

Course Unit	e Unit Telecommunications			Field of study	Telecommunications and Signal Processing	
Bachelor in	Electrical and Computers Engineering			School	School of Technology and Management	
Academic Year	2023/2024	Year of study	2	Level	1-2	ECTS credits 6.0
Туре	Semestral	Semester	2	Code	9112-742-2205-00-23	
Workload (hours)	162	Contact hours	T 30 TP T - Lectures; TP - Lectures a	- PL 30 T	C - S -	- Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s)

João Paulo Coelho

- Learning outcomes and competences
- At the end of the course unit the learner is expected to be able to:

- Understand the course unit the learner is expected to be able to.
 Understand the concepts and physical constraints behind distance communication processes using electrical signals.
 Design stages and electronic circuits for RF amplification, mixing and impedance matching operations.
 Simulate the radiation pattern emitted by antennas using EM software
 Analyze the dynamic behaviour of transmission lines under RF regime.
 Understand the communication process in different types of technologies for information transmission. Namely, mobile, computer and satellite communication processes 5 networks.

Prerequisites

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

- Solve basic linear differential equations.
 Analyze AC and DC circuits.
 Apply the Fourier and Laplace transforms.
 Matlab programming or another equivalent numerical computing language.

Course contents

Electromagnetic waves. Amplification, filtering and mixing of signals. Antennas. Transmission lines. Modulation and demodulation. Digital transmission.

Course contents (extended version)

- 1. Electromagnetic Waves
 - General concepts on waves
 - Maxwell equations and electromagnetic radiation

 - Electromagnetic wave energy
 Standing waves
 Electromagnetic radiation spectrum
 Wireless communication systems
- 2. Antennas
 - Attennas
 Attennation, propagation and polarization
 Actionative and reactive EM fields
 Friis equations and Fresnel region
 Radiation pattern and link budget
 Radio and radar equations
 Attenna impedance
- Antio and radar equations
 Antenna impedance
 Analysis of common antenna types: monopole, dipole and loop
 Emergent technologies: Phase arrays
 Transmission lines
 Reactive elements

 - Transmission lines electrical model
 Reflexion and losses
- Impedance matching
 Amplifiers, Mixers and Oscillators
 Pi model for the MOSFET
 Types of amplifiers

 - Low-noise and power amplifiers
 Types of mixers

 - Double-balanced and ring mixers
 Oscillators and PLL
- 5. Modulation and demodulation Amplitude modulation
- Angle modulation Other modulation techniques: QPSK and QAM
- 6. Digital transmission Formats for digital transmission

 - Line coding
 Case studies: serial, I2C, SPI and IrDA

Recommended reading

- Communication Systems, 5th Edition; A. Bruce Carlson, Paul B. Crilly; McGraw-Hill, 2009
 Digital Telephony, 3rd Edition; Bellamy, J. C.; John Wiley and Sons, 2000
 Telecommunications Engineering, 3rd edition; J. Dunlop, D. G. Smith; Stanley Thornes, 1998
 Mobile Communications, 2nd Edition; J. Schiller; Addison-Wesley, 2003
 Practical Antenna Handbook, 4th Edition, J. J. Carr, McGraw-Hill, 2001

Teaching and learning methods

Theoretical- Practical (TP) classes where the subjects are presented using several audiovisual resources. Laboratory classes where a set of experiments, according to the concepts introduced in the TP classes, will be performed.

Assessment methods

- Alternative 1 (Regular, Student Worker) (Final, Supplementary, Special)

 Practical Work 50% (Laboratory exam to take place in the last week of the semester.)
 Final Written Exam 50% (Written exam to take place on a date and time defined by the school.)

 Alternative 2 (Student Worker) (Final, Supplementary, Special)

 Final Written Exam 50% (Written exam to take place on a date and time defined by the school.)
 Alternative 2 (Student Worker) (Final, Supplementary, Special)

 Final Written Exam 50% (Written exam to take place on a date and time defined by the school.)
 Practical Work 50% (Laboratory examination is to take place simultaneously with the written test.)

Language of instruction

Portuguese

Electronic validation				
João Paulo Coelho	José Augusto de Almeida Pinheiro Carvalho	José Luís Sousa de Magalhaes Lima	José Carlos Rufino Amaro	
19-02-2024	26-02-2024	27-02-2024	02-03-2024	