



IDENTIFYING DATA

Computer science: Computing for engineering

Subject	Computer science: Computing for engineering			
Code	P52G382V01107			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	Spanish			
Department				
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General description	This course belongs to the module of Basic education, and its main goal is providing to the students an overview of the world of the computers. The course is focused on making the students to learn how a computer works internally, from hardware and software perspective, as well as to design programs employing a high level language. She/he will familiarise also with the systems of management of databases.			

It is proposed a course of computing and conceptual programming sufficiently general, oriented to provide to the student a perspective of designer and programmer of small applications. Although the course is not oriented to the study of a particular operating system or programming language, it does necessary employ a concrete language in the realization of the practical activities, becoming the learning of this language a secondary aim of the course.

Training and Learning Results

Code	
B3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
C3	Basic knowledge on the use and programming of computers, operating systems, databases and software applications in engineering.
D1	Analysis and synthesis
D2	Problems resolution.
D5	Information Management.
D6	Application of computer science in the field of study.
D7	Ability to organize and plan.
D17	Team working.

Expected results from this subject

Expected results from this subject	Training and Learning Results		
Skills in handling computers and operating systems	B3	C3	D2
	B4		D5
			D6
			D7
Basic understanding of how computers work	B3	C3	D1
			D6
Database fundamentals	B3	C3	D5
			D6

Capability to implement simple algorithms using a programming language	B3 B4	C3	D1 D2 D5 D6 D7 D17
Structured and modular programming fundamentals	B3	C3	D6 D7
Skills regarding the use of computer tools for engineering	B3 B4	C3	D5 D6
ENAAE learning outcome: KNOWLEDGE AND UNDERSTANDING: LO1.1- Knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [Intermediate (2)].	B3	C3	
ENAAE learning outcome: ENGINEERING ANALYSIS: LO2.2.- Ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical - societal, health and safety, environmental, economic and industrial - constraints [Intermediate (2)].	B4	C3	D1 D2
ENAAE learning outcome: ENGINEERING DESIGN: LO3.2.- Ability to design using some awareness of the forefront of their engineering specialisation [Intermediate (2)].	B4		D7
ENAAE learning outcome: ENGINEERING PRACTICE: LO5.2.- Practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Intermediate (2)].	B4	C3	D2
ENAAE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.2.- Ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers [Intermediate (2)].			D7 D17

Contents

Topic

Concepts and basic programming techniques applied to engineering	<p>Objectives and development: This topic aims to explore the concepts and basic programming techniques and algorithms, as well as modular and structured programming methodologies.</p> <p>Topic index: Introduction to programming. Programming methodologies. - Modular programming. - Structured programming. Algorithms and its description. Programming languages. Phases in the development of a program. Conclusions.</p>
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Introduction to C programming language	<p>Objectives and development: Once the student has mastered the basic concepts of programming, this unit introduces the C programming language. Most of this unit will be addressed in the practical sessions of the course.</p> <p>Topic index: Data types - Variables. - Expressions. - Operators. Structure of a C program. - Style in programming. - Basic instructions. - Sequential structure. The conditional structure. - Simple conditional structure. - Multi-conditional structure. The repetitive structure. - Repetitive structures controlled by condition. - Repetitive structures controlled by counter. Strings and arrays. - Strings. - Vectors and matrices. Files. - Input and output with format. - Handling files. Structured programming. Modules and subroutines. - Definition of functions. - Passing parameters by value and by reference. Conclusions.</p>
Foundations of operating systems: concept, evolution and structure	<p>Objectives and development: The objective of this unit is, on the one hand, to establish the concept of operating system, its functions and its aims, and on the other hand, to present its structure and main components to provide to the student with an overview.</p> <p>Topic index: Concept of operating system. History and evolution of the operating systems: types of systems. Components and services of the operating system. Structure of the operating system. Conclusions.</p>
Introduction to database management systems (DBMS)	<p>Objectives and development: In this unit the management systems of relational databases are presented to the students: the basic concept as well as the SQL language will be addressed.</p> <p>Topic index: Basic concepts: relational model, primary and foreign keys. Indexes. The SQL language. Conclusions.</p>
Basic computer architecture	<p>Objectives and development: This unit is intended to present the structure and main components of a computer to provide to the student with an overview of its operation.</p> <p>Topic index: History and evolution of computers. Basic computer architecture. Main components. Conclusions.</p>
Practice 0: Introduction to the computer lab and its tools.	<p>Objectives and development: In the first session of laboratory the student will familiarise with the tools to be used during the course: Linux operating system, the command interpreter, gcc compiler and different text editors emacs, saw, nano, gedit, etc.</p>

