signals.**

- Linear modulation.
- Angular modulation.

**Thematic block III. Modulation of digital signals.**

- Digital Modulation.
- Pulse Modulation.

## PREVIOUS KNOWLEDGE

### Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

### Other requirements

It is recommended to have studied the subjects of:

Mathematics
Physics
Circuits and electronic and photonic components

## OUTCOMES

### 1402 - Degree in Telecommunications Electronic Engineering

- R4 - Ability to analyze and specify the fundamental parameters of communication systems.
- R5 - Ability to assess the advantages and drawbacks of different technological alternatives for the deployment and implementation of communications systems, from the point of view of signal space, perturbations and noise and analogue and digital modulation systems.

- R1 - Ability for self-learning of new knowledge and techniques appropriate for the conception, development and exploitation of telecommunications systems and services.
- G3 - Acquisition of the knowledge of the basic and technological subjects that allows students to learn new methods and theories and endows them with the versatility to adapt to new situations.
- G4 - Ability to solve problems with initiative, decision-making and creativity, and to communicate and transmit knowledge, abilities and skills, understanding the ethical and professional responsibility of the activity of a telecommunications technical engineer.
- G5 - Knowledge to carry out measurements, calculations, assessments, evaluations, loss adjustments, studies, reports, task planning, and other analogous work in the specific field of telecommunications.
- G6 - Ability in the handling of specifications, regulations and norms of compulsory compliance.
- R8 - Ability to understand the mechanisms of propagation and transmission of electromagnetic and acoustic waves, and their corresponding transmitting and receiving devices.
- R15 - Understand the standards and regulations of telecommunications in Spain, Europe and Internationally.

## LEARNING OUTCOMES

**Learning Outcomes**

This course allows for the following learning outcomes:

• Be able to analyze and specify the key parameters of a communications system (G3, G5, R4).

• Evaluate the advantages and disadvantages of different technological alternatives for deployment or implementation of communications systems, from the standpoint of signal space, disturbance and noise modulation systems and analog and digital (G3, G4, G5, G6, R5).

• Autonomy in the apprehension of new knowledge and techniques for the design, development or operation of telecommunications systems and services (G4, R1, R15).

• Analysis / design elements of communications from a systemic point of view (G4, G5, G6).

**To acquire skills**

To complement the above results, this subject also to acquire the following skills and social skills:

• Understand units of measurement in communications and the need to understand the process of signal modulation. Know the different modes of signal propagation. Familiar with the terminology associated with electronic noise.

• Know the representation of signals in the frequency domain. Apply Fourier's theorem for the representation of signals.

• Identify the basic techniques for the modulation of analog and digital signals and how to implement them. Determine bandwidth and power of the modulated signal. To compare different modulation techniques.

• Understand the concept of transmission line. Understanding the limitations of the model parameters located. Identify the transient effect on signal propagation in an ideal line. Ditto for the case of steady state.

• Encouraging research, developing the students' ability to analyze new problems with the tools learned.

• In the laboratory, foster teamwork. Teamwork requires cooperation, consensus, conflict resolution and respect for other team members, while requiring an ability to argue and defend one's opinions, from rational criteria and without discrimination of any kind.

• Ability to build a comprehensive and organized written document, as well as the ability to present these results in public. Our students, in their professional future, they must present analysis, studies, reports, etc.. to customers, suppliers, managers, etc.., the drafting and presentation must be clear and concise. This type of social skill is therefore of great importance.

• Ability to obtain adequate information (literature search and online) with which to tackle the analysis, design and verification of a measuring system.

## DESCRIPTION OF CONTENTS

### 1. GENERAL CONCEPTS ABOUT COMMUNICATIONS SYSTEMS

1.1. Historical background.
1.2. Components of a communication system.
1.3. Signal processing for transmission: the concept of modulation.
1.4. Signal transmission: guided and unguided media.
1.5. Example of a telecommunication system: the superheterodyne receiver.
1.6. The electromagnetic spectrum.
1.7. Bulletin of problems.

### 2. SIGNAL REPRESENTATION IN THE DOMAIN FREQUENCY

2.1. Time and frequency analysis of signals.
2.2. Description of signals by Fourier series.
2.2.1. Determination of coefficients.
2.2.2. Parseval's theorem.
2.3. Description of signals by Fourier transforms.
2.3.1. Rayleigh theorem.
2.4. Properties of the Fourier transform.
2.5. Bulletin of problems.

