University School of Computer Science. TECHNICAL UNIVERSITY OF MADRID

Bachelor's Degree Program in Computer Engineering

	Basics Mandatory Disciplines of Engineering Studies	Basic Mandatory Disciplines Common to Other Science Studies	Computer Mandatory Courses	Software Engineering Mandatory Courses	Optional courses	

Course	Syllabus	ECTS	Year	Semester
Physical Foundations of Computer Science	Electromagnetism, circuit theory and semiconductors. Representation and encoding of information systems combinational and sequential logic	6	1	1
Mathematical Analysis	Differential calculus, integral calculus, difference equations, sequences, asymptotic behavior, numerical series and power series.	6	1	1
Social, Ethics, Professional and Legal Issues	They are approached from the point of view of computer science. They represent disciplines which allow professionals in the sector to make informed decisions from an ethical point of view, within the framework of the existing legal regulations, and in accordance with established codes of professional behavior	6	1	1
Programming Foundations	Structured Programming: Programming Basics, basic components of programming languages, sub-programming, static data structures, files, dynamic variables, dynamic structured data. Programming Languages	6	1	1
Digital Systems	Representation and coding of information, Boolean Algebra, combinational logic systems, sequential logic systems, elements of timing and memorization, analysis and synthesis with commercial logic and interpretation of the Data Sheet	6	1	1
Discrete Mathematics	Sets, functions and relations. Logic, induction and recursion, Combinatory and graph theory	6	1	2
Algebra	Modular integer arithmetic, linear algebra and introduction to correcting codes.	6	1	2

Computer Structure	Form, function and internal organization of the components of a digital computer including processors, registers, memory, input and output devices, as well as its corresponding set of instructions in Assembly language. Input and output systems. Increase in benefits. Multiprocessor and cluster. Throughput evaluation and design of memory systems.	6	1	2
Data Structure	Dynamic data structures: lists, trees and graphs. Programming languages.	6	1	2
Computer Technology	Understanding commercial integrated circuits manuals and descriptive files Comparing, evaluating and selecting the most appropriate hardware devices for each application according to certain given parameters or indicators Analyzing technological features in circuits and digital systems Indentifying digital components as part of higher hierarchical logical structures. Evaluating digital systems performance and capabilities	6	1	2
Statistics	Descriptive statistics, probability, random variables, models of distribution and statistical inference.	6	2	1
Information Management (DB) Theory Information Theory for Data Management	Theoretical models for the representation, storage and processing of information. Indexing techniques based on trees and direct access according to a key value. Structures of secondary storage and direct access techniques for information retrieval. Advanced techniques and structures for indexing. Processing and solutions with files for external sorting. Introduction to databases: architecture and hardware.	6	2	1
Software Process Engineering	Basic concepts and terminology of the life cycle processes. Infrastructure processes. Measurement on the processes and products. Definition of processes. Configuration management. Management of change. Development of products under the change and configuration management. Rules on definition of processes, and configuration and change management. Automation of the process.	6	2	1
Computer Architecture	The computer. Basic architecture of the MIPS 64. Pipeline segmentation. Dynamic scheduling. Superscalar processors. Memory. Input/Output systems.	6	2	1
Algorithms and Complexity	Solutions (algorithms) to problems; temporal and spatial complexity: Time and space tradeoffs in algorithms according to input size. Search and internal sorting algorithms. Algorithmic schemes: backtracking, greedy algorithms, divide and conquer, and dynamic programming. Algorithms on graphs: graph traversals, obtaining	6	2	1

