GENERAL INFORMATION

Course information	
Name	Smart Systems applied to Industry
Code	DEA-MIC-512
Degree	MIC
Year	1
Semester	Fall
ECTS credits	6 ECTS
Type	
Department	Electronics, Control Engineering and Communications
Area	
Coordinator	Álvaro Sánchez Miralles

Lecturer	
Name	Álvaro Sánchez Miralles
Department	Electronics, Control Engineering and Communications
Area	
Office	D-IIT
e-mail	alvaro@comillas.edu
Phone	
Office hours	Ask for an appointment by email.
Lecturer	
Name	
Department	
Area	
Room	
e-mail	
Tutorial timetable	

DETAILED INFORMATION

Contextualization of the course

Contribution to the professional profile of the master

The purpose of the course is to provide students with a basic overview of the smart system concept and its application to the Industry 4.0.

By the end of the course, students will:

- Know the basic features of a smart system.
- Have practical experience dealing and designing applications related with smart industry.
- Be able to develop data models (with medium complexity) for smart systems, and implement them in MySQL.
- Be able to develop simple C++ programs to implement smart algorithms and modules for the Industry 4.0.

Prerequisites

Students willing to take this course should be very familiar with undergraduate-level programming.

CONTENTS

Contents: Theory
Chapter 1: Introduction to smart systems (4h)
1.1 Main features. 1.2 Architecture. 1.3 Smart systems design. 1.4 Application to smart industry.
Chapter 2: Smart systems data model design and implementation (10h)
2.2 Data models: conceptual, logical and physical. 2.3 How to manipulate data: DML and DDL. 2.4 Implementation in MySQL.
Chapter 3: Smart systems programming (16h)
3.1 Object oriented design. 3.2 Classes, constructors, destructors and attributes. 3.3 Operators and member functions. 3.4 Inheritance and polymorphism. 3.5 Implementation in C++: basic standard library template.
Contents: Laboratory
P1. Selection of a project application: business analysis, actors, architecture of the selected project (2h) P2. Data model design of the selected project. MySQL database training (8h). P3. Project design. Application programming training (14h). P4. Project development (6h)

COMPETENCES AND LEARNING OUTCOMES

Competences and Learning Outcomes	
Competences	
General Competences	
CG3.	The capability of adapting to new theories, methods and changing engineering situations based on a sound technical training.
CG4.	The capability of solving problems with personal initiative, efficient decision making, critical reasoning and transmitting technical information in the engineering world.
CG5.	The capability of conducting measurements, calculations, assessments, studies, reports, planning, etc.

CG10. The ability to work in a multilingual and multidisciplinary environment.

Basic Competences

Specific Competences

Learning outcomes

RA1. The student understands the basic principles behind Smart systems.

RA2. The student has a basic and practical experience in researching about Smart Industry.

RA3. The student has a practical experience in developing data models.

RA4. The student has a practical experience in programming to develop systems for the Smart Industry.

RA5. The student has practical experience in team working.

RA6. The student has a practical experience in developing initiative, creativity and autonomy skills to propose and develop a real project related to the Smart Industry.

TEACHING METHODOLOGY

General methodological aspects

Theory and practice will be combined along the course. The teacher will explain the basics of the subject and will go in depth in the more important issues with illustrative examples. The students will be grouped in pairs in order to put in practice the proposed methods and techniques in a collaborative way.

In-class activities

1. **Lectures and problem-solving sessions (28 hours)**: The lecturer will introduce the fundamental concepts of each chapter, along with some practical recommendations, and will go through worked examples to support the explanation. Active participation will be encouraged by raising open questions to foster discussion and by proposing short application exercises to be solved in class either on paper or using a software package.
2. **Lab sessions (28 hours):** Under the instructor's supervision, students, divided in small groups, will apply the concepts and techniques covered in the lectures to real problems and will become familiar with technologies used in development of smart solutions in the context of Industry 4.0.
3. **Assessment (4 hours)**

Off-class activities

1. **Personal study** of the course material and resolution of the proposed exercises (30 hours)
2. **Lab session** preparation, programming and reporting (30 hours).
3. **Development of the final project** (60 hours).

ASSESSMENT AND GRADING CRITERIA

Assessment activities	Grading criteria	Share
Continuous evaluation	• Understanding of the theoretical concepts. • Application of these concepts to problem-solving.	10%
Final exam	• Understanding of the theoretical concepts. • Application of these concepts to problem-solving.	30%
Lab sessions and reports	• Application of theoretical concepts to real problem-solving. • Ability to program. • Attitude and effort: Initiative and proactive work will be encouraged. • Written communication skills. There will be an intra-group evaluation method to differentiate among team members.	30%
Final project development	• Quality of the project design. • Quality of the project implementation.	30%

GRADING AND COURSE RULES

Grading

Regular assessment

- **Theory** will account for 40%, of which:
  - Continuous evaluation: 10%
  - Final exam: 30%

- **Lab** will account for the remaining 60%

In order to pass the course, the mark of the Lab must be greater or equal to 5 out of 10 points and the mark of the Theory must be greater or equal to 5 out of 10 points. Otherwise, the final grade will be the lower of the two marks.

Retakes

There will be only a final exam which will be the 100% of the grade. It will include both practical questions and theoretical concepts.

Course rules

- Class attendance is mandatory according to Article 93 of the General Regulations (Reglamento General) of Comillas Pontifical University and Article 6 of the Academic Rules (Normas Académicas) of the ICAI School of Engineering. Not complying with this requirement may have the following consequences:

  - Students who fail to attend more than 15% of the lectures may be denied the right to take the final exam during the regular assessment period.

  - Regarding laboratory, absence to more than 15% of the sessions can result in losing the right to take the final exam of the regular assessment period and the retake. Missed sessions must be made up for credit.

- Students who commit an irregularity in any graded activity will receive a mark of zero in the activity and disciplinary procedure will follow (cf. Article 168 of the General Regulations (Reglamento General) of Comillas Pontifical University).

WORK PLAN AND SCHEDULE[1]

In and out-of-class activities	Date/Periodicity	Deadline
• Continuous evaluation activities to review and self-study of the concepts covered in the lectures	Periodically on demand.	-
• Final exam	Last week	-
• Lectures and lab sessions	Weekly	-
• Review and self-study of the concepts covered in the lectures	Weekly	-
• Project preparation	Weekly	-

STUDENT WORK TIME SUMMARY			
IN-CLASS HOURS			
Lectures	**Lab sessions**	**Assessment**	
28	28	4	
OFF-CLASS HOURS			
Self-study	**Lab preparation and reporting**	**Project development**	
30	30	60	
		ECTS CREDITS:	**6 (180 hours)**

BIBLIOGRAPHY

Basic
• Presentations prepared by the lecturer (available in Moodle).
Complementary

[1] A detailed work plan of the subject can be found in the course summary sheet (see following page). Nevertheless, this schedule is tentative and may vary to accommodate the rhythm of the class.

ORIENTATIVE SCHEDULE

THEORY PROGRAM	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10	w11	w12	w13	w14	w15
Introduction to Smart Systems															
Smart systems data model design and implementation															
Smart systems programming															

LABORATORY PROGRAM	w1	w2	w3	w4	w5	w6	w7	w8	w9	w10	w11	w12	w13	w14	w15
P1. Selection of project application															
P2. Data model design															
P3. Project design															
P4. Project development															