

CAMPUS EUROPAE
ENGINEERING COMMITTEE

UNIVERSIDAD AUTONOMA DE MADRID
COMPUTER ENGINEERING

Credit system:

- In our credit system, **1 credit** refers to **10 hours** carried out collectively in the classroom and/or the laboratory (lectures, exercises, laboratory activities);
- Each year is equivalent about 75 ECTS credits

Number of years of the degree and intermediate titles (Bachelor, Master, etc)

- **“Ingeniero Superior”** degree equivalent to the **Bachelor + Master** degree: 4 years;
- In most of the Spanish universities there are a 3 year degree called “Ingeniero Tecnico”. Nowadays, the “Ingeniero Superior” is a five year degree (over 350 credits) in most of the Spanish schools.

Year	Obligatory credits	At choice credits	Total
1	75	0	75
2	61	14	75
3	47	28	75
4	33	42	75

Year 1st and 2nd is named the *first cycle*, whereas 3rd and 4th year are part of the *second cycle*.
The subject at choice are marked as (OP) mining optional.

Types of examination in each subject

Four types of examination depending on the nature of the subject can be stated:

- **Written examination:** Exercises and/or to answer to theoretical questions in a written way. The legal allocated time is 3 hours.
- **Oral examination:** Short exercises and practical aspects in front of the computer. The allocated time varies from 5 to 10 minutes depending on the subject.
- **Project:** A short project related to a software/hardware implementation. The project duration is near 2 months.

Areas of excellence of your school

The areas of excellence are:

- **Area of Languages and Computer Systems**
Object Oriented Software.
User Interfaces.
Internet technology.
Speech recognition.

- **Area of Computer Science and Artificial Intelligence.**
Neural Networks.
Neurocomputation.
Pattern Recognition.

- **Area of Computer Architecture.**
Microelectronic: SiO₂, Si₃N₄, SiO_xN_y, CSi, amorphous Si, CdTe, NbLi.
High Speed Digital Design. FPGAs. VHDL.
Microprocessors / DSPs / Robotics.
Internet technology.

Describe if different specialization roadmaps exists in your degree (eg: Telematic, Robotic, etc)

- There is not a programmed specialization. Students can select optional courses related to:
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- **Languages and Computer Systems.**
- **Computer Science and Artificial Intelligence.**
- **Computer Architecture.**

PROGRAM DESCRIPTION COMPUTER ENGINEERING DEGREE

Subject	Semester	Year	Credits	Description	Bibliography
Algebra 1	1	1	7.5	Set theory, the Z and Z+ rings, The R[x] and C[x] rings, elementary theory of groups, vector spaces.	
Mathematical Analysis 1	1	1	7.5	Function of one variable, limits and continuity, differentiation, Integration, Series	
Physics 1	1	1	7.5	Oscillatory movement and waves, electrostatics, electric current, conductors and dielectrics: condensers, magnetic field, magnetic induction, transitory state in electric circuits, alternate current circuits.	
General Informatics 1	1	1	7.5	General concepts, evolution of the computer science, operating systems, data representation, data manipulation, hardware (CPU, memories, peripheral), networks.	- A. Prieto, A. Lloris, J. C. Torres. Introducción a la Informática (2ª Ed). - P.-A. Goupille. Introduction to Computer Hardware and Data. - A. Santodomingo. Introducción a la informática en la empresa.
Methodology and Technology of the Programming 1	1	1	7.5	Introduction to the programming, basic Programming in Pascal, programming methodologies, advanced data structures, engineering of the Software, Introduction to the language C, Laboratory.	- D. Cooper. Oh! Pascal!, 3rd. Ed. - S. Leestma and L. Nyhoff. Programación en Pascal, 4a ed. - B. W. Kernighan and D. M. Ritchie. The C Programming Language, 2nd Ed.
Algebra 2	2	1	7.5	Linear Applications, determinant, systems of lineal equations, eigenvalues and eigenvector, Euclidean spaces and quadratic forms.	
Mathematical Analysis 2	2	1	7.5	Function of several variables, differentiation, integration of functions of two variables, and three variables, Integration of line and surface	
Physics 2	2	1	7.5	Circuit analysis (current, tension, power), Maxwell equations, quantum mechanics, physics of semiconductors, the P-N union, introduction to the electronic devices	
Data and Information Structure 1	2	1	7.5	Introduction to the software development, advanced Topics of C, Introduction to the abstract data types, the heap abstract data type, the queue abstract data type, the list abstract data type, recurrence, the binary tree abstract data type, ordination Algorithms	
Structure and Technology of Computers 1	2	1	7.5	numeration systems: binary code, Boolean algebra, logical functions, basic digital circuits, flip-flop, registers and sequential circuits, arithmetic circuits, memory circuits (ram, rom, prom, pld and fpga), controllers, architecture of computers.	- J. Hayes. Introducción al Diseño Lógico Digital. - T.L.Floyd. Fundamentos de Sistemas Digitales. - C. Roth. Fundamental of Logic Design - J. Velasco, J. Otero. Problemas de Sistemas Electrónicos Digitales. - H. Taub. Circuitos digitales y microprocesadores. - J. Wakerly. Diseño Digital. Principios y Practicas..
Methodology and Technology of the Programming 2	1	2	7.5	Introduction to the Analysis of Algorithms, ordination Algorithms, search Algorithms, selection Problems and opponent's strategies, Numeric Algorithms.	- Aho, Hopcroft, Ullman. Design and analysis of computer algorithms - Base. Computer algorithms - Cormen, Leiserson, Rivest. Introduction to algorithms - Sedgwick. Algorithms in C - Weiss. Data structures and algorithm analysis in C.

