Universidad de Alcalá

# TEACHING GUIDE

# Computer Structure and Organization

## Degree in
**Computer Engineering (GIC)**
**Computer Science Engineering (GII)**
**Computer Science Engineering and Business Management and Administration (GII-ADE)**

## Universidad de Alcalá

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**Academic Year 2024/2025**

1st Year - 2nd Semester (GIC+GII)

2nd Year - 2nd Semester (GII-ADE)

Approved by the EPS School Board on June 14th, 2024

# TEACHING GUIDE

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|---|---|
| Course Name: | **Computer Structure and Organization** |
| Code: | **780010 (GIC+GII+GII-ADE)** |
| Degree in: | **Computer Engineering (GIC)**<br>**Computer Science Engineering (GII)**<br>**Computer Science Engineering and Business Management and Administration (GII-ADE)** |
| Department and area: | **Automática**<br>**Computer Architecture and Technology** |
| Type: | **Basic (GIC+GII+GII-ADE)** |
| ECTS Credits: | **6.0** |
| Year and semester: | **1st Year - 2nd Semester (GIC+GII)**<br>**2nd Year - 2nd Semester (GII-ADE)** |
| Teachers: | Antonio J. de Vicente<br>Juana Mª. López |
| Tutoring schedule: | Consultar al comienzo de la asignatura |
| Language: | English |

# 1. COURSE SUMMARY

Computers Structure and Organization is a first year, second semester, mandatory and 6 ECTS subject.

The main aim of this subject is getting the knowledge about the main blocks and their interrelationships to compound Von Neumann architecture. Different blocks design will be presented in order to assess overall efficiency. Moreover, several assembly languages will be used in laboratory classes.

This subject provides essential knowledge for oriented programming students as well as system managers. Subject contents are based on previous subjects as Computer Technology Fundamentals and will be necessary for further subjects of this study plan.

# 2. SKILLS

### Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following basic, generic and cross curricular skills:

**en_CG4** - Ability to define, evaluate and select hardware and software platforms for the development and execution of computer systems, services and applications, in accordance with the knowledge acquired as set out in section 5, annex 2, of resolution BOE-A-2009 -12977.

**en_CG6** - Ability to conceive and develop centralized or distributed computer systems or architectures integrating hardware, software and networks in accordance with the knowledge acquired as set out in section 5, annex 2, of resolution BOEA-2009-12977.

**en_CG8** - Knowledge of the basic subjects and technologies, which enable them to learn and develop new methods and technologies, as well as those that provide them with great versatility to adapt to new situations.

**en_CG9** - Ability to solve problems with initiative, decision making, autonomy and creativity. Ability to know how to communicate and transmit the knowledge, skills and abilities of the profession of Computer Engineering Engineer.

**en_CG11** - Ability to analyze and assess the social and environmental impact of technical solutions, including the ethical and professional responsibility of the activity of the Technical Computer Engineer.

**en_CB1** - That students have demonstrated to possess and understand knowledge in an area of study that is based on general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study.

**en_CB2** - That the students know how to apply their knowledge to their work or vocation in a professional manner and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.

**en_CB3** - That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

**en_CB4** - That students can transmit information, ideas, problems and solutions to both a specialized and non-specialized public.

**en_CB5** - That the students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

**en_TRU1** - Capacity of analysis and synthesis.

**en_TRU2** - Oral and written competencies.

**en_TRU3** - Ability to manage information.

**en_TRU4** - Autonomous learning skills.

**en_TRU5** - Team work.

## Specific Skills

This course contributes to acquire the following specific skills:

**en_CI9** - Ability to know, understand and evaluate the structure and architecture of computers, as well as the basic components that make them up.

**en_CIB5** - Knowledge of the structure, organization, operation and interconnection of computer systems, the fundamentals of their programming, and their application for solving engineering problems.

## Learning Outcomes

**LO1**. To describe Interrelationship between Von Neumann Architecture Blocks.

**LO2.** Understand how different data path design options, instruction set, control unit, memory, and input/output systems affect final performancel.

**LO3.** To know the essential characteristics of the Von Neumann architecture and its associated programming model, differentiating the Von Neumann model from other computation models.