## 3. MODULACIÓN LINEAL

3.1. Fundamentals of linear modulation.
3.1.1. AM. Modulation index. Definition and methods of determination.
3.1.2. Spectrum, power and bandwidth.
3.1.3. DBL BLU. Spectrum, power and bandwidth.
3.1.4. Analysis of a subsystem for generating an AM signal.
3.2. Analysis of a subsystem for generating AM signals.
3.3. AM demodulation: the envelope detector.
3.4. Bulletin of problems.

## 4. ANGULAR MODULATION

4.1. Fundamentals of angle modulation.
4.2. FM frequency modulation.
4.2.1. Spectral Analysis of FM. Cases.
4.2.2. Comparison between linear and angular modulation.
4.2.3. Basic techniques for modulation and demodulation.
4.2.4. FM modulation by VCO. Other FM modulation techniques.
4.3. Phase-locked loops. PLLs.
4.3.1. Linear model of PLL.
4.3.2. Communications applications.
4.4. Bulletin of problems.

## 5. DIGITAL MODULATION

5.1. Basic digital modulation ASK, FSK and BPSK. Spectra.
5.2. M-ary modulations. Constellations.
5.2.1. QPSK and 8-PSK.
5.2.2. QAM modulation.
5.3. Efficiency of digital modulations. Comparison.
5.4. Current applications of digital modulations.
5.5. Bulletin of problems.

## 6. PULSE MODULATION

6.1. Fundamentals of modulation pulses. The Nyquist sampling theorem.
6.2. Encodings PAM, PWM and PPM.
6.3. Pulse coded modulation: PCM. Pulse modulations.
6.4. TDM versus FDM technique. Comparison.
6.5. Bulletin of problems.

## WORKLOAD

| ACTIVITY | Hours | % To be attended |
|---|---|---|
| Theory classes | 30,00 | 100 |
| Laboratory practices | 20,00 | 100 |
| Classroom practices | 10,00 | 100 |
| Development of group work | 10,00 | 0 |
| Development of individual work | 5,00 | 0 |
| Study and independent work | 5,00 | 0 |
| Readings supplementary material | 5,00 | 0 |
| Preparation of evaluation activities | 12,00 | 0 |
| Preparing lectures | 30,00 | 0 |
| Preparation of practical classes and problem | 15,00 | 0 |
| Resolution of case studies | 8,00 | 0 |
| **TOTAL** | **150,00** | |

## TEACHING METHODOLOGY

The development of the course is structured around four themes: the theory and problem solving sessions, tutorials, presentation of evidence of continuous assessment and presentation of technical documentation testing practices.

**Group learning with the teacher** (G3, G4, G5, G6, R4, R5, R15)

The sessions of theory and problems using the model of lecture. In the theoretical sessions the teacher will present the fundamental contents of this subject using the media at their disposal, (presentations, transparencies, blackboard). In the problem sessions, the professor will explain a number of problems-type, through which the student will learn to identify the essential elements of posing and solving problems. They also use the participatory approach to the problem sessions, which is to prioritize the communication between students and student / teacher. To this end, the teacher will advance which day will be devoted to solving problems and what problems could be solved, so that the student can attend these classes with the approach of the problems, but its resolution will be completed in class forming groups of four or five students who then have to go to the blackboard to explain the problem and resolve the doubts that have the other fellow.

**Tutorials** (G3, G4, G5, G6, R1, R4, R5, R15)

The students will have a schedule of tutoring whose purpose is to solve problems, questions, guidance on jobs, etc.. The schedule of these tutorials will be indicated at the beginning of the academic year. They will also have the opportunity to clarify some questions via email or discussion forums by using the tool "Virtual Classroom" which provides the University of Valencia.

**Individual study** (G4, G6, R1)

A voluntary student may submit the resolution of a series of quizzes in total have 7 continuous assessment tests (PEC, one per lesson). These tests are voluntary self-assessment and should be resolved exclusively by students without any help from the teacher.

**Group work with colleagues** (G3, G4, G5, R1, R5)

The practice groups will consist of a maximum of two people, which should be organized for the design, installation and experimental evidence. Each practice will consist of two distinct parts each with an estimated duration of 2 hours. The first part is theoretical and its resolution is required to perform the second part of a purely experimental.

**Teaching materials available** (G3, G4, G5, G6, R1, R4, R5, R15)

To make a success of the teaching methodology described the student has the Virtual Classroom, from the beginning of the academic year, the following documents:

• **Teaching Guide** provides the information elements sufficient to determine what it is intended that the student learns, how it will do, under what conditions and how it will be evaluated.