Practice 1: Variables. Data Input/Output.	Objectives and development: The fundamental goal of this session is that the student knows the different types of existent data, and that understands which functions allow to carry out the data input by keyboard and the data output by screen.
Practice 2: Flow diagrams.	Objectives and development: The goal of this session is that the student learns to develop flow diagrams in the design phase of a program.
Practice 3: Selective and repetitive structures.	Objectives and development: The main goal of these sessions is that the student understands the operation of the selective structures if-else and switch as well as the repetitive structures for, while and do-while.
Practice 4: Manipulation of strings and arrays.	Objectives and development: The main goal of this session is that the student understands how the mechanisms of manipulation of strings and arrays work in the C language.
Practice 5: Manipulation of files.	Objectives and development: The fundamental goal of this session is the familiarization with data files. The student learns to design and implement solutions to a problem where it is necessary to access to text file to read and/or write data, being also an objective that the student understands how the system calls work.
Practice 6: Functions.	Objectives and development: The main goal of this session is the familiarization of the student with the modular programming and the use of functions. It will have to know also the differences between passing parameters to functions by value and by reference.
Practice 7: Programming project.	Objectives and development: This practice consists in the resolution of a more complex problem, posed so that its solution needs the cooperative work of two students (or three students, as an exception).
Practice 8: Introduction to SQL.	Objectives and development: Its goal is that the students learn to connect to a management system of relational databases (in particular, MySQL) from a Linux terminal and to interact with it by using the SQL language to carry out basic tasks: to create a table, to insert data, to make queries, etc. Students are expected to work only at the level of system user, not admin.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	14	28	42
Practices through ICT	18	18	36
Project based learning	10	8	18
Seminars	15	13	28
Problem solving	7	0	7
Systematic observation	0	0	0
Essay questions exam	11	4	15
Essay questions exam	2	2	4

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Participatory masterclasses. In these sessions, the faculty will explain in detail the basic theoretical contents of the course, exposing clarifying examples that help to better understand the concepts. Computer presentations and the blackboard will be used, especially to transmit information like definitions, charts, algorithms, etc. When it is possible, a copy of the slides will be given to the students in advance, focusing the effort of the lecturers and the students on the exhibition and understanding of the concepts. Anyway, the reproductions in paper of the slides should not be considered like substitutes of the texts, but like complementary material.

Practices through ICT	<p>Small participatory master sessions. Sometimes, it will be necessary to explain in the laboratory practical concepts giving useful advices for the best advantage of the practical classes.</p> <p>Supervised laboratory practices. The didactic method to be followed in the teaching of the practical classes consists in that the lecturer supervises the work and progress done by the different groups. The practices of laboratory are headed to strengthen the theoretical concepts tackled in the sessions in the classroom (with the master sessions as well as with the design of the project).</p>
Project based learning	<p>Project-based learning. As the course progresses, it will be proposed a project to be done in group (preferably of two people) that will last several weeks. We will use the educational methodology of project-based learning. The solution of the project will demand the contribution of the knowledge acquired by each member of the group, guaranteeing the positive interdependence that is required for the success of the collaborative work. On the other hand, the project will be evaluated guaranteeing the individual work and the positive interdependence, this is, all the members of the group must have worked and contributed to the final product and have to know all the aspects of the project. It will be provided material and bibliography, and it will exist the possibility of a public presentation of the project.</p>
Seminars	<p>An intensive course (15 hours long) is organized for those students who have failed the subject at first call, prior to the exam in second call. Group tutoring with the lecturer.</p>
Problem solving	<p>Resolutions of problems and/or exercises. These sessions, that take place in seminars and under the format of small group meetings, will serve for the resolution of questions about the project. Problems and exercises will be resolved by the students themselves.</p>

Personalized assistance

Methodologies Description

Problem solving	<p>Regarding tutorials, it is possible to distinguish between academic and personalised tutorials. Students will be offered office hours so that they can ask every question related to contents, organisation and planning of the course. They can be one-to-one tutorials although group tutorials will be fostered in order to sort out the problems related to group activities or just in order to inform the instructor of the development of group work. Regarding one-to-one tutorials, each student will be able to talk to the instructor about any problem which is preventing her/him from coping with the subject properly, so that both can find a solution. By merging both kinds of tutorials, it is intended to compensate the different learning paces through measures of attention to diversity. The teachers will personally answer to the questions and queries of the students, both in person, according to the timetable that will be published on the centre's website, and by telematic means (e-mail, videoconference, Moovi forums, etc.) by appointment.</p>
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Assessment