	ARCMs, minimum.			
Object Oriented and Concurrent Programming	Evolution of programming languages, elements of OOP (classes, objects, methods, messages), inheritance, polymorphism, handling exceptions, files and streams, libraries (collections, data structures, GUI's), parameterized programming, concurrent programming, models of shared memory paradigm (synchronization of low-level synchronization of concurrent languages tools: traffic lights, monitors, etc) and message passing	6	2	2
Introduction to Economics and Business Management	Introduction to economics. Business Fundamentals: management, finance, human resources, production and marketing. Accounting and financial statements analysis.	6	2	2
Programming Languages Theory	Introduction to translators, interpreters and compilers. Development of lexical, syntax and semantics analyzers for programming languages. Use of formal languages for programming languages specification. Use of generating tools for practical assignments.	6	2	2
Information Security foundations	Introduction to computer security. Data protection. Security standars and legislation. Security policies and plans. ISMS controls. Introduction to cryptography. Symmetric and asymmetric encryption. Hash functions. Public key infrastructure. Digital signature and certificates. Applied cryptography. Cryptographic protocols	6	2	2
Input/output Devices and Computer Peripherals	Functional units of the computer, machine language and assembly language, memory, organization and memory hierarchy, arithmetic of the computer, buses, increased benefits, units of i/o, communications and peripherals, management, languages and applications-oriented architectures.	6	2	2
Optional Courses		4/6	3	1
Operating Systems	OS structure. APIs. Resource management (processes, memory, I/O, files). Security. Administration. System performance.	6	3	1
Computer Networks	Communication of information, wide area networks, local Area Networks, TCP/IP communications architecture, multiservice networks and convergence IP, services on TCP/IP networks, TCP/IP communication interfaces.	6	3	1
Robotics	Manipulators, kinematics, dynamics, autonomous robots, structure and locomotion, sensory systems, architectures of control, functional decomposition, architectures based on behaviors, environments modeling architectures.	4	3	1

New Technology Seminars	A course focused on current Computer Technologies. It is an open-content course. Therefore there is no regular content.	2	3	1
Systems Integration	Project of integration of systems; definition of project; formulation of objectives; phases; market study; documentation; programming and follow-up tasks, allocation of resources; estimate of costs and benefits; economic evaluation of the project; drafting and presentation of the project; development of the project; choice of the target architecture; analysis of tasks; logical management of tasks; choice of hardware/software of each task implementation; use of description languages hardware (LDH); methodology for the dump of the structures PLD or FPGA design; study of the time required for each of the tasks and the time to perform the complete design; cosimulation of the complete system.	6	3	2
Advanced Networks and Services	Data communications, wide area networks, local area networks, architecture TCP/IP, multiservice networks and convergence IP, services on TCP/IP networks, TCP/IP communication interfaces.	4	3	2
Distributed Systems	Distributed systems definition and modeling. Communication among processes and groups of processes. Synchronization. Distributed shared memory and fault tolerance.	6	3	2
System Administration	System startup and shutdown. Installing and updating software. User Management. Resource management. System security. Automating tasks. Filesystems and disks. Advanced use of disk. Backups. Printer management.	4	3	2
Optional Courses		4/6	3	2
Practicum/ Optional Courses		6/12/18	4	1
English for Professional and Academic Communication	Professional Oral Communication for Computing. Computer Terminology and phraseology; factors involved in an oral presentation: context, users, degrees of specialization and degrees of formality; body language; informality and expressions used in different contexts by users from a professional and academic context; expression of opinion, comparison, argumentation and the cause/effect relationship. Written Communication for Computing; professional written communication; characteristics and types: professional letters, reports, the summary, the memorandum, and other genres; academic written communication; characteristics and types: abstract, article, Final Project Work, other genres.	6	4	1

	According to the Reference Level Descriptions (http://www.coe.int/t/dg4/linguistic/DNR_EN.asp), in order to get registered for this course, students should be credited B2 level of English.			
Degree Thesis	The student will make a real practical project related to one or more of the professional profiles of the degree. This working memory is accompanied by a description of the project developed that will highlight the most important aspects of work and include the necessary documentation in a draft Computer Engineering.	12	4	1
Optional Courses		30	4	1/2