• **Transparencies** of each course topic.

• **Newsletter problems** in each lesson.

• **The practice outlines** the following structure:

- Objectives.
- Material.
- Prior knowledge.
- Theoretical basis.

Activities and experimental procedure.

## EVALUATION

For the first round, it will be applied the continuous evaluation method. This means that, in addition to the final examination, class and laboratory work will also be evaluated according to the following rules:

1. Student work, up to 2 points, broken down as follows:

1.1. Participation in class, answers questions and solving exercises/tests in class (G3, G4, G5, G6, R4, R15).

1.2. Resolution of tasks deliverables that the professor calls for and other non-classroom-based volunteer work (G3, G4, G5, G6, R1, R5).

2. Continuous assessment of laboratory, up to 3 points. Obtained by:

2.1. The students will answer a test after each laboratory project, to determine the mark for each laboratory project.

2.2. The final mark will be the average of all the laboratory project marks. The unattendance to any of the laboratory sessions will provide a 0 mark for the corresponding laboratory project (G4, G5, R4).

3. Final exam, up to 5 points.

3.1 Exam regarding theoretical and practical issues of the subject (G3, G4, G5, G6, R4, R5).

It will be necessary to obtain at least a mark of 4 on 10 in laboratory and a final exam sections to be evaluated the course in first round.

The final mark will be the sum of the three sections, it must obtain a minimum mark of 5 points on a total of 10 points to pass the course.

For the second round, a final examination will be held regarding the theoretical and practical content taught in the classroom and an additiona exam regarding the work done in in the laboratory.

Both of these exams will have the same percentage as in the first round and it must obtain a mark of 4 on 10 in both of these exams to be evaluated.

The final grade will be given, as in the first round, by the sum of the three sections. It must obtain a minimum mark of 5 points on a total of 10 points to pass the course.

In case of not taking the exam, the corresponding grade will be "Not presented".

In any case, the evaluation system will be subordinate to the Evaluation and Qualification Regulation of the University of Valencia for Masters and Degrees

(https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639).

## REFERENCES

### Basic

- Referencia b1: Sistemas de Comunicaciones Electrónicas. W. Tomasi. Prentice-Hall.
  Referencia b2: Sistemas de Telecomunicación. C. Pérez y otros. Textos Universitarios de la Universidad de Cantabria.
  Referencia b3: Fundamentos y Electrónica de las Comunicaciones. E. Sanchis, coord. Colección manuales nº 72, PUV.

### Additional

- Referencia c1: Sistemas Electrónicos de Comunicaciones. Floyd. Pearson.
  Referencia c2: Electronic Communications for Technicians. T. Wheeler. Prentice-Hall.
  Referencia c3: Texto referencia

## ADDENDUM COVID-19

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

**Contents**

The contents initially included in the teaching guide are maintained.

**Workload and temporary teaching planning**

The different activities described in the teaching guide are maintained with the planned dedication.

The material for the follow-up of the classes of theory/practices allows to continue with the professor of temporary planning so much in days as in schedule, so much if the teaching is face-to-face in the classroom or if it is not.

**Teaching methodology**

In classroom theory and practices, students will tend to have the maximum physical attendance possible, always respecting the sanitary restrictions that limit the capacity of the classrooms as indicated by the competent public health authorities to the estimated percentage of their usual occupation.

Depending on the capacity of the classroom and the number of students enrolled, it may be necessary to distribute the students into two groups. If this situation arises, each group will attend classroom theory and practical sessions with physical presence in the classroom by rotating shifts, thus ensuring compliance with the criteria for occupying spaces.

The rotation system will be established once the actual enrollment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same.

With respect to laboratory practices, attendance at sessions scheduled in the schedule will be totally face-to-face.

Once the actual enrollment data is available and the availability of spaces is known, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaptation to each subject, establishing in said model the specific conditions in which it will be developed teaching the subject.

If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes of the subject, these will be replaced by non-contact sessions following the established schedules.

**Evaluation**

The evaluation system described in the teaching guide of the subject in which the different evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained.

If there is a closure of the facilities for health reasons that affect the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the Universitat de València.

The contribution of each evaluable activity to the final grade for the course will remain unchanged, as established in this guide.

**Bibliography**

The bibliography recommended in the teaching guide.