1. OVERVIEW

Subject area	Computer Architecture
Degree	Bachelor's Degree in Computer Engineering
School/Faculty	School of Architecture, Engineering and Design
Year	First
ECTS	6 ECTS
Type	Core
Language(s)	Spanish
Delivery mode	On campus / Online
Semester	Second semester
Year	2022 / 2023
Coordinating professor	Sergio Bemposta Rosende
Teacher	Sergio Bemposta Rosende

2. INTRODUCTION

Contextualisation of the contents of the subject area within the Computer Engineering subject. The student will gradually acquire the skills associated with this subject, due to the order of the subject areas that it comprises.

Therefore, the subject area Fundamentals of Computer Science (first semester) will enable the student to learn how a computer works from the inside, the parts it contains, as well as how the computer communicates at a low level.

Afterwards, this knowledge will be applied in the subject area Computer Architecture. This allows the student to build simple digital systems, as well as apply the knowledge acquired in the way the computer handles information to carry out programming problems in assembly language. Later, in the subject area Computer Architecture (third semester), students will apply the knowledge acquired of how computers work in order to evaluate complex architectures.

3. SKILLS AND LEARNING OUTCOMES

Basic skills (CB, by the acronym in Spanish):

- CB1: Students have demonstrated knowledge and understanding of a study area originating from general secondary school education, and are usually at the level where, with the support of more advanced textbooks, they may also demonstrate awareness of the latest developments in their field of study.
- CB2: Students can apply their knowledge to their work or vocation in a professional manner and possess the skills which are usually evident through the forming and defending of opinions and resolving problems within their study area.
- CB3: Students have the ability to gather and interpret relevant data (usually within their study area) to form opinions which include reflecting on relevant social, scientific or ethical matters.
- CB5: Students have developed the learning skills necessary to undertake further study in a much more independent manner.

Transversal skills (CT, by the acronym in Spanish):

- CT10: Initiative and entrepreneurial spirit: Ability to undertake difficult or risky actions with resolve. Ability to anticipate problems, propose improvements and persevere to ensure they are implemented. Willingness to take on and carry out tasks.
- CT13: Problem solving: Ability to resolve an unclear or complex issue or situation which has no established solution and requires skill to reach a conclusion.

Specific skills (CE, by the acronym in Spanish):

- CE5: Knowledge of the structure, organisation, operation and interconnection of computer systems, the fundamentals of their programming, and how they are used to solve engineering problems.

- CE12: Knowledge and application of the basic algorithmic procedures of computer technologies to solve problems, analysing the suitability and complexity of the proposed algorithms.
- CE27: Ability to assess the computational complexity of a problem, know algorithmic strategies that can be used to solve it, and recommend, develop and implement the strategy that guarantees the best performance according to the established requirements.

Learning outcomes (RA, by the acronym in Spanish):

- RA1: Solve and understand simple digital sequences.
- RA2: Build low-level programming applications.
- RA3: Understand the inner workings of a Control Unit.
- RA4: Differentiate the different types of I/O and communications of a microcontroller. •

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes
CB1, CB2, CB3	RA1
CB1, CT5	RA2
CB1, CB2, CB5, CT12, CE5, CE12, CE27	RA3
CB1, CT10, CE12, CE27	RA4

4. CONTENTS

Unit 1. Digital Systems

- Resource 1. Digital Circuit
- Resource 2. Sequence Systems
- Resource 3. Counters and Sequences

The aims of this unit are:

- Understand combinational logic.
- Know how to carry out simple sequence circuits.

Unit 2. Microcontrollers

- Resource 1. Assembly language
- Resource 2. Arduino and ATmega328P
- Resource 3. Programming in assembly

The aims of this unit are:

- To introduce the assembly programming.
- Its concepts from a theoretical point of view without linking it to a specific microprocessor.

Unit 3. Data handling

- Resource 1. Atmel registers and memory
- Resource 2. Basic operations and addressing

The aims of this unit are:

- Analyse assembly data storage
- Study assembly arithmetic operations
- Study conditional assembly statements

Unit 4. Code execution

- Resource 1. The Stack and functions
- Resource 2. Parameter passing
- Resource 3. Interruptions and UART

The aims of this unit are:

- Study the handling of the stack software in assembly.
- Study the operation of “functions” and message passing in assembly.
- Study the serial port and communication with the PC.

Unit 5. Advanced characteristics

- Resource 1. Analogue Inputs and Outputs
- Resource 2. Timer and Watchdog
- Resource 3. Power control

The aims of this unit are:

- Study ATmega328P analogue signals. Both inputs and outputs.
- Study the use of assembly timers for ATmega328P.
- Drive a motor (motor, servo or PaP) from assembly for ATmega238P.

Unit 6. Advanced Architectures

- Resource 1. Performance measures
- Resource 2. Cache coherence
- Resource 3. High-performance machines

The aims of this unit are:

- Analyse how to compare computers from different families with each other.
- Study the problems of multiprocessor computers - The problem of cache memory.
- Study the current trends in high-performance computer design.

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- MD2. Lectures, subjects of study and seminars. The “lectures” taught in the on-campus delivery mode are called subjects of study and seminars in the online delivery mode, and are conducted through readings on the topic, technical notes and webinars (which are recorded for students to access).
- MD3. Laboratory work: the laboratories will mainly be used in the on-campus delivery mode.
- MD4. a) Group research and/or b) group problem-solving. This learning method will be used for the development of both declarative and procedural knowledge. In method type a), a different topic will be assigned to each group to be investigated. Later, new groups will be formed with students who have all studied a different topic, and these new groups will be proposed comprehension and problem-solving activities. In method type b), a series of questions and short problem activities will be proposed to be solved in groups.
- MD5. Designs, understood as practical proposals for solving specific problems (unlike the study of practical cases, it is not a question of delving deeper into the analysis and the real problems. Instead, it is based on this knowledge, and the aim is to provide new solutions in accordance with engineering standards). These learning methods will be used for the development of procedural knowledge. They will be used in all delivery modes and help to develop creative potential and technical skills in the field of engineering.

