



1. General information

Course: CONCURRENT AND REAL TIME PROGRAMMING

Type: CORE COURSE

Degree: 407 - DEGREE PROGRAMME IN COMPUTER SCIENCE ENGINEERING

Center: 108 - SCHOOL OF COMPUTER SCIENCE OF C. REAL

Year: 2

Main language: English

Use of additional
languages:

Web site:

Code: 42317

ECTS credits: 6

Academic year: 2023-24

Group(s): 20 21 22

Duration: C2

Second language: Spanish

English Friendly: N

Bilingual: Y

Lecturer: ANA MARÍA FERNÁNDEZ SÁEZ - Group(s): 22				
Building/Office	Department	Phone number	Email	Office hours
Fermin Caballero	TECNOLOGÍAS Y SISTEMAS DE INFORMACIÓN		ana.fernandez@uclm.es	
Lecturer: FERNANDO GUALO CEJUDO - Group(s): 21				
Building/Office	Department	Phone number	Email	Office hours
	TECNOLOGÍAS Y SISTEMAS DE INFORMACIÓN		Fernando.Gualo@uclm.es	
Lecturer: MIGUEL ANGEL REDONDO DUQUE - Group(s): 21				
Building/Office	Department	Phone number	Email	Office hours
Fermin Caballero / A 1.2	TECNOLOGÍAS Y SISTEMAS DE INFORMACIÓN	926295245	miguel.redondo@uclm.es	Available at https://esi.uclm.es/index.php/grado-en-ingenieria-informatica/profesorado/
Lecturer: DAVID VALLEJO FERNANDEZ - Group(s): 20 21 22				
Building/Office	Department	Phone number	Email	Office hours
Fermin Caballero / 2.01	TECNOLOGÍAS Y SISTEMAS DE INFORMACIÓN	926052112	david.vallejo@uclm.es	Available at https://esi.uclm.es/index.php/grado-en-ingenieria-informatica/profesorado/
Lecturer: ARTURO JOSÉ VILLEGAS GÓMEZ - Group(s): 21 22				
Building/Office	Department	Phone number	Email	Office hours
	TECNOLOGÍAS Y SISTEMAS DE INFORMACIÓN		ArturoJ.Villegas@uclm.es	

2. Pre-Requisites

This subject relies on the competences and learning outcomes gained in the following courses:

- Programming Fundamentals I
- Programming Fundamentals II
- Operating Systems I

The course Operating Systems I represents the most important prerequisite.

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

Based on the evolution of modern operating systems and multi-processing, the course Concurrent and Real-Time Programming offers students the possibility of mastering the fundamental techniques of concurrency management, such as synchronization mechanisms and inter-process communication. Additionally, real-time programming is another relevant topic to be able to design and develop critical systems that plays an important role in our everyday's life.

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.
INS01	Analysis, synthesis, and assessment skills.
INS04	Problem solving skills by the application of engineering techniques.
PER01	Team work abilities.

PER02	Ability to work in multidisciplinary teams.
PER04	Interpersonal relationship skills.
PER05	Acknowledgement of human diversity, equal rights, and cultural variety.
SIS01	Critical thinking.
SIS03	Autonomous learning.
UCLM02	Ability to use Information and Communication Technologies.

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: Basic concepts

Unit 1.1 The process concept

Unit 1.2 Foundations of concurrent programming

Unit 1.3 Foundations of real-time programming

Unit 2: Semaphores and shared-memory

Unit 2.1 Basic concepts

Unit 2.2 Implementation

Unit 2.3 Classical synchronization problems

Unit 2.4 Basic synchronization patterns

Unit 3: Message passing

Unit 3.1 Basic concepts

Unit 3.2 Implementation

Unit 3.3 Classical synchronization patterns

Unit 4: Other synchronization mechanisms

Unit 4.1 Introduction

Unit 4.2 Concurrency in Ada

Unit 4.3 Protected objects

Unit 4.4 Monitors

Unit 5: Scheduling in real-time systems

Unit 5.1 Introduction

Unit 5.2 The concept of real-time

Unit 5.3 Scheduling schemes

Unit 6: Reliability and fault tolerance

Unit 6.1 Basic concepts

Unit 6.2 Prevention and fault tolerance

Unit 6.3 Static and dynamic redundancy

Unit 6.4 Safety, reliability and dependability

ADDITIONAL COMMENTS, REMARKS

Labs

+ Process management

+ Semaphores and shared-memory

+ Message passing

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]	Lectures	BA04 CO06 CO07 CO08 CO14	0.72	18	N	-	Teaching of the subject matter by lecturer (MAG)
Individual tutoring sessions [ON-SITE]		BA04 CO06 CO07 CO08 CO14	0.18	4.5	N	-	Individual or small group tutoring in lecturer's office, classroom or laboratory (TUT)
Study and Exam Preparation [OFF-SITE]	Self-study	BA04 CO06 CO07 CO08 CO14 SIS01 SIS03	2.1	52.5	N	-	Self-study (EST)
Other off-site activity [OFF-SITE]	Practical or hands-on activities	BA04 CO06 CO07 CO08 CO14 INS01 INS04 SIS03	0.6	15	N	-	Lab practical preparation (PLAB)
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	BA04 CO06 CO07 CO08 CO14 INS04 PER01 PER04 PER05 SIS01 SIS03	0.6	15	Y	N	Worked example problems and cases resolution by the lecturer and the students (PRO)
Writing of reports or projects [OFF-SITE]	Self-study	BA04 CO06 CO07 CO08 CO14 INS01 INS04 PER02 PER04 PER05	0.9	22.5	Y	N	Preparation of essays on topics proposed by lecturer (RES)
Laboratory practice or sessions	Practical or hands-on activities	BA04 CO06 CO07 CO08	0.6	15	Y	Y	Realization of practicals in laboratory

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

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).

Same characteristics as the resit/retake exam call.

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Silberschatz, A., Galvin, P., Gagne, G.	Operating Systems Concepts	Mc Graw-Hill		978-1118093757	2013	
Vallejo, D., González, C., Albusac, J.A.	Programación Concurrente y Tiempo Real (3ª Edición) http://www.libropctr.com/	Amazon CreateSpace		978-1518608261	2016	
Burns, A., Wellings, A.	Sistemas en tiempo real y lenguajes de programación	Addison-Wesley		978-8478290581	2003	
Kernighan, B., Ritchie, D.	El lenguaje de programación C	Prentice-Hall		978-9688802052	1991	
Rochkind, M.	Advanced Unix Programming	Prentice-Hall		978-0131411548	2004	