**LO4**. To applymicroprogrammingfundamentals.

**LO5**.To know cachememorysystems.

**LO6**.Know the basic methods of synchronization in incoming/outgoing transfers

**LO7.** To know the i80x86 instruction set and about programming techniques

# 3. CONTENTS

| Theoretical Block Contents | Total hours |
|---|---|
| **Block 1: ALU**<br><br>• Performance<br>• ALU structure and operators<br>• Speeding up the add operation and influence on performance<br>• Multiply and divide operation | 6 hours. |
| **Block 2: Instruction set**<br><br>• Operation and instruction types<br>• Addressing modes<br>• Instructions coding and use frequency.<br>• RISC vs. CISC | 6 hours. |
| **Block 3: Control Unit and Datapath**<br><br>• Elemental operations<br>• Execution Instruction Chronogram<br>• Microprogramming and wired logic design<br>• Data path and clock frequency | 6 hours. |
| **Block 4: Memory hierarchy**<br><br>• Memory fundamentals<br>• Memory Hierarchy<br>• Cache memory | 5 hours. |
| **Block 5: Input/Output system**<br><br>• Synchronization<br>• Buses<br>• Massive storage Buses | 5 hours. |

| Practice Block Contents | Total hours |
|---|---|
| • x86 bits software architecture<br>• Instruction set<br>• Programming and development tools<br>• Procedures and system calls | 28 hours. |
| | |

# 4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

## 4.1. Credits Distribution

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|---|---|
| Number of on-site hours: | 60 hours (56 hours on-site +4 exams hours) |
| Number of hours of student work: | 90 |
| Total hours | 150 |

## 4.2. Methodological strategies, teaching materials and resources

This is a 6 ECTS subject. Formative activities for this learning process will be the following:

- Lectures
- Solving problem sessions
- Laboratory sessions
- Folowing-up activities
- Practices' delivery
- Tutorial sessions. Both, individual and group ones

Moreover, following formative activities can be used:

- Individual or group homework.
  Attending to related to the subject conferences.
- To guarantee the acquisition of competences by the student, the subject activities are distributed as:
  3 theoretical ECTS, lectures and discussing activities.
  3 practical ECTS, problem solving and laboratory activities

Communication and Information activities may be used as formative activities support. Through the BlackBoard platform, the following materials are made available to students for download and study: slides used in theory classes, exercise statements for each lesson for autonomous completion, solutions to some of the proposed exercises to facilitate studying, and additional exercises. Students can also be provided with other educational resources and multiple-choice question exercises through other platforms such as Woodclap or Kahoot.

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|---|---|
| | • Lectures<br>• Practical problem solving<br>• Folowing-up activities<br>• Practices' delivery<br>• Partial exams |
| Homework | • Individual study<br>• Problem solving<br>• Activity participation |
| Tutorial sessions | • Tutorial sessions may be grouped or individual ones. Students ask to the teacher about related to this subject doubt during these sessions. |

Students can download subject documentation from the subject Website

# 5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

## 5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

**Evaluation Procedures**

**1. Ordinary exam:** Evaluation in the ordinary exam should be based on continuous assessment criteria (Regulatory Standards of teaching and learning processes, NRPEA , Article 3) , consistent with the acquisition of the specified competencies in the subject.
a. **Continuous Assessment:** students must pass laboratory practices and two practices exams. Homework must be passed too. A global exam must be passed too. Evaluation of practices and homework deliveries will take place throughout the semester.
b. **Final assessment:** consist in doing and passing a final exam.

**2. Extraordinary exam:** two different situations arise:
a. Students with passed homework and practices. Student can choose if previous is kept. The rest of the evaluation will be based on a final exam
b. The student has mark or choose not to take it into account. The evaluation would consist of a full final exam.

## 5.2. EVALUATION

Evaluation criteria should address the acquisition of skills by students. Next ones are defined:

- **EC1**. Student can infer how arithmetic operations, rounding techniques are performed
- **EC2**. Student is able to program different instruction sets, as well as design new ones.
- **EC3**. Student has enough knowledge to differentiate among diverse computational models
- **EC4**. Student has enough knowledge to design a control memory with different approaches
- **EC5**. Student can design a memory system hierarchy from a performance requirement document
- **EC6**. Student has knowledge about I/O systems, buses and different synchronization methods
- **EC7**. Student has enough knowledge of the i80x86 instruction set and about programming techniques

### Assessment Tools.

This section specifies the evaluation tools to be applied to each of the evaluation criteria.

