UAB
Universitat Autònoma de Barcelona

Cyberphysical Systems

Code: 44732
ECTS Credits: 6

2025/2026

Degree	Type	Year
Research and Innovation in Computer based Science and Engineering	OP	1

Contact

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

None

Objectives and Contextualisation

The objective of the subject is to train students to be able to design computating systems that are integrated into processes that interact with the physical world.

- Learn to model and analyze the behaviour of the physical world
- Learn to design control systems
- Propose control systems and create simulation environments to evaluate their characteristics
- Create control systems that interact with the physical world in real time

Learning Outcomes

1. CA08 (Competence) Design innovative applications in the fields of science and engineering by applying solutions theoretical models and using techniques and tools based on cyber-physical systems.
2. CA09 (Competence) Analyse research results to obtain new products or processes based on cyber-physical systems, and assess their industrial and commercial viability for their transfer to society.
3. KA12 (Knowledge) Describe the principles, functions and attributes of cyber-physical systems, embedded systems and the Internet of Things (IoT) paradigm, as well as identify the specifications and performance metrics of the different cases.
4. KA13 (Knowledge) Describe the operation of sensing, connection and cognition features; sensors, actuators, computation and communication protocols; modelling, analysis and tools.
5. SA14 (Skill) Solve problems that require elements of the IoT value chain in order to implement cyber-physical systems by structuring the tasks at each level (device, periphery, cloud), and selecting appropriate technologies and tools.
6. SA15 (Skill) Design the optimal solution for specific cyber-physical systems based on cost-performance criteria (real time and energy efficiency) and using sensors and actuators, embedded and real or virtual mobile platforms, for both computing and communication.
7. SA16 (Skill) Develop project solutions in the different fields of cyber-physical systems taking into account aspects of multidisciplinary co-design, privacy and data security.

8. SA17 (Skill) Select information from the scientific literature using the appropriate channels, then integrate this information using synthesis and debate skills and analyse any viable alternatives.

Content

1. Introduction to cyber-physical systems and applications
2. Modeling of continuous dynamics systems
3. Modeling of discrete systems
4. Computing models (dataflow, state machines, etc.) and hybrid systems
5. Systems simulation
6. Embedded computing platforms
7. Control algorithms
8. Platform development and integration
9. Project presentation

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory classes	26	1.04	CA09, KA13, SA17, CA09
Type: Supervised			
Discussion and laboratory sessions	24	0.96	KA13, SA14, SA15, SA16, KA13
Type: Autonomous			
Project development	80	3.2	CA08, SA14, SA15, SA16, CA08

Theory classes:
Presentations on the board of the theoretical part of the subject syllabus. The basic knowledge of the subject is presented and instructions on how to complete and deepen the materials.

Project development:
The scientific and technical knowledge presented in the master classes is worked on in the context of challenges to implement specific cyber-physical systems. The challenges will be worked on iteratively in discussion seminars with the teacher as well as with laboratory sessions where the implementation will be carried out on the final execution platform. Students will have to make several presentations in the class as they progress in defining their project and will have to deliver the presentation made during the class through the virtual campus. In these sessions and the development sessions in the laboratory, the ability to analyze and synthesize, critical reasoning is promoted, and the student is trained in communicating results and solving problems.

Use of AI:
For this subject, the use of Artificial Intelligence (AI) technologies is permitted exclusively in support tasks, such as bibliographic or information searches, text correction or translations. The student must clearly identify which parts have been generated with this technology, specify the tools used and include a critical reflection on how these have influenced the process and the final result of the activity.

The lack of transparency in the use of AI in this assessable activity will be considered a lack of academic honesty and may lead to a partial or total penalty in the grade of the activity, or greater sanctions in serious cases.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Laboratory work	40%	10	0.4	CA09, KA12, KA13, SA14, SA15, SA17
Presentations in class	60%	10	0.4	CA08, CA09, KA12, KA13, SA14, SA15, SA16, SA17

This subject does not provide for the single assessment system.

The assessment will be carried out by continuous assessment on the presentations made in class and also delivered through the virtual campus. At least 3 presentations will be made. In these presentations the student will defend the evolution of his project, both in the conceptual field and the work done in the laboratory. The continuous evaluation mark will be calculated as an average of the score obtained in each of these installments.

Attendance at the laboratory sessions is mandatory and there is no mechanism established for the recovery of sessions not attended. In case of not attending more than 50% of laboratory sessions, the subject will be suspended with a final grade proportional to the number of sessions attended.

Evaluation Considerations:

- The subject is considered non-evaluable when no presentation has been taken and no more than two laboratory sessions have been held.
- Awarding an honors matriculation qualification is the decision of the teaching staff responsible for the subject. UAB regulations indicate that MH can only be granted to students who have obtained a final grade equal to or higher than 9.00. Up to 5% of MH of the total number of enrolled students can be awarded.
- In case of not passing the subject by continuous assessment and having attended the minimum number of laboratory sessions, the student may take a final exam on the subject given in all the activities of the course.
- Without prejudice to other disciplinary measures that are deemed appropriate, and in accordance with current academic regulations, irregularities committed by a student that may lead to a variation of the grade will be graded with a zero (0). For example, plagiarizing, copying, allowing copying, ..., an assessment activity, will involve failing this assessment activity with a zero (0). Assessment activities qualifiedinthis way and by this procedure will not be recoverable. If it is necessary to pass any of these assessment activities to pass the subject, this subject will be failed directly, without the opportunity to recover it in the same course.

Bibliography

- Lee, Edward Ashford, and Sanjit Arunkumar Seshia. *Introduction to embedded systems: A cyber-physical systems approach*. MIT press, 2016.

Software

Intel Quartus Prime Lite Edition (free).

Ptolemy II (free)

Arduino IDE (free)

Python 3 + Jupyter Notebook (free)

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLABm) Practical laboratories (master)	1	English	first semester	afternoon
(TEm) Theory (master)	1	English	first semester	afternoon