Escuela Técnica Superior de
Ingenieros de Telecomunicación

International Semester in Telecommunications Engineering
2023/2024

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Courses taught in English in 2023/2024

Area	Acronym	Name	ECTS	Semester[1]	UVa course code
Electronics	DE	Digital Electronics	6	1	45012
Signal Theory & Communications	FML	Fundamentals of Machine Learning	6	1	75097
	ICTA	Information and communications technology in automotive industry	6	1	46675
	WTS	Wireless Telecommunication Systems	6	2	45045
	ISP	Introduction to Signal Processing	6	2	75105
Mathematics	AM	Advanced Mathematics	6	1	45005
	NA	Numerical Algorithms	6	1	45032
Economy	ECO	Introduction to business economics and administration	6	1	45010
Signal Theory, Communications, Telematic Engineering and Electronics	PROJECT[2]	Bachelor's degree final project	6	1 or 2	45036
		Bachelor's degree final project	12	1 or 2	46683 or 46684 or 46680
		Internship	6	1 or 2	45035
		Master's degree final project	12	1 or 2	53817

[1] 1: Autumn (lectures from September 5 to December 22, 2022; exams from January 9 to February 10, 2023)
2: Spring (lectures from February 13 to June 2, 2023; exams from June 5 to June 30, 2023)

[2] PROJECT: students can choose one final project with or without internship, using the appropriate course codes, to make a combination 6, 12 or 18 ECTS.

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Project

Students of the International Semester can do their degree's final project with us. This can imply taking two UVa courses: one of the available bachelor's or master's final project (course codes and different effort in ECTS vary among the programs we offer), optionally complemented by an internship in the research group to make a deeper final project. The project can be taken in any of the two semesters and it is also possible to take it during the full year.

Students will have to develop a project in the area of Telecommunications. Two departments will offer projects to international students: Signal Theory, Communications and Telematic Engineering, and Electronics.

When a student wants to take a project, she/he must contact the ETSIT International Coordinator (IC) (subdireccion.relaciones.tel@uva.es) and send him both a Curriculum Vitae and a list of areas of interest. If the CRI considers that she/he is eligible, the IC will distribute the CV between the different research groups working in the areas suggested by the students. Research groups interested in the students will contact her/him directly and offer different topics for the project. When the student reaches an agreement with the research group, she/he will contact the IC and the research group to confirm the agreement. **This process has to be completed before signing any learning agreement.**

Maximum number of students in each course

The maximum number of admitted student in each course is 20.

English level for students

All students are required a B2 level of English.

Location

Classes will be planned in ETSITs rooms (classroom and laboratories). The project will be taken in the premises of each research group.

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Class schedule

Autumn Semester

	Monday	Tuesday	Wednesday	Thursday	Friday
9h	AM A107	FML A107	ICTA 1L013/1L014	NA A107	AM A107
10h	AM A107	FML A107	ICTA 1L013/1L014	NA A107	AM A107
11h	FML A107	DE A107	ICTA 1L013/1L014	DE 1L020	NA A107/2L001
12h	FML A107	DE A107	ICTA 1L013/1L014	DE 1L020	NA A107/2L001
13h					
14h					
15h					
16h			ECO A107	ECO A107	
17h			ECO A107	ECO A107	
18h					
19h					

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Spring Semester

	Monday	Tuesday	Wednesday	Thursday	Friday
9h			ISP A108	ISP 2L003	
10h			ISP A108	ISP 2L003	
11h					
12h					
13h					
14h					
15h					
16h		WTS A107			
17h		WTS A107			
18h				WTS 2L004-5	
19h				WST 2L004-5	

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Exam schedule

Students have two opportunities to pass the courses. The first (“ordinary” call) will be either a final exam or a set of intermediate exams or reports during the course. The second (“resit”) will always be a final exam or report and will only apply if a student fails in the first call.