Description	Qualification	Training and Learning Results
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Project based learning	The assessment of the programming project (practice 7) will be done by means of the following collection of strategies employed to value the process of project based learning: - Assessment of initial design of the project: 5% (Competencies CG3 (B3), CG4 (B4), CE3 (C3), CT1 (D1), CT6 (D6), CT7 (D7), CT17 (D17)). - Delivered final product (code and report): 30% (Competencies CG3 (B3), CG4 (B4), CE3 (C3), CT1 (D1), CT2 (D2), CT5 (D5), CT6 (D6), CT7 (D7), CT17 (D17)). - Improvements carried out over the initial specification of the project: 5% (Competencies CG3 (B3), CG4 (B4), CE3 (C3), CT1 (D1), CT2 (D2), CT5 (D5), CT6 (D6), CT7 (D7), CT17 (D17)). - Project defense (personal interview): Factor 0-1 (Competencies CG4 (B4), CE3 (C3), CT6 (D6), CT17 (D17)).	40	B3 C3 D1 B4 D2 D5 D6 D7 D17
<p>Since the project has to be evaluated so that it is guaranteed the individual work as well as the positive interdependence (this is, all the members of the group must have worked and contributed to the final product and have to control all the aspects of the project), in the defence session, any member of the group must be able to answer to any question regarding the project. All of them must show, therefore, deep knowledge of the delivered product, independently of the part on which they had focused their efforts. The project defense will allow the lecturers to assess the degree of involvement in its development and the defense result will be a factor that will multiply the qualification corresponding to 35% of the project (except for the design) so that, if the group is not capable of answering the questions posed, this factor will be zero, nullifying the qualification obtained. On the contrary, if the group defends the submitted project well, said factor will be 1 and will consolidate its rating.</p>			
Systematic observation	The participation and attitude of the student will be assessed during all the semester in theoretical classes and seminars as well as contributions in the online teaching platform.	5	B4 D2 D6 D7
Essay questions exam	Written exam: theoretical questions and problems The main goal of this exam is to assess the learning of all of the theoretical contents of the course. This exam must be complete, i.e., it will cover all of the contents, since the main goal is to assess what students know about the subject in general, not of a part of it. Second, the exam has to consist in a series of questions that make the conceptual and logical reasoning prevail, in order to verify the intellectual maturity of the students to obtain conclusions from the notions or the exposed theories in class.	35	B3 C3 D1 B4 D2 D6
Essay questions exam	The evaluation of the practices (with the exception of the practice 7 - project of programming) will be carried out through an examination of questions where it will be assessed the knowledge acquired by the student in the laboratory. This way, the instructor will ask about any aspect related to the practices implementation.	20	B3 C3 D1 B4 D2 D6

Other comments on the Evaluation

The evaluation criteria of each section will be published at the beginning of the semester.

The final assessment of student will be the sum of the punctuation awarded to each one of the before commented parts, being their grade of continuous evaluation (CEG): $CEG = 0,35 * THEORY EXAM GRADE + 0,4 * PROJECT GRADE + 0,2 * PRACTICAL EXAM GRADE + 0,05 * PARTICIPATION$.

However, some minimum requirements in any of the sections will be demanded to guarantee the balance between all the types of competencies. Those requirements are: 1. To get at least a 5 over 10 in the project evaluation. 2. To get at least a 4 over 10 in the theory exam.

Those students that do not fulfil any of the previous requirements, will have to attend to the ordinary examination to be able to pass the course, and their grade of continuous evaluation will be calculated as follows: $FINAL_CEG = \min(4, CEG)$.

All those students that wish to improve their qualification (obtained by continuous evaluation) will be able to attend to the ordinary exam. So much in the ordinary exam as in the extraordinary (July) all the competencies of the course will be evaluated. Thus, said examinations will include a practical programming test in the laboratory. Once finished the second semester, an intensive course (15 hours long) is organized to prepare the extraordinary exam.

ACADEMIC INTEGRITY: Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces*, **any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity**, regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.

Sources of information

Basic Bibliography

Osvaldo Cairó, **Fundamentos de Programación: Piensa en C**, Pearson Prentice Hall, 2006

Complementary Bibliography

A. Silberschatz, P. Galvin, y G. Gagne, **Operating Systems Concepts**, 8ª edición, John Wiley & Sons, 2008

Gregorio Fernández Fernández, **Curso de Ordenadores. Conceptos básicos de arquitectura y sistemas operativos**, 5ª Edición, 2ª Edición en el Servicio de Publicaciones de la E.T.S.I. Telecomunicación. UPM, 2004

Alan Beaulieu, **Aprende SQL**, 2ª edición, Anaya Multimedia/O'Reilly, 2009

Recommendations

Other comments

This course has no prerequisites and no prior knowledge about the course is expected. The knowledge and skills that are acquired will allow the student to develop with guarantees skills of later courses in which the management of a computer and / or computer applications related to engineering is required.

To be able to successfully complete the course, it is recommended that students have:

- a well-developed written and oral comprehension capacity,
 - capacity for abstraction and synthesis of information,
 - skills for group work and for group communication.
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