



1. General information

Course: CYBER-PHYSICAL SYSTEMS**Type:** CORE COURSE**Degree:** 2359 - MASTERS DEGREE PROGRAMME IN COMPUTER ENGINEERING (CR-2019)**Center:** 108 - SCHOOL OF COMPUTER SCIENCE OF C. REAL**Year:** 1**Main language:** Spanish**Use of additional languages:****Web site:** <https://campusvirtual.uclm.es>**Code:** 311047**ECTS credits:** 6**Academic year:** 2021-22**Group(s):** 20**Duration:** First semester**Second language:** English**English Friendly:** Y**Bilingual:** N**Lecturer:** JULIAN CABA JIMENEZ - Group(s): 20

Building/Office	Department	Phone number	Email	Office hours
3.05	TECNOLOGÍAS Y SISTEMAS DE INFORMACIÓN	6725	julian.caba@uclm.es	Available at https://esi.uclm.es/categories/profesorado-y-tutorias

Lecturer: MARIA JOSE SANTOFIMIA ROMERO - Group(s): 20

Building/Office	Department	Phone number	Email	Office hours
3.08	TECNOLOGÍAS Y SISTEMAS DE INFORMACIÓN	3724	mariajose.santofimia@uclm.es	Available at https://esi.uclm.es/categories/profesorado-y-tutorias

2. Pre-Requisites

It is recommended that the student (at least) be familiar with the concepts of the following areas:

- Computer Networks
- Distributed Systems
- Embedded Systems
- Microprocessor-Based Systems Design

The syllabus to be developed in this course assumes that the student knows the basic concepts of the above topics and he/she has acquired these skills: (a) either by taking the subjects directly related to these subjects in the corresponding Degree: Computer Engineering, Technical Engineering in Computer Systems or Technical Engineering in Computer Management; (b) or for the development of his/her professional activity.

3. Justification in the curriculum, relation to other subjects and to the profession

In the last years, we have seen a revolution in the way people and computer systems interact. Applications are being migrated to user-transparent platforms instead of running them on a particular PC or even on a particular server. Users can access to applications (and services) through mobile devices (such as smartphones and tablets) that are permanently connected, offering the behaviour of a ubiquitous computing system.

In this context appears the idea of the "Internet of Things" that significantly changes the way devices relate to each other and to people.

It must be mentioned that, in the short and medium term, the development of technologies and systems that make possible the commercial implementation of these applications will be reflected in a significant demand of this kind of professionals and will open up clear business opportunities in a market segment that will be exploited.

This course is presented as a training complement at an academic and professional level that aims to provide a critical vision of the current technology for all systems related to IoT, cyber-physical systems (CPS) and their future projection. Specifically, in this course the student will acquire knowledge of the existing technology and its application in industry and home.

4. Degree competences achieved in this course

Course competences

Code	Description
CE04	Ability to model, design, architecture define, implement, manage, operate, administrate and maintain applications, networks, systems services and computer content.
CE11	Ability to design and develop systems, applications and computer services on embedded and ubiquitous systems.
INS02	Organising and planning skills.
INS04	Problem solving skills by the application of engineering techniques.
INS05	Argumentative skills to logically justify and explain decisions and opinions.
PER01	Team work abilities.
PER03	Ability to work in an international context.
SIS01	Critical thinking.
SIS03	Autonomous learning.
UCLM01	Command of a second language at a B1 level within the Common European Framework of Reference for Languages
UCLM02	Ability to use Information and Communication Technologies.
UCLM03	Accurate speaking and writing skills.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Understand the concept and the scope of embedded and ubiquitous systems

Learn different technological solutions for the design of applications based on embedded and ubiquitous systems

Know how to effectively apply communications support to a hardware infrastructure

Know how to determine the embedded and ubiquitous system requirements in terms of hardware support, communications and system software

6. Units / Contents

Unit 1: Introduction to Cyber-Physical Systems

Unit 2: Physical Systems, Modelling and Examples

Unit 3: Sensors and Data Acquisition

Unit 4: Actuators and Environmental Control/Monitoring

Unit 5: Communications and Distributed Processing

ADDITIONAL COMMENTS, REMARKS

This subject follows the project/problem-based learning methodology, thus hands-on activities includes such technologies studied in the syllabus