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity (AF, by the acronym in Spanish)	Number of hours

AF1: On-campus/online lectures, reading topics and complementary materials, implementation of activities carried out independently and collectively.	50 h
AF2: Work carried out in the classroom independently and in groups Case studies, problem solving, project development, simulation	25 h
AF3: Independent working	50h
AF4: Tutorials, academic monitoring and assessment	25 h
TOTAL	**150 h**

Online:

Learning activity (AF, by the acronym in Spanish)	Number of hours
AF6: Independent reading on complementary topics and materials and implementation of activities carried out independently. Subsequently, asynchronous group discussion on the Campus Virtual forum, and online seminars with the synchronous e-learning tools on the Campus Virtual.	50 h
AF7: Work carried out on the Campus Virtual independently and in groups. Case studies, problem solving, project development, simulation	25 h
AF3: Independent working	50 h
AF8: Tutorials, academic monitoring and assessment through the Campus Virtual.	25 h
TOTAL	**150 h**

7. ASSESSMENT

The assessment systems, plus their weighting in the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
SE1: Objective tests: in-class assessable tasks carried out individually.	40%
AS2, AS3, AS6: Various tasks carried out inside and outside the classroom: work, exercises, practice and mini-projects.	50%
AS2, AS3, AS4, AS6: Skill-based aspects of participation in tasks carried out inside and outside of the classroom.	10%

Online:

Assessment system	Weighting
SE8: 2 Objective tests: in-class assessable tasks carried out individually.	60%
AS9, AS10, AS12: Various tasks carried out outside the classroom: work, exercises, practice and mini-projects. Deliverables carried out individually.	20%
AS9, AS10, AS12: Various tasks carried out outside the classroom: work, exercises, practice and mini-projects. Deliverables worked on in groups	15%
AS9, AS10, AS11, AS12. Skill-based aspects of participation in tasks carried out inside and outside of the classroom.	5%

On the Campus Virtual, when you open the subject area, you will find all the details of your assessable tasks and the deadlines and assessment procedures for each task.

7.1. Ordinary exam period

To pass the subject area in the ordinary exam period, you will need a final grade of at least 5.0 out of 10.0 (weighted average) for the subject area. Additionally, you will need:

- A grade of at least 5.0 out of 10.0 in all individual, group and laboratory tasks separately.
- A grade of at least 5.0 out of 10.0 in all knowledge, written or oral tests.
- Laboratory work must be delivered on the day of the activity, at the end of class. It cannot be carried out at any other time.

- The grade in the ordinary exam period will appear as NP (No grade reported) if the student fails to submit any assessable task which counts towards the weighted average.

Note on the use of a calculator: The use of calculators that allow programming, have memory or convert to binary is prohibited in the assessment activities.

7.2. Extraordinary exam period (resits)

In the extraordinary exam period, you must deliver the activities indicated by the professor, which will be compulsory for all activities where 5 out of 10 has not been achieved individually.

In addition, the following restrictions will apply:

- In the extraordinary exam period, there are no group activities, they are all to be carried out individually. Therefore, each member of the original group must deliver the activity individually.
- If you fail the in-person test, you must retake it under the same conditions as in the ordinary exam period.
- If you fail the laboratory activity, you will have the same time to complete it as in the ordinary exam period and you will have the same material available to you. This activity must be completed in the laboratory and in person.
- In the event that you pass the objective tests and you only have individual or group tasks to carry out in the extraordinary exam period, the professor will reserve the right to hold a face-to-face or online confrontation to defend any exercise that the professor considers appropriate to demonstrate the knowledge acquired.

Note on the use of a calculator: The use of calculators that allow programming, have memory or convert to binary is prohibited in the assessment activities.

8. TIMELINE

The timeline with submission dates for the assessable tasks in this subject area will be indicated in this section:

Assessable tasks	Date
Sequence recogniser circuit	Week 2
Basic Input Output	Week 4
Registers	Week 5
Bit shift	Week 6
Functions	Week 7
Parameters to functions	Week 8
Analogue input	Week 10
Analogue output (PWM)	Week 12
Microprocessors	Week 14
Assessment	Week 16

The timeline may be subject to change for logistical reasons related to the activities. Students will be informed of any changes in due time and course.

9. BIBLIOGRAPHY

The reference material for the subject area is as follows:

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The recommended bibliography is indicated below:

10. DIVERSITY AWARENESS UNIT

Students with special educational needs:

To ensure equal opportunities, curricular adaptations or adjustments for students with special educational needs will be outlined by the Diversity Awareness Unit (UAD, Spanish acronym).

As an essential requirement, students with special educational needs must obtain a report about the curricular adaptations/adjustments from the Diversity Awareness Unit by contacting unidad.diversidad@universidadeuropea.es at the beginning of each semester.

11. STUDENT SATISFACTION SURVEYS

Your opinion matters!

Universidad Europea encourages you to complete our satisfaction surveys to identify strengths and areas for improvement for staff, degrees and the learning process.

These surveys will be available in the survey area of your campus virtual or by email.

Your opinion is essential to improve the quality of the degree. Many thanks for taking part.