

**1. General information****Course:** CONCURRENT AND REAL TIME PROGRAMMING**Code:** 42317**Type:** CORE COURSE**ECTS credits:** 6**Degree:** 406 - UNDERGRADUATE DEGREE IN COMPUTER SCIENCE AND ENGINEERING (AB)**Academic year:** 2023-24**Center:** 604 - SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (AB)**Group(s):** 10 11 12**Year:** 2**Duration:** C2**Main language:** Spanish**Second language:** English**Use of additional languages:****English Friendly:** N**Web site:****Bilingual:** Y**Lecturer:** PABLO BERMEJO LOPEZ - Group(s): 10

Building/Office	Department	Phone number	Email	Office hours
ESII / 0.C.14	SISTEMAS INFORMÁTICOS	2620	pablo.bermejo@uclm.es	Office hours can be found at: https://www.esiib.uclm.es/pers.php?codpers=725&curso=2023-24

Lecturer: M^a DEL CARMEN RUIZ DELGADO - Group(s): 10 11 12

Building/Office	Department	Phone number	Email	Office hours
ESII / 0.A.15	SISTEMAS INFORMÁTICOS	2430	mcarmen.ruiz@uclm.es	Office hours can be found at: http://esiib.uclm.es/pers.php?codpers=113&curso=2023-24

2. Pre-Requisites

This course builds on the skills and knowledge acquired in the subjects:

Programming Fundamentals I

Programming Fundamentals II

Operating Systems I

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

The Real Time and Concurrent Programming course is a compulsory subject of the Degree in Computer Engineering and its justification is directly linked to the evolution of operating systems, particularly the concepts of multithreading and multiprocessor. In this context, the student must know and master the basic techniques of management of racing conditions, such as synchronization and communication mechanisms between processes. Also, programming for real-time systems is another key aspect to obtain the skills necessary to design and implement this type of critical systems that are part of our daily lives.

In the professional market, a graduate must ensure some knowledge on concurrent and real-time scheduling, taking particular account of market developments processors and processing systems in general, which show a clear trend of multiprocessing .

4. Degree competences achieved in this course**Course competences**

Code	Description
BA04	Basic knowledge about the uses and programming of computers, operating systems, data bases, and digital programmes with applications in engineering.
CO06	Knowledge and application of basic algorithms in digital technologies for the development of solutions, analysing their appropriateness and complexity.
CO07	Knowledge, design, and efficient use of types of data and structures which arise as most appropriate in problem solving.
CO08	Ability to analyse, design, build and maintain applications in a strong, safe, and efficient manner by selecting the most appropriate paradigms and programming languages.
CO14	Knowledge and application of fundamental principles and basic techniques on parallel, converging, distributed, and real time programming.
PER02	Ability to work in multidisciplinary teams.
PER05	Acknowledgement of human diversity, equal rights, and cultural variety.

5. Objectives or Learning Outcomes**Course learning outcomes**

Description

Resolution of complex problems and responses in real time by the use of concurrent programming concepts and tools, planning their tasks, as well as an efficient utilization of memory.

6. Units / Contents

Unit 1: Introduction

Unit 2: Busy Wait Synchronization

Unit 3: Shared-Memory Communication

Unit 3.1 Semaphores

Unit 3.2 Monitors

Unit 4: Message-Passing Communication

Unit 5: Real Time

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	CO07 CO08 CO14 PER05	1.32	33	N	-	Problem-based learning and master lesson. Presentation of the contents of the subject and consolidation by carrying out exercises
Computer room practice [ON-SITE]	Practical or hands-on activities	BA04 CO06 CO07 CO08 CO14 PER02 PER05	0.8	20	Y	Y	Application of the contents studied through exercises in the JAVA programming language. Team work
Progress test [ON-SITE]	Assessment tests	CO06 CO07 CO08 CO14	0.16	4	Y	N	There will be two mid-term exams of the theory part
Final test [ON-SITE]	Assessment tests	CO06 CO07 CO08 CO14	0.12	3	Y	Y	
Study and Exam Preparation [OFF-SITE]	Self-study	CO06 CO07 CO08 CO14	2.4	60	Y	N	
Study and Exam Preparation [OFF-SITE]	Problem solving and exercises	CO06 CO07 CO08 CO14	1.2	30	Y	N	Preparation and study of the laboratory practices. Team work.
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
Assessment of active participation	5.00%	0.00%	Delivering correctly resolved the practices carried out during the course and in the indicated deadlines may mean an increase in the grade by a maximum of 10 points, and its value will be added to the Final note, provided that between Theory and Practice 50 points or more are reached.[PRES:10%]
Theoretical exam	70.00%	70.00%	There will be two midterms. The first one in the middle of the course and the last one on the date set for the ordinary exam. The Theory grade will be calculated as: (Midterm 1 * 0.35) + (Midterm 2 * 0.35). A minimum grade of 4 (out of 10) is required in each part in order to add them up to obtain the final grade of the Theory part. [ESC:55% INF:15%]
Laboratory sessions	30.00%	30.00%	Both for continuous and non-continuous evaluation, the same evaluation will be carried out. [LAB:25% INF:5%]
Total:	105.00%	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:

To overcome the subject the student must obtain a 50 out of 100 in the subject, fulfilling the following criteria:

- Theory: (Maximum 70 points):

It will be mandatory to reach 40% of the grade in the Theory part to be able to add it with the Practice part.

There will be two midterms. The first one in the middle of the course and the last one on the date set for the ordinary exam.