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Combination of methods	CE04 CE11	0.96	24	N	-	Teaching of the subject matter by lecturer (MAG)
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	CE04 CE11 INS02 INS04 INS05 PER01 PER03 SIS01 SIS03 UCLM01 UCLM02 UCLM03	0.96	24	Y	Y	Realization of practicals in laboratory/computing room (LAB)
Group tutoring sessions [ON-SITE]	Group tutoring sessions	CE04 CE11 INS02 INS04 PER01 SIS01	0.18	4.5	N	-	Individual or small group tutoring in lecturer's office, classroom or laboratory (TUT)
Writing of reports or projects [OFF-SITE]	Project/Problem Based Learning (PBL)	CE04 CE11 INS02 INS04 INS05 PER01 PER03 SIS01 SIS03 UCLM01 UCLM02 UCLM03	2.4	60	Y	Y	Preparation of reports or case studies (EVA)
Study and Exam Preparation [OFF-SITE]	Self-study	CE04 CE11 INS02 INS04 INS05 PER01 SIS01 SIS03 UCLM02 UCLM03	0.32	8	N	-	Self-Study (EST)
Final test [ON-SITE]	Assessment tests	CE04 CE11 INS02 INS04 INS05 SIS01 UCLM03	0.06	1.5	Y	Y	Test of the syllabus of the subject (EVA)
Project or Topic Presentations [ON-SITE]	Debates	CE04 CE11 INS02 INS04 INS05 SIS01 UCLM03	0.08	2	Y	N	Lab practical preparation (PLAB)
Workshops or seminars [ON-SITE]	Lectures	CE04 CE11 INS02 INS04 INS05 PER03 SIS01 UCLM01 UCLM02 UCLM03	0.16	4	N	-	
Writing of reports or projects [OFF-SITE]	project-based learning	CE04 CE11 INS02 INS04 INS05 PER01 SIS01 SIS03 UCLM02 UCLM03	0.88	22	Y	Y	
Total:			6	150			
Total credits of in-class work: 2.4			Total class time hours: 60				
Total credits of out of class work: 3.6			Total hours of out of class work: 90				

As: Assessable training activity

Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Oral presentations assessment	10.00%	10.00%	Non-Compulsory activity that can be retaken (EVA).
Practicum and practical activities reports assessment	20.00%	20.00%	Non-compulsory activity that can be retaken. To be carried out during the theory/lab sessions. (LAB)
Assessment of problem solving and/or case studies	25.00%	25.00%	Theoretical and/or practical work, reports and/or problem solving and cases. (EVA). Compulsory activity that can be retaken.
Final test	30.00%	30.00%	Theoretical and/or practical work, reports and/or resolution of problems and cases. (EVA). Compulsory activity that can be retaken.
Self Evaluation and Co-evaluation	15.00%	15.00%	Self-evaluation test. Compulsory activity that can be retaken. (EST)

Total:	100.00%	100.00%	
---------------	----------------	----------------	--

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

In compulsory activities, a minimum mark of 40% is required in order to pass that activity and have the possibility to therefore pass the entire subject. The evaluation of the activities will be global and therefore must be quantified by means of a single mark. In the case of the activities that may be retaken (i.e., rescheduling), an alternative activity or test will be offered in the resit/retake exam call (convocatoria extraordinaria).

The final exam will be common for all the theory/laboratory groups of the subject and will be evaluated by the lecturers of the subject in a serial way, i.e., each part of the final exam will be evaluated by the same lecturer for all the students.

A student is considered to pass the subject if she/he obtains a minimum of 50 points out of 100, taking into account the points obtained in all the evaluable activities, and also has passed all the compulsory activities.

For students who do not pass the subject in the final exam call (convocatoria ordinaria), the marks of activities already passed will be conserved for the resit/retake exam call (convocatoria extraordinaria). If an activity is not recoverable, its assessment will be preserved for the resit/retake exam call (convocatoria extraordinaria) even if it has not been passed. In the case of the passed recoverable activities, the student will have the opportunity to receive an alternative evaluation of those activities in the resit/retake exam call and, in that case, the final grade of the activity will correspond to the latter grade obtained.

The mark of the passed activities in any call, except for the final exam, will be conserved for the subsequent academic year at the request of the student, provided that mark is equal or greater than 50% and that the activities and evaluation criteria of the subject remain unchanged prior to the beginning of that academic year.

The failure of a student to attend the final exam will automatically result in her/him receiving a "Failure to attend" (no presentado). If the student has not passed any compulsory evaluation activity, the maximum final grade will be 40%.

Non-continuous evaluation:

Students may apply at the beginning of the semester for the non-continuous assessment mode. In the same way, the student may change to the non-continuous evaluation mode as long as she/he has not participated during the teaching period in evaluable activities that together account for at least 50% of the total mark of the subject. If a student has reached this 50% of the total obtainable mark or the teaching period is over, she/he will be considered in continuous assessment without the possibility of changing to non-continuous evaluation mode.

