Universidad de Alcalá

TEACHING GUIDE

Communication Theory

Degree in
Telecommunication Technologies Engineering (GITT)
Telecommunication Systems Engineering (GIST)
Telematics Engineering (GIT)
Electronic Communications Engineering (GIEC)

Universidad de Alcalá

Academic Year 2025/2026

2nd Year - 2nd Semester (GITT+GIST+GIT+GIEC)

Approved by the EPS School Board on June 16th, 2025

TEACHING GUIDE

Course Name:	**Communication Theory**
Code:	**350019 (GITT+GIST+GIT+GIEC)**
Degree in:	**Telecommunication Technologies Engineering (GITT)** **Telecommunication Systems Engineering (GIST)** **Telematics Engineering (GIT)** **Electronic Communications Engineering (GIEC)**
Department and area:	**Teoría de la Señal y Comunicaciones** **Signal Theory and Communications**
Type:	**General (GITT)** **Compulsory (GIST+GIT+GIEC)**
ECTS Credits:	**6.0**
Year and semester:	**2nd Year - 2nd Semester (GITT+GIST+GIT+GIEC)**
Teachers:	See web page of the course
Tutoring schedule:	To be determined on the first class.
Language:	English

1. COURSE SUMMARY

A Communication Theory course intends to show to the students the development and functioning of a complete telecommunications system, starting with the information input at the transmitter, and ending with the reception and interpretation of said information at the receiver. The fundamentals of both analog and digital communication systems will be addressed. For both kinds of communication systems, not only the sort of information to be transmitted will be taken into account, but also how it is actually transmitted, along with the effects of alien impairments on the transmitted signal, such as noise, attenuation or the band limitation of the transmission channel.

This course casts the basic foundations in order to understand any other subsequent course closely related to the Telecommunications domain (Digital Communications, Communication Networks, Mobile Communications, Telecommunication Systems, Optical Communications, and so on).

This course will thus be a basic asset for any telecommunication engineer working in any field related to communications.

To take full advantage and better understanding of the course, it would be convenient for the student to have previous and sound knowledge of the courses of Signal and Systems, and Statistics, taken during the first semester of the second year.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/352/2009:

en_TRU1 - Capacity of analysis and synthesis.

en_TRU4 - Autonomous learning skills.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/352/2009:

en_CT1 - Skills for autonomous learning of new concepts and techniques suitable for the conception, development or commissioning of telecommunication systems and services.

en_CT2 - Ability to use telecommunications and computing aplications (ofimatics, data bases, advanced calculus, project management, visualization, etc) in order to support the exploration and development of nets, services and aplications of telecomunications and electronic.

en_CT4 - Skills for analyze and specify the fundamental parameters of a communications systems.

en_CT5 - Competence to evaluate the advantages and disadvantages of different technological alternatives in order to deploy or implement telecommunication systems, from the point of view of the signal space, perturbations and noise, and of either analog or digital modulation systems.

Learning Outcomes

After succeeding in this subject the students will be able to:

RA1. Knowledge and understanding of the basic concepts and techniques for telecommunications, analog and digital: modulation process, noise, demodulation process. It contributes to the

acquisition of skill en_CT1.

RA2. Ability to perform bibliographical or information searches related to telecommunications. It contributes to the acquisition of skill en_CT1.

RA3. Ability to perform communication systems' computer simulations, in order to support the development and exploitation of networks, services and applications in telecommunications. It contributes to the acquisition of skill en_CT2.

RA4. Ability to analyze and specify the basic parameters of any communication system, along with the ability to develop technical skills in the field of telecommunication technologies, emphasizing the analysis and mathematical characterization of the communication systems. It contributes to the acquisition of skill en_CT4.

RA5. Ability to describe the communication signals in the signal space, and to characterize the perturbations and noise affecting analog or digital modulation systems. It contributes to the acquisition of skill en_CT5.

3. CONTENTS

Contents Blocks	Total number of hours
Block 1. Preliminary concepts Study of a complete communication system, including all possible processing blocks.	• 4 hours
Block 2. Analog modulations Presentation and study of the different analog communication technique. Amplitude and angular modulations. Problems solving.	• 4 hours
Block 3. Effects of noise in analog modulations Noise in communication systems. Effects of noise in analog modulations. Problems solving.	• 2 hours
Block 4. Optimal detection. Signals' geometrical representation. Modulation and detection in Gaussian channels. Error probability calculation. Correlation receiver. Matched filter receiver. Problems solving.	• 16 hours
Block 5. Baseband Digital Transmission Baseband pulse transmission. Pulse amplitude modulations (PAM). Line codes' power spectral density. Intersymbol interference (ISI). Frequency and time zero-ISI conditions. Problems solving	• 14 hours
Block 6. Passband digital transmission. PSK, FSK, MSK, ASK and QAM modulations. Error probabilities for each modulation. Power spectral density in passband signals. Problems solving.	• 18 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	28 hours in large group 28 hours in small group 2 hours for examinations
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

The formative activities that are going to be considered during the teaching process are the following:

1. Theoretical lesson.
2. Problems solving lesson.
3. Lessons focusing on software simulations.
4. Individual or group tutoring.

The theoretical lessons (3 ECTS) are expositive lessons performed using means like the blackboard or adhoc slides. These theoretical lessons will be complemented with examples clarifying the concepts explained.