Structure and Technology of Computers 2	1	2	7.5	Processor based Systems, the 8086 microprocessor, programming in assembler language, Hardware of the 8086, Technique of input-output programming, peripheral programming, software resources of the PC, the PC screen, disk storage, the 80286 and 80386 microprocessor. Laboratory	Yu-Cheng-Liu, Glenn Gibson. Arquitectura, programación y diseño de sistemas basados en microprocesadores M.A.Rodríguez. 8088-8086/8077. Programación en ensamblador J.M Angulo. Microprocesadores 8086,80286,80386
Electronic	1	2	7	Analysis of lineal nets invariables in the time, circuit analysis with time dependent excitements, circuits with diodes, circuits with bipolar transistors, circuits with field effect transistors, differential and operational amplifiers, analogical-digital conversion (A/D) and digital-analogical (D/A), logical families, VLSI technology, VLSI design introduction.	- Schilling, Belove. Circuitos electrónicos: discretos e integrados - Nilsson. Electric circuits - Millman, Grabel. Microelectrónica - E. Muqoz. Circuitos Electrónicos - Savant,Roden,Carpenter. Diseño Electrónico
Discrete mathematics	1	2	7.5	Combinatorial Enumerate (count, list, set), graph theory and algorithms, recurrence, generating function	- Bender-Williamson. Foundations and Applied Combinatorics - Grimaldi. Matemáticas Discreta y Combinatoria - Ross-Wright. Matemáticas Discretas - Tucker. Applied Combinatorics - Graham-Knuth-Patashnik: 'Concrete Mathematics' - Wilson. Introducción a la Teoría de Grafos - Biggs. Discrete Mathematics
General Economics (op)	1	2	7	Economy, economic activity Indicators. money market, work market, public sector, external sector, European Union.	
Operating systems	2	2	7.5	Introduction, processes, communication among processes, memory administration, file systems, input-output, blocking, security, case study: UNIX.	- Tanenbaum. Sistemas Operativos Modernos - Silverschatz, Peterson and Galvin. Sistemas Operativos: Conceptos Fundamentales
Data and Information Structure 2	2	2	7.5	Graph algorithms (representation, searches, cycles, minimum spanning trees), external files (organization and access costs, compression of files, B and B+ Trees, Hashing)	- Folk, M y Zoellick, B. File structures - Cormen, Leiserson, Rivest. Introduction to algorithms
Automata theory and Formal Languages I	2	2	9	Introduction (regular expressions, grammars), finite automata and regular languages, stack automata and context free languages, Turing machines and recursive languages.	- Alfonseca, M., Sancho, J. y Martínez, M. Teoría de lenguajes, gramáticas y Automatas' - Linz, P. An introduction to Formal Languages and Automata
Statistics	2	2	7.5	Probability, random variables, Independence of random variables, the law of large numbers and central limit theorem, parametric estimation, Contrast hypothesis, introduction to the regression models	- DeGroot, M.H. Probabilidad y Estadística. - Mendenhall, Scheaffer, and Wackerly. Mathematical Statistics with Applications. - Ross, S.M. Probability and Statistics for Engineers and Scientists. - Trivedi, K.S. Probability and Statistics with Reliability, Queuing and Computer Science Applications.
Economics in business (op)	2	2	7	First approach to the company, administration - accounting, investment - financing, production - provisioning, sales - marketing, human resources	
Computers Architecture and Engineering	1	3	9	Computers design foundations, the memory system, processors pipeline, reduced instructions set computers (risc), instruction level parallelism and superscalar processors, multiprocessors systems and parallel architectures	- Wilkinson, B. Computer Architecture: Design and performance - Patterson D. And Hennessy J. Estructura y Diseño de Computadores. - Stallings W. Organización y Arquitectura de Computadores - Patterson D. And Hennessy J. Organización y Diseño de Computadores: La interfaz hardware software. - Feldman and Retter "Computer Architecutre: A designer's text based on a generic RISC. - Hwang and Briggs. Computer Architecture and parallel processing.