The assessment methodology for this course entails continuous evaluation, which comprises two theory partial exams, denoted as PEI1 and PEI2, each with a different weight. Specifically, the first theory exam accounts for 30% of the final grade, while the second theory exam carries a weight of 40%. Moreover, students could earn up to 10% of the final mark within the 40% weight by completing certain activities or deliverables.

Regarding the practical component of the course, students will be evaluated through two partial exams. It is important to note that up to 10% of the mark within the 30% weight may be obtained through the assessment of practice deliveries. Students are required to attend a minimum of 80% of laboratory session**s**.

In final evaluation and in the extraordinary exam, the total weight of the theory is 70% and the laboratory 30%.

### Flinal Marks Criteria

This section summarizes the evaluation criteria for passing the subject.

**Ordinary exam - continuous assessment**

Ordinary exam - continuous assessment. The relationship among criteria, instruments and marks will be as follows

| Competences | Learning Outcomes | Evaluation Criteria | Assessment Tools | Weight in Mark |
|---|---|---|---|---|
| en_CG4, en_CG6, en_CG8, en_CG9, en_CG11, en_CB1, en_CB2, en_CB3, en_CB4, en_CB5, en_CIB5, en_CI9 | LO1-LO3 | EC1-EC4 | Theory partial exam | 30% |
| | L05-LO7 | EC2,EC6, EC7 | Practices, partial exam | 30% |
| | L05-L06 | EC5-EC6 | Theory partial exam, follow-up activities | 40% |

It is required to pass the subject, in continuous assessment, to pass at least 3 practices of 4, as well as pass the practices exam. As a general rule, those students in ordinary session that not submitted to the evaluation of 2 practices and at least 2 following activities will get a mark of “NOT ATTENDED”.

Ordinary exam – Final Exam

| Competences | Learning Outcomes | Evaluation Criteria | Assessment Tools | Weight in Mark |
|---|---|---|---|---|
| en_CG4, en_CG6, en_CG8, en_CG9, en_CG11, en_CB1, en_CB2, en_CB3, en_CB4, en_CB5, en_CIB5, en_CI9 | LO1-LO6 | EC1-EC6 | Theory exam | 70% |
| en_CG4, en_CG6, en_CIB5, en_CI9 | LO2-LO7 | EC2, EC6, EC7 | Practice exam | 30% |

Extraordinary exam - Final exam

| Competences | Learning Outcomes | Evaluation Criteria | Assessment Tools | Weight in Mark |
|---|---|---|---|---|
| en_CG4, en_CG6, en_CG8, en_CG9, en_CG11, en_CB1, en_CB2, en_CB3, en_CB4, en_CB5, en_CIB5, en_CI9 | LO1-LO6 | EC1-EC6 | Theory exam | 70% |
| en_CG4, en_CG6, en_CIB5, en_CI9 | LO2-LO7 | EC2, EC6, EC7 | Practice exam | 30% |

# 6. BIBLIOGRAPHY

## 6.1. Basic Bibliography


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- Computer Organization and Design. RISC-V Edition, David A. Patterson, John Hennessy. Morgan-Kaufman 2018.
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- El lenguaje ensamblador de los 80x86. J. Beltrán de Heredia. Anaya Multimedia
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## 6.2. Additional Bibliography

- Guía Práctica de RISC-V: El Atlas de una Arquitectura AbiertaPrimera Edición, 1.0.5. David A. Patterson, Andrew Waterman. 2018.
- Organización de Computadores. Carl Hamacher, Zvonko Vranesic y Safwat Zaky. McGraw Hill, 2003.
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- Structured Computer Organization. Andrew S. Tanenbaum. Prentice Hall, 4th edition, 1999.

- Lenguaje ensamblador para computadoras basadas en Intel. 5ª Edición. 2008.
- Microprocesadores: el 8088/86. F. Remiro Domínguez y A. Martín García. AKALâ€Biblioteca Tecnológica

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## Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.