In these theoretical lessons, the student will acquire the course's specific competences. It is most convenient that the students contribute with their own personal or group effort in order to complement the knowledge presented during the lessons (e.g. particular cases study or of hints made by the teacher).

For the problems solving lessons and software simulations (3 ECTS) the teacher will provide a set of reference problems, and a maximum of 50% of those problems will be selected to be solved during the classes. The teacher will let the students know which problems will be solved during the next lesson, so that the student can try to solve them in advance. The student should strife to solve any doubt that could have arisen when trying to solve the problems.

For a better understanding of the mental procedure followed while solving the problems, it would be convenient that the students themselves in the blackboard, under the teacher's guidance, rather than the opposite, perform the solving process. This will foster the interchange of critical opinions about the resolution process and about the results obtained.

Moreover, **software simulation lessons** guided by the teacher will use didactic equipment or personal computers. The teacher may provide guidelines in advance, so the student can prepare the practical work. During these lessons, the student will be able to compare between the expected theoretical results and the obtained simulated results, and this could lead to a discussion.

In both **individual or group tutoring**, the teacher could solve doubts, or brain storm matters related to the course. The students will have the possibility to establish a more personal relationship, so that they could address questions impossible to discuss in a greater group.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Assessment is a polyedric activity and this section aims to describe only the facet devoted to verify the student's competence acquisition. Provided that the assessment unavoidably modifies the teaching-learning process, we understand that it should favor the student's progressive and continuous study.

Ordinary call

a. Continuous assessment. Consisting on two mid-term tests and a final exam.
b. Final exam assessment. Consisting on one final exam.

Extraordinary call

Consisting on one final exam.

5.2. EVALUATION

EVALUATION CRITERIA

In those written tests, no matter if the student is following regular or extra assessment, the following criteria will be valued:

CE1. Analysis and synthesis ability (TRU1). Autonomous learning ability (TRU4).

CE2. Autonomous ability to learn new concepts and adequate techniques related to Communication Theory (CT1, CT2).

CE3. Ability to analyze and specify basic parameters of baseband or passband communication systems (CT4).

CE4. Ability to represent signals in the signal space to characterize and assess the effect of noise in both analog and digital modulations (CT5).

GRADING TOOLS

Continuous assessment marks will be determined using the following tools:

1. Mid-term test (PEI). Consisting of the resolution of theory applied problems or theoretical questions.
2. Final exam (PEF). Consisting of the resolution of theory applied problems or theoretical questions.

GRADING CRITERIA

For each assessment period and type, grading will follow these criteria:

Regular assessment period, continuous assessment.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Percentage of the student's final grade
TRU1, TRU4, CT1, CT4.	RA1, RA2, RA3, RA4.	CE1, CE3, CE4.	PEI1	30%
TRU1, TRU4, CT1, CT4, CT5.	RA2, RA3, RA4, RA5.	CE1, CE3, CE4.	PEI2	30%
TRU1, TRU4, CT1, CT2, CT4, CT5.	RA1, RA2, RA3, RA4, RA5.	CE1, CE2, CE3, CE4.	PEF	40%

As a general criterion, those students taking at least one mid-term test (PEI) will be considered as presented in the regular assessment period. Students not undergoing any of these mid-term tests will get a 0 grade in that particular test. Structure and timing of these tests will be set at the beginning of the semester.

For those students that prove in the final exam evidences that they have complemented the partially credited competences obtained in the mid-term exams, those competences will be considered achieved in the regular assessment period.

Regular assessment period, final exam assessment

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Percentage of the student's final grade
TRU1, TRU4, CT1, CT2, CT4, CT5.	RA1, RA2, RA3, RA4, RA5.	CE1, CE2, CE3, CE4.	PEF	100%

Extra assessment period.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Percentage of the student's final grade
TRU1, TRU4, CT1, CT2, CT4, CT5.	RA1, RA2, RA3, RA4, RA5.	CE1, CE2, CE3, CE4.	PEF	100%

The teaching-learning methodology and the evaluation process will be adjusted when necessary, with the guidance of the Diversity Support Unit, to apply curricular adaptations for students with specific needs"

6. BIBLIOGRAPHY

6.1. Basic Bibliography

COMMUNICATION SYSTEMS

Author: S. Haykin
Ed.: Wiley

COMMUNICATION SYSTEMS
Author: A.B. Carlson y otros
Ed.: McGraw-Hill

COMMUNICATION SYSTEMS ENGINEERING
Author: J.G. Proakis y otros
Ed.: Prentice Hall

THEORY AND PROBLEMS OF ANALOG AND DIGITAL COMMUNICATIONS
Author: Hwei P. Hsu
Ed.: Schaum's outline series. McGraw-Hill

6.2. Additional Bibliography

COMUNICACIONES DIGITALES.
Autor: A. Artés, F. Pérez y otros
Edita: Prentice Hall

DIGITAL COMMUNICATION
Autor: Bernard Sklar
Edita: Prentice-Hall

PRINCIPLES OF COMMUNICATIONS
Autor: R.E. Ziemer y W.H. Tranter
Edita: Wiley

CONTEMPORARY COMMUNICATION SYSTEMS USING MATLAB
Autor: J.G. Proakis y otros
Edita: Thompson-Brooks/Cole

Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.