Artificial Intelligence	1	3	7.5	Introduction: intelligence, rationality, and rational Agents, problems resolution through search, methods of informed search, games with opponents, propositional logic reasoning and inference, first order logic reasoning and inference, planning, natural Language.	- Russell S. and Norvig P.: Artificial Intelligence, a modern approach. - Nilsson N.J.: Principios de Inteligencia Artificial. - Rich E. and Knight K.: Inteligencia Artificial. - Nilsson N.J.: Artificial Intelligence, a new synthesis. - Steele G.L.: Common LISP the Language.
Telecommunication Networks 1	1	3	7	Telecommunications networks, network architectures, physical layer, Media Access Control layer, Data Link Control layer, Transport layer, Network Layer.	- Tanenbaum, A. Redes de Ordenadores. - Castro Lechtaler, A. Fusario, R. Teleinformática Aplicada.
Subject at choice					
Algorithm analysis (op)	1	3	7	Graph algorithms, Algorithms Design (divide and conquer, greedy, dynamic programming, backtracking), algorithmic complexity introduction.	- Aho Ullman Foundations of Computer Science. - Sedgewick Algorithms in C. Addison Wesley. - Weiss. Data Structures and Algorithm Analysis in C. - Cormen, Leiserson, Rivest. Introduction to Algorithms.
Scientific computation 1 (op)	1	3	7	Introduction to the numeric calculation, systems of linear equations, eigenvalues and eigenvector, resolution of non linear equations, interpolation and extrapolation, fitting and approximation of functions, numerical quadratures, functions Optimization, Tools for the scientific calculation.	
Multimedia Technology: Foundations and Applications (op)	1	3	7	Introduction to multimedia technology, hypertexts and browsing, images and graphics, sound processing, video processing, multimedia applications programming, multimedia in distance education, development of multimedia products, multimedia applications.	- Andleigh and K. Thakrar. Multimedia Systems Design. P.K. - Steinmetz and. Nahrstedt. Multimedia: Computing, communications and applications.
Digital Circuits Structure and Design (op)	1	3	7	Introduction to VLSI circuits, design with standard cells, FPGA architecture, Xilinx - ViewLogic design, pipelining, design for testability, algorithms and tools for electronic design automation, VHDL, low density programmable devices, low power design.	
Operating Systems 2 (op)	1	3	7	Introduction to the distributed operating systems (OS), communication in distributed O.S, synchronization in distributed O.S, processes administration in distributed O.S, file administration in distributed O.S, case study: COM, DCOM and actives, groupware.	- Tanenbaum, A. Sistemas Operativos Modernos, - Silberschatz, Peterson, Galvin. Operating Systems Concepts. - Stallings, W. Operating Systems.
Language Processors (Compilers)	2	3	9	Language translation (assembler, compiler, interpreter, compiler-interpreter, bootstrapping, interpreted Languages, compiled languages), translators parts. (symbol table, lexical analysis, syntactic analysis, semantic analysis, code generation, code optimization, interpreters, treatment of errors, memory management).	- Aho, Sethi, Ullman. Compilers: Principles, Techniques and Tools. - Fischer, C.N., LeBlanc Jr., R.J., Crafting a compiler with C. - Gries, D., Compiler construction for Digital Computers. - Wirth, N., Compiler Construction, Addison-Wesley, 1996.
Knowledge engineering	2	3	7.5	Nature and sources of the knowledge, knowledge based systems, methods of the knowledge representation, practical development of Knowledge based systems (knowledge acquisition, expert system development, practical applications)	
Telecommunication Networks 1	2	3	7	Introduction to internet protocols, IP encapsulation, internet layer, ARP and RARP protocols, IP routing, unreliable transport protocol: UDP, reliable transport: TCP, data flow TCP, time out and retransmission in TCP, benefits of TCP, SNMP: simple network management protocol, telnet and FTP, SMTP: Simple Mail Transfer Protocol, NFS: Network File System, Other Examples of Nets (X.25, SNA, Frame Relay, ISDN, ATM, Apple Talk)	- Tanenbaum, A. Computer Networks.
Subject at choice					
Scientific computation 2 (op)	2	3	7	Ordinary differential equations, numerical methods of parametric statistic, numerical methods using non parametric statistic, pattern recognition, prediction of temporary series, non-parametric function Approximation, signs and images processing	- Press, et all. Numerical Recipes: the Art of Scientific Computing. - Duda, R. O. Hart, P. E. Pattern Clasification and Scene Analysis. - Box, G. Jenkins, G. M. Time Series Analysis Forecasting and Control. - Wasserman, P. D. Advanced Methods in Neural Computing. - Simmons, F. Ecuaciones Diferenciales.