Autumn Semester

Course	Ordinary call	Resit
DE	Jan 11, morning & afternoon	Feb 1, morning & afternoon
FML	Interim reports	Final report
AM	Interim exams	Jan 30, afternoon
NA	Jan 19, afternoon	Feb 9, afternoon
ECO	Jan 8, morning	Feb 8, morning
ICTA	Jan 12, morning	Feb 2, morning

Spring Semester

Course	Ordinary call	Resit
WTS	Jun 12, afternoon	Jun 24, afternoon
ISP	Jun 5, afternoon	Jun 19, afternoon

Contact

ETSIT International Coordinator (CRI) is Eduardo Gómez Sánchez: subdireccion.relaciones.tel@uva.es

Courses Syllabus:

Digital Electronics (DE)			
Code number:	45012	Number of ECTS:	6 ECTS
Semester:	Autumn	Language:	English

Lecturer(s) and contact:

- Dr. Luis Alberto Marqués Cuesta (lmarques@ele.uva.es)

Learning goals:

At the end of the course, the student must be able to:

- Know and understand fundamental concepts related to digital electronic circuits.
- Analyze and design (synthesize) basic digital electronic circuits at the logic gate level.
- Understand the differences between logic families and their evolution to the present.
- Choose, among the different types of mass storage systems, those that fit a specific application.
- Use component specification sheets to extract the most relevant data and be able to compare between different alternatives.
- Work in groups to construct digital circuits from basic integrated components, and to use electronic instruments to check and test them.
- Organize, plan and manage laboratory time.
- Communicate, both in writing and orally, the procedure used in the laboratory and the difficulties that may arise.

Contents:

UNIT 1 – FUNDAMENTALS
- 1.1.- Introduction.
- 1.2.- Boolean Algebra.
- 1.3.- Two-variable logic functions. Functional completeness.
- 1.4.- Information coding.
- 1.5.- Minimization of logic functions. Canonical form.

UNIT 2 – LOGIC FAMILIES
- 2.1.- Introduction.
- 2.2.- The MOS transistor.
- 2.3.- The CMOS family.
- 2.4.- Other families. Comparative.

UNIT 3 – COMBINATIONAL CIRCUITS
- 3.1.- Introduction.
- 3.2.- AND-OR design and analysis.
- 3.3.- NAND-NOR design and analysis.
- 3.4.- Hazards.
- Lab session 1 – Implementation of a combinational circuit with logic gates.

UNIT 4 – COMBINATIONAL MODULES
- 4.1.- Introduction.
- 4.2.- Decoder.
- 4.3.- Encoder.
- 4.4.- Code converter.
- 4.5.- Multiplexer.
- 4.6.- Demultiplexer.
- 4.7.- Comparator.

4.8.- Adder.
4.9.- Arithmetic-Logic Unit (ALU).
Lab session 2 – Circuit implementation using combinational modules.
UNIT 5 – LATCHES AND FLIP-FLOPS
5.1.- Introduction.
5.2.- Static latches.
5.3.- Dynamic latches.
5.4.- Flip-flops.
UNIT 6 – SEQUENTIAL CIRCUITS
6.1.- Introduction.
6.2.- Design procedure.
6.3.- Moore and Mealy automata.
Lab session 3 – Implementation of a sequential circuit.
UNIT 7 – SEQUENTIAL MODULES
7.1.- Introduction.
7.2.- Storage registers.
7.3.- Transferring digital information. Buses.
7.4.- Counters.
7.5.- Shift registers.
7.6.- Operational registers.
Lab session 4 – Implementation of a register-based circuit.
UNIT 8 – MEMORIES
8.1.- Introduction.
8.2.- Random access memories.
8.3.- Sequential memories.
Lab session 5 – Final lab exam.

Prerequisites:
None.

Fundamentals of Machine Learning (FML)			
Code number:	75097	Number of ECTS:	6 ECTS
Semester:	Autumn	Language:	English

Lecturer(s) and contact:

- Dr. Miguel Ángel Martín Fernández (migmar@tel.uva.es)
- Dr. Lara del Val Puente (lara.val@uva.es)

Learning goals:

At the end of the course the student must be able to:

- Explain what machine learning is and enumerate the type of machine learning types.
- Describe the basic theory of machine learning and its practical implications in system design.
- Describe and apply various models of supervised and unsupervised machine learning.
- Describe and apply regularization, validation and aggregation techniques in the development of systems based on machine learning.
- Implement systems based on machine learning using Python.