Optionals Courses	Syllabus	ECTS	Year	Semester
Computer Graphics	Generation of 3 dimensional graphics with focus on the aspects of geometry, modeling, the coloring and lighting techniques	6	3/4	1
Communication Skills in Spanish for Engineers	Techniques of verbal expression: diction, tone, rhythm, etc; techniques of non-verbal expression; characteristics of the production and presentation of technical information in multimedia support; characteristics of written in environments of engineering communication: e-mail, memoranda, letters, reports, projects and other writings of the specialty	3	3/4	2
Assisted Translation for Engineers	Introduction to the concept of translation; fundamental language concepts; categories of the translation; translation procedures; specialized translation: gender; Pragmatics of the exercise of the translation; (TAO/CAT) computer-assisted translation.	3	3/4	1
Unix and Linux	System installation. Basic commands. Objects and mechanisms: files, redirection, regular expressions, processes, scripts, users, groups, permissions. Process communication. Open development environments. Administration.	6	3/4	1
Intelligent Systems	State-Space Exploration. Bio-inspired learning. Neural networks, evolutionary computation. Inductive decision trees. Shape recognition.	3	3/4	1
Information Coding	General concepts of encoding information. Correcting codes: linear codes, cyclic codes and applications. Cryptology foundations: theory of numbers, primality tests. Public key cryptographic systems, RSA, ElGamal and elliptic curve cryptosystems	6	3/4	1
Parallel Architectures	Different models to exploit parallelism. Intra and inter-chip interconnection networks. Multiprocessors and advanced cache coherence systems. Multicore and multirow processors. Superscalar organization. Massively parallel systems. Systolic and vector processing. Consumption management and fault tolerance.	6	3/4	2

Mechatronics	Control from PC of mechatronic, communications systems for remote control of devices, design and use of electromechanical systems, buses of high-performance, digital electronic systems (data acquisition and A/D and D/A converters), automatic, and electronic power controllers programmable logic, SCADA systems, standards and regulations of mechatronic products	6	3/4	1
Signal Processing Methods	Fourier transform of discrete Fourier, convolution and correlation, transformed Fast Fourier transform, z transform and Laplace transform.	3	3/4	2
Business Models	Analysis of business environment. Corporate strategies. Market and competition. Analysis of financial viability. Making a Marketing Plan.	3	3/4	1
Digital Signal Processing	Introduction; DSP´s architectures; systems in the frequency transfer functions; sampling and reconstruction of - 100 - signals; analysis and design of frequency selective filters; structures of digital systems: IIR, FIR, lattice; processing multiple rate digital; adaptive filtering; identification of systems; modeling of systems, spectral estimation of frequency.	3	3/4	2
Microcontrolers and Microprocessors Systems	Techniques for construction of printed circuit boards. Microcontrollers (architectures, integrated peripherals). Microprocessors. Development environments. Industry standards	6	3/4	1
Control Systems	Introduction to one variable control systems. Stability. Tansitional and permanent system. Controller design techniques. Multivariable systems. Description of state space systems. Multivariable control techniques.	6	3/4	2
Real-Time Systems	Characteristics of Real Time Systems (RTS). RTS programming aspects. Failure tolerance. STR planning. STR modelization. STR design methodologies. Embedded systems. High integrity systems.	6	3/4	2

Artificial Vision	Physical and logical diagram of an AVS, imaging, changes in the spatial domain, changes in the frequency domain, changes in color, segmentation, identification and representation	6	3/4	1
Operational Research	Stochastic processes, Markov chains, systems of networks of queues, queues, simulation, simulation of queueing, networks tools.	6	3/4	2
Network Security	Introduction to security, security in the network and access, firewall (firewall), intrusion detection, security in wireless networks, security in the web, tunnels and VPNs, security against attacks (hacking), prevention of attacks, forensic analysis	6	3/4	2
Electronic Commerce	Introduction to e-commerce: notions of web technology, scripts, CGI, server applications, etc.; Applied Cryptography; certificates and PKI structure; Protocol SSL and TLS; transactional systems; Protocol SET; standards for electronic payment; cards; smart cards; secure payment gateways and TPVV; structure and implementation of virtual shops.	6	3/4	2
Internet Services	Introduction to Internet Services , network interfaces, Domain Name System, e-mail Service, World Wide Web Service.	6	3/4	2