

Course Unit	Telecommunications	Field of study	Telecommunications and Signal Processing
Bachelor in	Electrical and Computers Engineering	School	School of Technology and Management
Academic Year	2025/2026	Year of study	3
Type	Semestral	Semester	2
Level	1-3	ECTS credits	6.0
Code	9112-852-3204-00-25		
Workload (hours)	162	Contact hours	T - TP 30 PL 30 TC - S - E - OT - O -

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) João Paulo Coelho, Rui Vitor Pires Fernandes

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Understand the theoretical fundaments of telecommunications in signal processing, in a transmission oriented perspective.
2. Understand how the transmission between 2 points is possible, identifying the subjacent problems and the techniques that allow its minimization.
3. Identify the components of a telephone network and understand how it works.
4. Understand the mechanisms of signalling and switching (public telephone networks).
5. Describe how the data communication is processed and to identify the preponderant elements that constitute a public telephone network.
6. Describe how the radio and television broadcast systems (analog and digital) work.
7. Understand the operation of wireless networks and satellite systems.
8. Identify the main elements of the wireless networks and have acquired basic knowledge of the techniques used in the transmission, in these networks.

Prerequisites

Before the course unit the learner is expected to be able to:

1. Knowledge in signal representation in the frequency domain (Fourier Transform).
2. Knowledge in Electronics.

Course contents

Transmission channel definition. Modulation systems. Introduction to the information theory. Telephone and Communication Networks. Audio and Video Systems. Wireless and satellite networks.

Course contents (extended version)

1. Transmission channel definition.
 - Time and frequency domain analysis of the transmission channels characteristics.
 - Disruptive effects on transmission channels (non-linearity and temporal dispersion).
2. Modulation systems.
 - Analog modulations: Amplitude (AM, DSB, SSB and VSB), Phase (PM) and frequency (FM). Characteristics
 - Impulse modulation: Impulse Formatting. Sampling Time Division Multiplexing (TDM).
 - Pulse codification modulation - binary PCM. Linear and non-linear quantization.
 - Base band digital transmission: Line codes: requirements, features and implementation.
 - Bit error probability: Symbol and symbol interference definitions. Eye diagram.
 - M-ary codification: symbol and bit error probabilities in M-ary transmission.
 - Digital Modulation: ASK, PSK, FSK, QAM e GMSK (characteristics and properties).
3. Information theory introduction.
 - Information Theory fundamentals. Digital memoryless sources codification.
 - Shannon-Fano and Huffman codes. Coding efficiency. Number and Kraft's inequality.
4. Telephone and Communication Networks.
 - Telephone Communication: Fundamentals. Switching. Routing.
 - POTS - Plain Old Telephone Service. Multiplexing. Telephone traffic: Fundamentals. Blocking.
 - Digital Telephony: Integrated Services Digital Network (ISDN). Digital Subscriber Line (DSL).
 - Data communication: Networks, architectures and switching. Protocols. Public networks, X25.
5. Audio and Video Systems.
 - Audio: Concepts and systems. Analog / digital processing. DAB - Digital Audio Broadcast.
 - Video: Concepts and systems. Television: Fundamentals, evolution, digital television. MPEG standards
6. Wireless and satellite networks
 - Cellular communications Fundamentals. Current systems.
 - GSM, UMTS, DECT and TETRA.
 - Satellite Telecommunications: GPS - Global Positioning System.

Recommended reading

1. Communication Systems, 5th Edition; A. Bruce Carlson, Paul B. Crilly; McGraw-Hill, 2009
2. Digital Telephony, 3rd Edition; Bellamy, J. C. ; John Wiley and Sons, 2000
3. Telecommunications Engineering, 3rd edition; J. Dunlop, D. G. Smith; Stanley Thornes, 1998
4. Video Demystified: A Handbook for the Digital Engineer, 5th Edition; Keith Jack; Newnes - Elsevier Inc. 2007
5. Mobile Communications, 2nd Edition; J. Schiller; Addison-Wesley, 2003

Teaching and learning methods

Lectures: exposure of theoretical concepts using the whiteboard and slides. Lectures and problem-solving: resolution of exercises and implementation of practical exercises in the laboratory. Use of the whiteboard and the laboratory. Non presencial hours: study of the concepts presented, resolution of exercises, clarification of doubts, accompanied implementation of practical works.

Assessment methods

1. Alternative 1 - (Regular, Student Worker) (Final, Supplementary, Special)
 - Practical Work - 50%
 - Final Written Exam - 50%
2. Alternative 2 - (Student Worker) (Special)

Assessment methods

- Final Written Exam - 100%

Language of instruction

Portuguese

Electronic validation

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