COMILLAS
UNIVERSIDAD PONTIFICIA
ICAI ICADE CIHS

Syllabus
2025 - 2026

GENERAL INFORMATION

Data of the subject

Subject name	Fundamentals of Telecommunications
Subject code	DEAC-MSG-512
Mainprogram	Master in Smart Grids
Level	Postgrado Oficial Master
Credits	3,0 ECTS
Type	Optativa
Department	Department of Electronics, Control and Communications
Coordinator	Luis Cucala García

Teacher Information

Teacher

Name	Luis Cucala García
Department	Department of Electronics, Control and Communications
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DESCRIPTION OF THE SUBJECT

Contextualization of the subject

Prerequisites

Students willing to take this course should be familiar with linear algebra, basic probability and statistics, and undergraduate-level programming. Previous experience with MATLAB is also desired although not strictly required.

Course contents

Contents

Theory

BLOCK 1: FUNDAMENTALS OF INFORMATION TRANMISSION

Unit 1. Introduction

1.1 Introduction to the transmission of information

1.2 Divide et impera: OSI Layer stack

1.3 Packet Vs. Circuit switching

Unit 2. Application Layer's Functions

2.1 Main functions for the Application Layer
2.2 HTTP and FTP examples
Unit 3. Transport Layer's Functions
3.1 Connection-Oriented Vs. Non-Connection-Oriented transmissions
3.2 Segmentation and Reassembly
3.3 Flow control: Sliding Window
3.4 Error Control: ARQ, go-back-N, Stop and Wait, and Selective Retransmission
3.5 TCP Vs. UDP
Unit 4. Network Layer's Functions
4.1 Fundamental Routing Functions
4.2 Network Resolution
4.3 IPv4 Vs. IPv6
Unit 5. Medium Access Functions
5.1 ALOHA
5.2 CSMA / CD / CA
Unit 6. Internet Stack
6.1 TCP/IP
6.2 ARP
6.3 Examples for common applications

BLOCK 2: FUNDAMENTALS OF SIGNAL TRANMISSION

Unit 7. Signals and Linear Systems
7.1 Analog Vs. Digital Signals
7.2 Linear Systems
7.3 Fourier Series and Fourier Transform for analog signals
Unit 8. Sampling and Digitalization
8.1 Sampling
8.2 Quantization and Quantization Noise
8.3 Fourier Transform for digital signals
Unit 9. Fundamental Modulation Techniques
9.1 Modulation for analog signals: AM / FM
9.2 Electronic Noise
9.3 Modulation for digital signals: Base-Band and Pass-Band modulations
9.4 Signal-to-Noise Ratio and Bit-Error Rate
Unit 10. Multiplexing Systems
10.1 FDM
10.2 TDM
10.3 CDM

Laboratory

Lab 1. TCP/IP

In this first session, students will user a common software tool when trying to sniff the traffic in a communication network: Wireshark. This tool will be used to analyze the traffic generated in a laboratory LAN.

Lab 2. Matlab for Signal Processing

The aim of this session is that students become familiar with one of the tools that they will be using throughout the course: Matlab. Even if they are already familiar in general with the tool, this session will focus on how it can be used for signal processing thanks to the built-in libraries.

Lab 3. Sampling and Quantization

In the third lab session, students will use the previously acquire skills with Matlab to implement an ideal sampler. They will become familiar with concepts studied in theory such as the aliasing effect and the quantization noise.

Lab 4. Analog Modulation and Spectral Analysis

In the final session, students will leave the abstraction of software tools to perform some electrical experiments on modulation. During this session, the use of the Spectrum Analyzer will be introduced.

EVALUATION AND CRITERIA

The use of AI to produce full assignments or substantial parts thereof, without proper citation of the source or tool used, or without explicit permission in the assignment instructions, will be considered plagiarism and therefore subject to the University's General Regulations.

Grading

Theory will account for 100%, based on a final exam. Lab activities and results will be included in the final exam by means of specfic questions.

Course rules

▪ Class attendance is mandatory according to Article 93 of the General Regulations (Reglamento General) of Comillas Pontifical University and Article 6 of the Academic Rules (Normas Académicas) of the ICAI School of Engineering. Not complying with this requirement may have the following consequences:

- Students who fail to attend more than 15% of the lectures may be denied the right to take the final the regular assessment period.
- Regarding laboratory, absence to more than 15% of the sessions can result in losing the right to take the final exam of the regular assessment period and the retake. Missed sessions must be made up for credit.

▪ Students who commit an irregularity in any graded activity will receive a mark of zero in the activity and disciplinary procedure will follow (cf. Article 168 of the General Regulations (Reglamento General) of Comillas Pontifical University).

AI usage rules

In laboratory activities (including report preparation) and in the group work activity, both face-to-face and distance learning, the use of AI is permitted under the following conditions:

- AI may be used for pre-assignment activities such as brainstorming, outlining, and initial research. This level focuses on the use of AI for planning, synthesizing, and generating ideas, but assessments should emphasize the ability to develop and refine these ideas

independently.

- AI may be used to assist in completing the assignment, including idea generation, feedback, and evaluation. Students should critically evaluate and modify the outcomes suggested by AI, demonstrating their understanding. In all cases, the use of AI must be cited and the sources independently verified by the student.

Paragraphs or entire sections generated entirely by AI will not be accepted. In all other assessed activities, the use of AI is prohibited.

WORK PLAN AND SCHEDULE

Activities	Date of realization	Delivery date
The work plan and schedule will be presented the first day of lesson		

BIBLIOGRAPHY AND RESOURCES

Basic References

- Slides prepared by the lecturer (available in Moodle)
- Discrete-Time Signal Processing (2nd Edition). Oppenheim, Schafer, Buck. Prentice-Hall.
- Digital Signal Processing Handbook. Vijay K. Madisetti, Douglas B. Williams. Chapman & Hall
- Alan V. Oppenheim. Signals and Systems
- J. D. Sherrick. Concepts in Systems and Signals, Prentice-Hall
- Digital & Analog Communication Systems, 7th edition. Leon W. Couch. Prentice Hall