Universidad de Alcalá

TEACHING GUIDE

Industrial Computing

Degree in
Industrial Electronics and Automatics Engineering

Universidad de Alcalá

Academic Year 2025/2026

2nd Year - 2nd Semester

Approved by the EPS School Board on June 16th, 2025

TEACHING GUIDE

Course Name:	**Industrial Computing**
Code:	**600011**
Degree in:	**Industrial Electronics and Automatics Engineering**
Department and area:	**Automática** **Computer Architecture and Technology**
Type:	**Compulsory**
ECTS Credits:	**6.0**
Year and semester:	**2nd Year, 2nd Semester**
Teachers:	Por definir
Tutoring schedule:	Consultar al comienzo de la asignatura
Language:	English

1. COURSE SUMMARY

Industrial Computing is a compulsory curse for the Degree in Industrial Electronics and Automation Engineering lectured in the second year, second semester. It is the second course of two on the matter of Computer Programming; the first is a basic course offered in first year.

In this subject the student is introduced to the elementary concepts of computers and the development of programs for industrial engineering, describing programmable elements from a functional point of view.

Concepts covered include Microcontroller programming, operating systems and real time systems focused on the solution of industrial problems and situations. The program development part is done using a general-purpose programming language.

It is strongly recommended to have taken the Computer Programming course offered in the first year

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/351/2009:

en_TR2 - Knowledge in basic and technological subjects, which enables them to learn new methods and theories, and gives them versatility to adapt to new situations.

en_TR3 - Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.

en_TR4 - Knowledge to carry out measurements, calculations, assessments, appraisals, appraisals, studies, reports, work plans and other similar works.

en_TR9 - Ability to work in a multilingual and multidisciplinary environment.

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.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/351/2009:

en_CEI6 - Ability to design analog, digital and power electronic systems.

en_CEI10 - Applied knowledge of industrial computing and communications.

Learning Outcomes

RASP6. To explain the specific characteristics of the architecture of a microprocessor-based system.

RASP7. To explain the functions and basic concepts associated to Operating Systems and tools for Industrial Software Development.

RASP8. To explain basic characteristics of embedded systems used for the control of Industrial Processes.

RASP9. To use techniques for the design and development of Industrial control based on a specific Microprocessor.

RASP10. To program peripherals in a microcontroller system for the development of industrial process control systems

RASP11. To design a specific electronic system for the control of industrial processes that includes sensors, actuators, interfaces and a microcontroller..

3. CONTENTS

Contents Blocks	Total number of hours
Module 1. Computer Architecture Concepts	36 hours
Module 2. Tools for application development in Industrial Engineering	3 hours
Module 3. Operating Systems	12 hours
Module 4. Real-time Operating Systems	1 hours
Module 5. Programming an industrial software application using the ARM microprocessor architecture and an embedded OS	6 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site +2 exams hours)
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

The strategic followed is based on a reflexive learning model, which facilitates the discovery and the questioning of possible previous ideas the student may have about the subject as well as the application to problems posed.

For this very reason, theory classes taught in large groups are based on lectures that allow the teacher to introduce the most important concepts and invites to the quest for further knowledge using problem-based learning. The main tool for this is lectures in the large class using slides or computer presentations.

Practical lectures taught mostly in small groups based on solving and problems by the teacher as well as the development of the project work for the course which consists on the development of software applications for each concept taught in lecture classes.

Information Technologies and Communication may be used to aid learning activities (Internet, forums, learning virtual platforms, etc.)

Depending on the available resources and the number of students in the class, innovative and more participate teaching methods may be used

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.

Ordinary Call

Continous Assessment:

The main assessment tools will be:

1. **Laboratory Work (PA):** It consists on the design of hardware and software for an application that should perform some specific processing of input data throwing the expected correct results
2. **Assessment** Tests (PE). consist on practical problems resolution and answering basic concepts of application development. Specifically
    1. PEP-1. Cuestion/Code/ Problem solving on the subject of developing an industrial application on a microcontroller for a determined industrial problem, and with the help of the facilities of an Operating System
    2. PEP-2. Resolve practical facts of the developement of applications on a microcontroller-based platform
    3. PEP-3. One or several test related to the resolution of theorical or practical questions of programmable devices and their architecture, and spceially focus on microcontrollers.