Logic and knowledge representation (op)	2	3	7	Propositional Logic, Logic of predicates, automatic methods of reasoning, non monotonous reasoning, epistemic logic, temporal Logics.	- Genesereth, Nilsson. Logical Foundations of Artificial Intelligence. - Levesque, H. Knowledge Representation and Reasoning. - Stickel, M. Automated Theorem Proving.
Object Oriented Programming 1 (op)	2	3	7	Object oriented programming concepts, object oriented programming in Java, user's interfaces in object oriented programming, distributed objects, advanced topics on object oriented programming.	- Luis Joyanes Aguilar. Programación Orientada a Objetos, 2nd ed - Daconta, M. Java 1.2 and JavaScript for C and C++ Programmers.. - C. S. Horstmann, Gary Cornell. Core Java 1.2, Volume I and II.
Pattern Recognition (op)	2	3	7	Introduction, bayes rule, recognition without models, recognition using linear models, recognition using neural networks, recognition using genetic algorithms, recognition using decision trees, not supervised recognition	- Vetterling, Numerical Recipes in C: The Art of Scientific Computing - Brandt, S. Statistical and computational methods in data analysis. - Johnson & Wichern, Applied Multivariate Statistical Analysis (3 rd ed) - Fausett, L. Fundamentals of neural networks - Bishop, C. Neural Networks for Pattern Recognition - M. Mitchell, R. Haupt, S. Haupt. An introduction to genetic algorithms
Signal Analysis and Systems (op)	2	3	7	Introduction to DSPs (Digital Signal Processors), linear systems, frequency Analysis, signals filters, sampling and conversion.	- Oppenheim A.V. and Wilsky A. Señales y Sistemas. - Oppenheim A.V. and Schafer R. W. Discrete-Time Signal Processing. - Proakis J. and Manolakis D.G. Tratamiento Digital de Señales.
Software Engineering 1	1	4	7,5	Introduction to software engineering, life cycles methodologies, viability study, software project planning, requirements definition and analysis, design, Implementation, verification and validation, distribution, maintenance.	
Informatics systems 1 (Databases)	1	4	7,5	Databases administration systems, Methodology: entity-relationship model, applications examples, SQL standards, integration with programs written in procedural languages, implementations.	- Korth, H. y Silberschatz, A.: Fundamentos de Bases de Datos (3 rd ed). - Elmasri, R. & Navathe, S. Fundamentals of Database Systems (2 nd ed) - Date, C. and Darwen, H. A guide to the SQL standard (3 rd ed) - Date, C.J.: Introducción a los Sistemas de Bases de Datos.
Subject at choice					
Foundations of Neurocomputation (op)	1	4	7	Introduction to neurocomputation, Neurobiology and neurocomputation, artificial Neuronal networks, feedforward networks, associative networks, competition based networks, other networks.	
Object Oriented Programming 2 (op)	1	4	7	Concepts of object oriented programming (OOP), programming Languages guided to objects (Smalltalk; C++); OOP analysis and design (UML, Booch, Jacobson, Rumbaugh); objects oriented middleware (OMG, CORBA, OODB).	- Meyer, Bertrand. Object-Oriented Software Construction. - Shlaer and Mellor. OO System Analysis: Modelling the World in Data. - Orfali, Harkey. The Essential Distributed Objects Survival Guide.
Automata Theory Formal Languages 2 (op)	1	4	7	Introduction (algorithms, languages, Turing machines and complexity); Turing machines of and undecidability; Complexity of Algorithms (P, NP and NP-complete); NP-Completeness	
Artificial Intelligence and Programming Paradigms (op)	1	4	7	Revision of LISP, introduction to CLOS (Common Lisp Object System), logical programming, knowledge representation and reasoning, introduction to natural languages, Language origins and meanings.	- Abelson, et al. Structure and Interpretation of Computer Programs - Ginsberg, M. Essentials of Artificial Intelligence. - Graham, P. On Lisp: Advanced Techniques for Common Lisp.
Telecommunication Networks 3 (op)	1	4	7	Introduction (communications technology current situation), transfer modes, ATM foundations, traffic engineering, wide band switching, traffic Control, ATM applications.	
Software Engineering 2	2	4	10.5	Software maintenance, project administration and management, CASE Tools, software configurations management, quality guaranty of the software, software metrics, software reusability, reengineering and inverse engineering, economic aspects of the software	
Informatics systems 2	2	4	7.5	Introduction to the client server systems, communications support in server systems, Design of client server systems, transactions servers, database server, groupware servers, distributed objects, object – Web	- Orfali, Harkey, Edwards. The Essential Client/Server Survival Guide. - Renaud, P. Introduction to Client / Server Systems: A Practical Guide for Systems Professionals.

