Computer Structure

Academic Year: (2024 / 2025) **Review date: 18-04-2024**

Department assigned to the subject: Computer Science and Engineering Department

Coordinating teacher: GARCIA CARBALLEIRA, FELIX

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Programming (Course 1 - Semester 1)
Computer technology (Course 1 - Semester 2)

SKILLS AND LEARNING OUTCOMES

- Know the representation systems used in a computer with special attention to the representation of floating-point numbers and understand the trade-off between precision and performance of arithmetic operations.
- Know, understand and evaluate the structure and architecture of a computer, as well as its basic components.
- Be able to express assembly language subprograms and understand their relationship to high-level languages

OBJECTIVES

The main objective of the course is to describe the main components of a computer and the basic behaviour of a computer.

DESCRIPTION OF CONTENTS: PROGRAMME

The basic concepts of this course are: organization and structure of a computer; data representation; basic arithmetic; execution of instructions; assembly programming; main memory; cache memory; virtual memory; input/output systems.

1. Introduction to computers
   - Von Neumann architecture
   - Computer programming
   - Characteristic parameters of a computer
   - Computer performance

2. Data representation and basic arithmetic
   - Number representation
   - Floating point
   - Basic arithmetic

3. Assembly programming
   - Machine instructions representation
   - Programming model of a computer
   - Data, instructions, and control flow structures
   - Addressing modes
   - Instructions format
   - Procedures and stack usage

4. Processor
   - Processor components

- Control unit
- Execution of instructions
- Execution modes
- Interrupts
- Control unit design
- Starting of a computer
- Program execution time
- Microcontrollers

5. Memory Hierarchy
   - Technology of memories
   - Memory Hierarchy concept
   - Cache memory
   - Virtual Memory

6. input/output systems
   - Input/output devices
   - Storage based on disks
   - Input/output modules
   - Input/output techniques

LEARNING ACTIVITIES AND METHODOLOGY

* Lectures: 1 ECTS. They aim to achieve the specific cognitive competences of the subject, as well as the transversal competences of analysis and abstraction.
* Practical classes: 1 ECTS. They aim to initiate the development of the specific instrumental competences, as well as the transversal competences problem solving and application of knowledge.
* Continuous evaluation exercises: 2 ECTS. Initiated during the practical classes and completed outside of them, they aim to complete the development of the specific instrumental competences and to initiate the development of the specific attitudinal competences, as well as the transversal competences problem solving and application of knowledge.
* Practical work: 1.5 ECTS. Developed without the presence of the teacher, they aim to complete and integrate the development of all the specific and transversal competences, in the resolution of two practical cases where the approach to the problem, the choice of the method of resolution, the results obtained and their interpretation are well documented.
* tutoring: TUTORIALS. Individualized assistance (individual tutorials) or in group (collective tutorials) to the students by the professor.
* Final exam: 0.5 ECTS. It aims to influence and complement the development of specific cognitive and procedural skills. It reflects especially the use of the master classes.

ASSESSMENT SYSTEM

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

The evaluation includes the following parts:

The continuous assessment (60 %) includes:
- Programming and laboratory projects: 30%
- Exercises and small exams to perform in the small groups: 30 %

All labs are mandatory. A student follows the continuous assessment when the student makes all lab projects.
The percentage of the final exam is: 40%. The final exam will include theoretical and practical concepts.
The minimum value for this exam will be 4.
The minimum value for the lab pojects will be 4.
The minimun value for each lab will be 2.

The final grade will be increased by 1 point to those students who complete all parts of the continuous assessment, obtain more than 7 in the continuous evaluation, and at least 4 in the final exam.

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

The final exam in the extraordinary period will include the theoretical and practical concepts of the course.

In this course, students should not use artificial intelligence tools to carry out the work or exercises proposed by the faculty. In the event that the use of AI by the student gives rise to academic fraud by falsifying the results of an exam or work required to accredit academic performance, the Regulation of the University Carlos III of Madrid of partial development of the Law 3/2022, of February 24th, of University Coexistence, will be applied.

BASIC BIBLIOGRAPHY

- Félix García, David Expósito, José Daniel García, Jesús Carretero Problemas resueltos de Estructura de Computadores, 2ª edición, Paraninfo, 2015

ADDITIONAL BIBLIOGRAPHY

- D. A. Patterson, J. L. Hennessy Computer organization and Design RISC-V Edition, Morgan Kaufmann , 2020

BASIC ELECTRONIC RESOURCES

- Félix García Carballeira, Alejandro Calderón Mateos . The Web Elemental Processor SIMulator: https://wepsim.github.io

- Félix García Carballeira, Alejandro Calderón Mateos . CREATOR Simulator (RISC-V programming): https://creatorsim.github.io