It is required to pass the laboratory activities (PA) as it is a part of the practical part acoording to art. 6.4 of applicable norms. It is mandatory to submit on time and with adequate presentation all and every practice. Obtaining a grade of 5 is considered enough to pass the subject. Additionally, students should attend at least 70% of in-person sessions, particularly those where the teacher should evaluate laboratory activities.

As a general criteria, if a student does not submit all the evaluation tests, he/she will obtain a “not presented”
It is mandatory to submit to all grading activities to approve the subject

Assessment through final exam:

In the case of evaluation by means of a final exam, the evaluation elements to be used will be the following:

• Final Exam (PEF): it consists on problems resolution by means of a software application and the desmonstration of level of acquisition of theoretical concepts of the subject

In this case and given that all regulative aspects are fulfilled in time, the final evaluation consists of a single exam for 100% of the grade. The required condition to attend this exam is to present all the laboratory activities and obtain at least 50% of the grade for each and everyone of these. Activities should be submited up to the day before scheduled for the final exam

Extraordinary Call

The procedure will be the same as that described for the assessment by means of a final exam in the ordinary call.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level in which the competences have been acquired by the student. For that purpose, the following are defined::

CE1. The student demonstrates capacity and initiative to solve practical problems posed for the development of computer programs in the industrial field

CE2. The student is able to completely develop a microcontroller-based system starting from functional requirements and time and resource requirements

CE3. The student classifies and identifies the essential factors of architectures of microcontroller-based systems

CE4. The student has technical knowledge for general purpose software applications development as well as for embedded and real-time systems

CE5. The student can develop software tools to execute under a given Operating system environment.

CE6. The student can correctly program a microprocessor using a development system

GRADING TOOLS

The work of the student is graded in terms of the assessment criteria above, through the following tools:

1. Ordinary call
    a. **Assessment Tests (PE)**. consist on practical problems resolution and answering basic concepts of application development.
    b. **Laboratory Work (PA):** It consists on the design of hardware and software for an application that should perform some specific processing of input data throwing the expected correct results
    c. **Final assessment (PEF)**

2. Extraordinary call.
    1. **Final assessment (PEF)**

GRADING CRITERIA

In the ordinary call-continuous assessment the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CEI6,CEI10,TR2,TR3,TR9	RASP6,RASP9,RASP11	CE1, CE3, CE4, CE5	PEP-1	40%
CEI10,TR3,TR4	RASP7,RASP8,RASP9	CE2, CE5, CE6	PEP-2	40%
CEI10,TR3,TR4	RASP7,RASP9,RASP10	CE5, CE6	PEP-3	20%

It is required to pass the laboratory activities (PA) as it is a part of the practical part acoording to art. 6.4 of applicable norms. It is mandatory to submit on time and with adequate presentation all and every practice. Obtaining a grade of 5 is considered enough to pass the subject. Additionally, students should attend at least 70% of in-person sessions, particularly those where the teacher should evaluate laboratory activities.

As a general criteria, if a student does not submit at any of the evaluation tests, he/she will obtain a “not presented”

It is mandatory to submit to all grading activities to approve the subject

In the ordinary call-final evaluation, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CEI6,CEI10,TR2,TR3,TR4,TR9	RASP6, RASP7, RASP8, RASP9, RASP10, RASP11	CE1, CE2, CE3, CE4, CE5, CE6	PEF	100%

The final evaluation is designed only for those students who obtain the permission to skip the continuous evaluation process. In this case and given that all regulative aspects are fulfilled in time, the final evaluation consists of a single exam for 100% of the grade. The required condition to attend this exam is to present all the laboratory activities and obtain at least 50% of the grade for each and everyone of these. Activities should be submited up to the day before scheduled for the final exam

Extraordinary call

In the case of the extraordinary call, the same percentages that have been established in the case of the evaluation by means of a final exam will be maintained.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- ARM Cortes-M3 Reference Manual https://developer.arm.com/documentation/ddi0337/
- The definitive Guide to the ARM CORTEX-M3. Second Edition, Joseph Yiu. Elsevier.
- Pthreads Programming. Ed: O'Reilly. Bradford Nichols, Dick Buttlar & Jacqueline Proulx Farrel
- RTX Reference Manual. https://www.keil.com/pack/doc/CMSIS/RTOS/html/index.html

6.2. Additional Bibliography

- Operating Systems. Andrew S. Tanenbaum. Pearson Education.
- Software engineearing. S. Pressman McGraw-Hill. Roger

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.