Graphics (op)	2	4	7	Introduction to computer graphics, two-dimensional representation, two-dimensional geometric transformations, three-dimensional representation, curves and surfaces, shading surfaces	<ul style="list-style-type: none"> - J. Foley, A. van Dam, S.K. Feiner and J.F. Hughes, "COMPUTER GRAPHICS: Principles and practice (C version). - Angel. Interactive Computer Graphics: a t-down approach w. OpenGL - Rogers and Adams "Mathematical Elements for Computer Graphics - Eugene L. Fiume The Mathematical Structure of Raster Graphics"
Modeling and Computer Simulation (op)	2	4	7	Basic concepts in computer simulation, dynamic systems, languages of simulation, simulation methodologies, applications.	<ul style="list-style-type: none"> - Aburdense, M.F.: Computer Simulation of Dynamic Systems. - Banks, J. & Carson, J.S.: Discret-Event System Simulation. - Colella, A.M., O'Sullivan, M.J., & Carlino, D.J.: Systems Simulation. - Evans, J.B.: Structures of Discrete Event Simulation.
Advanced topics on Informatics Engineering (Parallel programming) (op)	2	4	7	Introduction, parallelism in monoproductors (pipeline, superscalars and vector architectures), parallelism in multiproductors (historical perspective, design foundations, interconnection networks, programming paradigms), design of parallel applications (principles and examples, software tools), perspectives and conclusions.	
Practice in Company (op)	2	4	7	Practice in a computer or software company.	
Foundations in Autonomous Robotics (op)	2	4	7	Introduction to autonomous robots, sensors, control electronic, actuators, power electronic, introduction to system control, technical of design and error correction, stability analysis, adaptive and complex control algorithms, autonomous navigation, integrated architectures	<ul style="list-style-type: none"> - Paul Bergsman, Controlling the world with your PC. - Bolton, W. Mechatronics: Electronic control systems in mechanical engineering. - Kuo, Sistemas de Control Automático.
Cryptography	2	4	7	Introduction, elementary cryptographic methods, the data encryption standard (DES), stream ciphers, public key calculation: RSA, authentication and integrity, digital signatures.	<ul style="list-style-type: none"> - Van Der Lubbe, Basic Methods of Cryptography. - Stinson, Cryptography: Theory and Practice. - Menezes, Applied Cryptography