Contents:

LESSON 0: Presentation and introduction to Python

LESSON 1: Introduction to machine learning

LESSON 2: Is it feasible to learn? (First part)

LESSON 3: The linear model: Classification and linear regression

LESSON 4: Is it feasible to learn? (Second part)

LESSON 5: The linear model: Logistic regression

LESSON 6: Regularization

LESSON 7: Validation

LESSON 8: Neural networks

LESSON 9: Support vector machines (SVM)

LESSON 10: Decision trees

LESSON 11: Some aspects to take into account in the design of supervised learning systems

LESSON 12: Clustering

LESSON 13: Dimensionality reduction

LESSON 14: Recommender systems

LESSON 15: Association rules

Prerequisites:

Good knowledge in maths and basic programming skills. Students will need to bring their own laptop.

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Information and communications technology in automotive industry (ICTA)			
Code number:	46675	Number of ECTS:	6 ECTS
Semester:	Autumn	Language:	English

Lecturer(s) and contact:

- Dr. Juan Carlos Aguado Manzano (jaguado@tel.uva.es)
- Dr. Ignacio de Miguel Jiménez (Ignacio.miguel@tel.uva.es)

Learning goals:

At the end of this sections, the student should be able to:

- Use software tools for the analysis and design of commercial devices and ICT (Information and Communication Technologies) applications in vehicles.
- Analyze and decode traces of basic protocols in vehicles.
- Enumerate and describe the most important parameters of the physical layer of the basic protocols in vehicles.
- Enumerate and describe ICT applications and basic services in vehicles.
- Enumerate and describe basic elements of communications in intra-vehicular, inter-vehicular and vehicle to infrastructure communication networks.
- Design and program applications and devices for intra-vehicular communications.
- Use the documentation from OEM to develop and analyze ICT devices and applications in vehicles.

Contents:

1. Introduction to Vehicle Telematics.
2. Intra-Vehicular communications. CAN Bus.
3. Inttroduction to CANoe.
4. Programming in CAPL.
5. CANoe advanced options for emulating whole systems
6. Intra-vehicular communications. Other standards.
7. Design of ECUs.
8. ECU diagnosis.
9. Dataloggers.

Lab:

1. Physical layer of the CAN bus.
2. CAN analysis: IGN signals, TeleAid Info-Call and Volume Control.
3. CAN analysis: Airbag signals.
4. CAN analysis: Real car trace.
5. Sending CAN messages using CANoe.
6. CAPL Program.
7. Captur Electronic Architecture: Controlling Infotainment from CANoe
8. MOST Optical Bus Analyzer.
9. ECU simulation using CANister. Breathalyzer design and development.
10. Datalogger. Diagnostics.

Prerequisites:

This is an intermediate course, intended for learners with a background in computer and electrical engineering. To succeed in this course, you should have the following knowledge prerequisites:

- Intermediate programming experience, preferable in C.

- Familiarity with protocols, communications networks and telematic services.
- Basic use of laboratory equipment, mainly Oscilloscopes.

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Wireless Telecommunication Systems (WTS)			
Code number:	45045	Number of ECTS:	6 ECTS
Semester:	Spring	Language:	English

Lecturer(s) and contact:

- Dr. Ramón de la Rosa Steinz (ramros@tel.uva.es)
- Dr. Alfonso Bahillo Martínez (alfonso.bahillo@uva.es)

Learning goals:
At the end of this sections, the student should be able to:

- Know the options to experiment in the field of the radio amateur operation.
- Work with regulations related to the radio frequency spectrum management.
- Work with specifications related to radio telecommunication systems.
- Identify transmissions with spectrum analysis equipment.
- Connect the basic parameters that characterise a radio frequency system.
- Interpret the technology involved in the radio telecommunication systems.
- Estimate the radio coverage in point-to-point systems.
- Enumerate and describe the communication systems studied.
- Identify the planning requirements in terms of time and resources to develop projects

Contents:

1. AN INTRODUCTION TO RADIO:
   Concept revision. Logarithmic units. The radio frequency spectrum. Radio amateur operation as a way to experiment.
2. ANTENNA SYSTEMS TECHNOLOGY:
   Review of characteristics and parameters defining the antennas. Antenna feeders. Antennas applied to communication systems.
3. RECEIVERS AND TRANSMITTERS:
   Receivers technology. Transmitters technology. Interpreting transceiver wiring diagrams. The evolution of the radio. Software defined radio (SDR).
4. RADIO BROADCASTING:
   Amplitude modulation (AM) radio broadcasting. Frequency modulation (FM) and FM-stereo radio broadcasting. Digital broadcasting: RDS y DAB. Modulating in DAB. OFDM.
5. RADIO LINKS AND SATELLITE COMMUNICATIONS:
   Introduction and satellite orbits. Parameters that influence the communication: the link budget. Types of satellites. Satellites and radio amateur operation. Related modulating schemas: FSK and PSK. Radio links. Coverage estimation with software.
6. CELLULAR TELECOMMUNICATIONS:
   Basic standards. Second generation (2G): GSM, GPRS and EDGE. Modulations related to 2G. MSK, GMSK. Third generation (3G) and subsequent generations. UMTS, LTE, 5G. Modulations related to 3G and subsequent generations. Spread spectrum.
7. SHORT-RANGE WIRELESS DATA COMMUNICATIONS:
   Bluetooth. IEEE 802.11 – ISO/IEC 8802-11 (Wi-Fi). Other technologies.

Prerequisites:
It will be very helpful some basic knowledge about electronics to understand schemas, and ability to

understand the concept of electromagnetic waves and its location in the radio frequency spectrum. For the applied part of the subject, it will be helpful some basic knowledge of the laboratory of electronic instrumentation (oscilloscope, multimeter, function generator), reasonable manual skills and being resourceful to build small prototypes.

Advanced Mathematics (AM)			
Code number:	45005	Number of ECTS:	6 ECTS
Semester:	Autumn	Language:	English

Lecturer(s) and contact:

- Dr. Eduardo Cuesta Montero (eduardo@mat.uva.es)

Learning goals:

At the end of this sections, the student should be able to:

- Manage problems involving complex variable and vector calculus, and differential geometry.
- Solve analytically the most common partial differential equations in physic and engineering .
- Model mathematically a wide range of problems arisen in the degree.
- Discover the relationship between the subjects of the present course and other subjects, in fact the ones related to Telecommunication and Electronic Engineering.
- Use recommended bibliography to assess ideas and results.
- Understand further mathematical models related to Telecommunication and Electronic Engineering.

Contents:

1. CURVES AND SURFACES:
   Parametric curves, geometric curves, and orientation. Parametric surfaces, tangent plane, and orientation. Implicit's and Inverse's Theorem. Implicit curves and surfaces.
2. SCALAR AND VECTOR FIELDS:
   Gradient, equipotential varieties, curl, divergence, and Laplacian. Conservative fields, solenoidal fields, and potentials.
3. LINE INTEGRALS:
   Line integrals for scalar functions. Parametrizing with respect to arc length. Fields along curves. Green's Formula. Simply connected domains, and potentials.
4. SURFACE INTEGRALS:
   Integral in several variables. Surface integration of scalar functions. Parametric surface area. Field flux throughout a surface. Surfaces with oriented border. Stoke's Theorem. Gauss Theorem.
5. INTRODUCTION TO COMPLEX VARIABLE FUNCTIONS:
   Basic properties of complex numbers. Complex variable functions. Geometric representation of elementary functions.
6. HOLOMORPHIC FUNCTIONS:
   Limits and continuity. Holomorphic functions. Cauchy-Riemann's conditions. Geometrical meaning. Elementary holomorphic functions.
7. COMPLEX INTEGRATION:
   Definitions and properties. Relationship with the line integral. Cauchy's Integral Formula. Taylor expansions.
8. POWER EXPANSIONS:
   Sequences and series of complex numbers. Convergence of sequences and series of functions. Integration term by term. Power expansions. Convergence radius. Zero order. Taylor's expansions. Properties of functions defined by power expansions. Analytic functions.

9. LAURENT'S EXPANSIONS:
   Singularity classification. Development of Laurent's expansions.
10. FOURIER EXPANSIONS:
    Representation of functions in terms of Fourier expansions. Convergence and applications.
11. INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS:
    Background in partial differential equations. Eigenvalue Problems and Fourier expansions.
12. SEPARATED VARIABLE METHOD FOR PARTIAL DIFFERENTIAL EQUATIONS:
    General problems statement. Applications to equations of physic mathematic.

Prerequisites:
Some background on Calculus and Linear Algebra is strongly recommended.