The Theory grade will be calculated as: (Midterm1 * 35) + (Midterm2 * 35). A minimum grade of 4 (out of 10) is required in each part in order to add them up and obtain the final grade of the Theory part.

- Practice: (Maximum 30 points). It will be mandatory to reach 40% of the grade in the Practice part to be able to add them up with the Theory part. It will be evaluated with an exam on the same date as the ordinary exam of the subject.

To obtain the Final grade it is essential to have reached 40% of the grade of the Theory part and the Practice part. When this occurs, the final grade shall be calculated as:

Final = Theory + Practice + Participation

Participation: Actively participate in the activities developed in the classroom in the theory sessions may mean an increase in the grade by a maximum of 5 points (out of 100), and its value will be added to the Final note, provided that between Theory and Practice 50 points or more are reached.

If the minimum in Theory or Practice is not reached, the student will have a grade not exceeding 4 even if the sum obtained is another, including more than 5. This grade will be the highest of the parts not passed.

No part of the subject is saved from one academic year to another.

Non-continuous evaluation:

In the non-continuous evaluation the student can get up to 100% of the Final grade, and for this two exams will be carried out with the weight distribution and with the minimums demanded here:

- Theory part exam: 70% of the grade, it is necessary to obtain at least a grade of 40% in this exam
- Practice part exam: 30% of the grade, it is necessary to obtain at least a grade of 40% in this exam

Once the minimum marks have been passed, the student's mark will be calculated by applying the weights indicated. If the student passes 50%, he/she will have passed the course.

If the minimum in Theory or Practice is not achieved, the student will have a grade not exceeding 4 even if the sum obtained is another, including more than 5. This grade will be the highest of the parts not passed.

No part of the subject is saved from one academic year to another.

Specifications for the resit/retake exam:

In the retake evaluation the student can get up to 100% of the Final grade, and for this two exams will be carried out with the weight distribution and with the minimums demanded here:

- Theory part exam: 70% of the grade, it is necessary to obtain at least a grade of 40% in this exam
- Practice part exam: 30% of the grade, it is necessary to obtain at least a grade of 40% in this exam

Once the minimum marks have been passed, the student's mark will be calculated by applying the weights indicated. If the student passes 50%, he/she will have passed the course.

If the minimum in Theory or Practice is not achieved, the student will have a grade not exceeding 4 even if the sum obtained is another, including more than 5. This grade will be the highest of the parts not passed.

No part of the subject is saved from one academic year to another.

Note * If the student in ordinary or continuous call passed the theory (50% of the exam - or exams - of the Theory part) or the practices (50% of the exam of the Practice part) that grade can be saved for the extraordinary call, applying in the corresponding section and with the final formula 70-30 as indicated above.

Specifications for the second resit / retake exam:

The same criteria as in the retake exam

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Progress test [PRESENCIAL][Assessment tests]	4
Final test [PRESENCIAL][Assessment tests]	3
General comments about the planning: Lectures are given in a general scheme of three 1.5 hours weekly sessions. This course schedule is APPROXIMATE. It could vary throughout the academic course due to teaching needs, bank holidays, etc. A weekly schedule will be properly detailed and updated on the online platform (Campus Virtual). Note that all the lectures, practice sessions, exams and related activities performed in the bilingual groups will be entirely taught in English.	
Unit 1 (de 5): Introduction	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Combination of methods]	6
Study and Exam Preparation [AUTÓNOMA][Self-study]	9
Unit 2 (de 5): Busy Wait Synchronization	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Combination of methods]	4
Computer room practice [PRESENCIAL][Practical or hands-on activities]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	5
Study and Exam Preparation [AUTÓNOMA][Problem solving and exercises]	4
Unit 3 (de 5): Shared-Memory Communication	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Combination of methods]	10
Computer room practice [PRESENCIAL][Practical or hands-on activities]	11
Study and Exam Preparation [AUTÓNOMA][Self-study]	30
Study and Exam Preparation [AUTÓNOMA][Problem solving and exercises]	15
Unit 4 (de 5): Message-Passing Communication	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Combination of methods]	8
Computer room practice [PRESENCIAL][Practical or hands-on activities]	6
Study and Exam Preparation [AUTÓNOMA][Self-study]	12
Study and Exam Preparation [AUTÓNOMA][Problem solving and exercises]	11
Unit 5 (de 5): Real Time	
Activities	Hours

Class Attendance (theory) [PRESENCIAL][Combination of methods]	5
Study and Exam Preparation [AUTÓNOMA][Self-study]	4
Global activity	
Activities	hours
Progress test [PRESENCIAL][Assessment tests]	4
Computer room practice [PRESENCIAL][Practical or hands-on activities]	20
Class Attendance (theory) [PRESENCIAL][Combination of methods]	33
Study and Exam Preparation [AUTÓNOMA][Problem solving and exercises]	30
Final test [PRESENCIAL][Assessment tests]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	60
Total horas: 150	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Burns, Alan (1953-)	Concurrent programming	Addison-Wesley		0-201-54417-2	1993	
Hartley, Stephen J.	Concurrent programming : the Java programming language	Oxford University Press		0-19-511315-2	1998	
José Tomás Palma y otros	Programacion concurrente	Thomson Paraninfo		84-9732-184-7	2006	
Lea, Doug	Programación concurrente en Java : principios y patrones de	Addison Wesley		84-7829-038-9	2000	
Ben-Ari, Mordechai	Principles of concurrent and distributed programming www.pearsoned.co.uk/ben-ari	Addison-Wesley		978-0-321-31283-9	2006	