Students who take the non-continuous evaluation mode will be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences), through the assessment systems indicated in the column "Non-continuous evaluation".

In the "non-continuous evaluation" mode, it is not compulsory to keep the mark obtained by the student in the activities or tests (progress test or partial test) taken in the continuous assessment mode.

Specifications for the resit/retake exam:

Evaluation tests or activities will be conducted for all recoverable activities.

Specifications for the second resit / retake exam:

Same characteristics as the resit/retake exam call.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Unit 1 (de 5): Introduction to Cyber-Physical Systems	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Combination of methods]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	1
Writing of reports or projects [AUTÓNOMA][project-based learning]	2
Teaching period: 1 semana	
Group 20:	
Initial date: 04-10-2021	End date: 10-10-2021
Unit 2 (de 5): Physical Systems, Modelling and Examples	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Combination of methods]	6
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	6
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1.5
Writing of reports or projects [AUTÓNOMA][Project/Problem Based Learning (PBL)]	35
Study and Exam Preparation [AUTÓNOMA][Self-study]	4
Final test [PRESENCIAL][Assessment tests]	.5
Project or Topic Presentations [PRESENCIAL][Debates]	1
Writing of reports or projects [AUTÓNOMA][project-based learning]	3
Teaching period: 3 semanas	
Group 20:	
Initial date: 05-10-2021	End date: 31-10-2021
Unit 3 (de 5): Sensors and Data Acquisition	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Combination of methods]	2
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	4
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1.5
Writing of reports or projects [AUTÓNOMA][Project/Problem Based Learning (PBL)]	10

Study and Exam Preparation [AUTÓNOMA][Self-study]	1
Final test [PRESENCIAL][Assessment tests]	.5
Project or Topic Presentations [PRESENCIAL][Debates]	1
Writing of reports or projects [AUTÓNOMA][project-based learning]	5
Teaching period: 1 semana	
Group 20:	
Initial date: 08-11-2021	End date: 14-11-2021
Unit 4 (de 5): Actuators and Environmental Control/Monitoring	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Combination of methods]	4
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	4
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1
Writing of reports or projects [AUTÓNOMA][Project/Problem Based Learning (PBL)]	10
Study and Exam Preparation [AUTÓNOMA][Self-study]	1
Final test [PRESENCIAL][Assessment tests]	.25
Writing of reports or projects [AUTÓNOMA][project-based learning]	5
Teaching period: 2 semanas	
Group 20:	
Initial date: 15-11-2021	End date: 28-11-2021
Unit 5 (de 5): Communications and Distributed Processing	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Combination of methods]	8
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	10
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	.5
Writing of reports or projects [AUTÓNOMA][Project/Problem Based Learning (PBL)]	5
Study and Exam Preparation [AUTÓNOMA][Self-study]	1
Final test [PRESENCIAL][Assessment tests]	.25
Workshops or seminars [PRESENCIAL][Lectures]	4
Writing of reports or projects [AUTÓNOMA][project-based learning]	7
Teaching period: 4 semanas	
Group 20:	
Initial date: 29-11-2021	End date: 17-01-2021
Global activity	
Activities	hours
Workshops or seminars [PRESENCIAL][Lectures]	4
Writing of reports or projects [AUTÓNOMA][project-based learning]	22
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	4.5
Writing of reports or projects [AUTÓNOMA][Project/Problem Based Learning (PBL)]	60
Study and Exam Preparation [AUTÓNOMA][Self-study]	8
Final test [PRESENCIAL][Assessment tests]	1.5
Project or Topic Presentations [PRESENCIAL][Debates]	2
Class Attendance (theory) [PRESENCIAL][Combination of methods]	24
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	24
Total horas: 150	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Kevin Roebuck	Service-oriented Architecture (SOA): High-impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors http://books.google.es/books/about/Service_oriented_Architecture_SOA_High_i.html?id=mdKUZwEACAAJ&redir_esc=y	Emereo Pty Limited		9781743044926	2011	
Poslad, Stefan	Ubiquitous computing : smart devices, environments and interactions	Wiley		9780470035603	2009	
Dogan Ibrahim	Microcontroller based Applied Digital Control	John Wiley & Sons		978-0-470-86335-0	2006	
Raj Rajkumar, Dionisio de Niz, Mark Klein	Cyber-Physical Systems	O'Reilly		9780133416169	2016	
Ogata, Katsuhiko	Ingeniería de control moderna	Pearson-Prentice Hall		978-84-8322-660-5	2010	