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Numerical Algorithms (NA)			
Code number:	45032	Number of ECTS:	6 ECTS
Semester:	Autumn	Language:	English

Lecturer(s) and contact:

- Dr. Eduardo Cuesta Montero (eduardo@mat.uva.es)

Learning goals:
At the end of this sections, the student should be able to:
- Understand limitations of analytical methods and the need for numerical algorithms.
- Understand how computers represent numbers and how these impact mathematical computations on computers.
- Understand how we describe errors and approximations that result from using computers to solve mathematical equations and approximate mathematical functions.
- Learn how to solve a system of linear equations numerically using direct and iterative methods.
- Learn how to solve least-squares problems.
- Understand how to approximate the functions using interpolating polynomials.
- Learn how to solve definite integrals and initial value problems numerically.
- Learn the application of the FFT .
- Know how to solve complex differential problems.
- Demonstrate the applications of numerical techniques to simple problems drawn from telecommunications and electronic engineering fields.

Contents:
1. MATLAB programming.
2. Direct methods for solving of linear systems.
3. Least squares approximation.
4. Iteration: linear and nonlinear.
5. The matrix eigenvalue problem.
6. Lagrangian interpolation.
7. Numerical integration and differentiation.
8. Trigonometric interpolation.
9. Numerical solution to ordinary differential equations.
10. Numerical solution to partial differential equations.

Prerequisites:
Skills on Linear Algebra and Advanced Calculus.

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Introduction to business economics and administration (ECO)			
Code number:	45010	Number of ECTS:	6 ECTS
Semester:	Autumn	Language:	English

Lecturer(s) and contact:

- Dr. Guillermo Aleixandre Mendizabal (galeixandre@uva.es)
- Dr. Juan José Juste Carrión (juan.juste@uva.es)

Learning goals:

At the end of this sections, the student should be able to:

- Apply the basic principles of the economy and the company to the telecommunications sector.
- Identify the different types of companies, market structures, being able to calculate prices and quantities of equilibrium in each one of them.
- Distinguish the types of costs of the companies and their sources of financing.
- Interpret the economic, legal and institutional framework of the company.

Contents:

1. Preliminary concepts in economy.
2. The enterprise and the entrepreneur.
3. Competitive markets in the short term: demand and supply.
4. Production, costs, revenues and business benefits.
5. Firms in the perfect competition market.
6. Firms in non-competitive markets.
7. Project appraisal decisions in the company.
8. Financial statement analysis of the company and business financing.

Prerequisites:

There are no academic preconditions to take this course.

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Introduction to signal processing (ISP)			
Code number:	75105	Number of ECTS:	6 ECTS
Semester:	Spring	Language:	English

Lecturer(s) and contact:

- Dr. Tomasz Pieciak (tpieciak@tel.uva.es)

Learning goals:

At the end of the course, the student will be able to:

- Differentiate signal types and their representations.
- Analyze signals in time, frequency and time-frequency domains.
- Design low- and high-pass digital filters and filter a digital signal (i.e. electrocardiogram).
- Characterize the self-affinity of a biomedical signal.
- Implement own basic digital signal procedures.

Contents:

1. Introduction to signal processing, elementary algebra and mathematical analysis used in signal processing, continuous, discrete and digital signals.
2. Signal representations, sampling and quantization, aliasing.
3. Linear systems, convolution, correlation.
4. Continuous and discrete-time Fourier transform, discrete cosine transform, sliding DFT, coherence, short-time Fourier transform, Fast Fourier Transform (Cooley-Tukey algorithm).
5. Low- and high-pass filters, Finite and Infinite Impulse Response (FIR, IIR) filters design, filtering, parametric windows.
6. Detrended fluctuation analysis (DFA).

Laboratory classes:

1. Sinusoidal signal generation with specific parameters and noise distribution.
2. Implementing own DFT and sliding DFT procedures.
3. Implementing own low- and high-pass filter design procedures.
4. Implementing own linear convolution procedure, filtering electrocardiogram signal.
5. Implementing own short-time Fourier transform with an application to biomedical signals.
6. Implementing own FFT procedure (Cooley-Tukey algorithm).
7. Implementing own DFA procedure with an application to heart rate analysis.

Prerequisites:

Basic knowledge in algebra and mathematical analysis, basic programming skills. Students will need to bring their own laptop.