

Academic Year: ( 2023 / 2024 )

Review date: 09-02-2024

Department assigned to the subject: Computer Science and Engineering Department

Coordinating teacher: GARCIA SANCHEZ, JOSE DANIEL

Type: Electives ECTS Credits : 6.0

Year : 4 Semester :

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Programming Techniques (Year 1 / Term 2)

Sistemas Operativos (Year 2 / Term 2)

Computer Architecture (Year 3 / Term 1)

**SKILLS AND LEARNING OUTCOMES**

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study.

CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.

CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.

CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.

CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.

CG1. Students are able to demonstrate knowledge and understanding of concepts in mathematics, statistics and computation and to apply them to solve problems in science and engineering with an ability for analysis and synthesis.

CG3. Students can solve computationally with the help of the most advanced computing tools mathematical models coming from applications in science, engineering, economy and other social sciences.

CG4. Students are able to show that they can analyze and interpret, with help of computer science, the solutions obtained from problems associated to real world mathematical models, discriminating the most relevant behaviours for each application.

CG6. Students can search and use bibliographic resources, in physical or digital support, as they are needed to state and solve mathematically and computationally applied problems arising in new or unknown environments or with insufficient information.

CE10. Students have shown that they know and understand the algorithmic procedures to design and build programs that solve mathematical problems paying special attention to performance.

CE11. Students have shown that they know the concepts of imperative, generic, object oriented and functional programming and distinguish interpreted, virtual machine based and native programming languages as well as the impact that they have on performance of algorithms and applications.

CE13. Students have shown that they understand how computers work, and the impact of their structure and operation on programs performance as well as their physical limitations.

CE19. Students have shown that they know multiprocessor architectures as well as multi-core processors and computing accelerators and that they can use such knowledge to improve performance of mathematical algorithms with special attention to parallelization of those algorithms.

RA1. Students must have acquired advanced cutting-edge knowledge and demonstrated indepth understanding of the theoretical and practical aspects of working methodology in the area of applied mathematics and computing.

RA2. Through sustained and well prepared argument and procedures, students will be able to apply their knowledge, their understanding and the capabilities to resolve problems in complex specialized professional and work areas requiring the use of creative and innovative ideas.

RA3. Students must have the capacity to gather and interpret data and information on which they base their conclusions, including where relevant and necessary, reflections on matters of a social, scientific,

and ethical nature in their field of study.

RA4. Students must be able to perform in complex situations that require developing novel solutions in the academic as well as in the professional realm, within their field of study.

RA5. Students must know how to communicate with all types of audiences (specialized or not) their knowledge, methodology, ideas, problems and solutions in the area of their field of study in a clear and precise way.

RA6. Students must be capable of identifying their own education and training needs in their field of study and the work or professional environment and organize their own learning with a high degree of autonomy in all types of contexts (structured or not).

RA7. Students must possess the professional maturity necessary to choose and evaluate their work objectives in a reflexive, creative, self-determined and responsible way, for the betterment of society.

## OBJECTIVES

The main goal of this course is to acquire advanced knowledge on concurrent and parallel programming.

To achieve this goal:

- + A deep knowledge on concurrent programming is acquired.
- + Typical problems in concurrent software development are considered.
- + Different design alternatives for concurrent data structures are discussed.
- + Different approaches to shared memory parallel programming are covered.
- + A special attention is devoted to data parallelism both in multi-core processors and accelerators.
- + Applications are optimized by means of parallel programming.

## DESCRIPTION OF CONTENTS: PROGRAMME

- 1.- Introduction: concurrent and parallel programming
- 2.- Thread management and synchronization mechanisms.
- 3.- Concurrency memory models
- 4.- Synchronized and lock-free data structures design
- 5.- Parallel programming models and high performance computing
- 6.- Parallel programming in shared memory environments
- 7.- Data parallelism

## LEARNING ACTIVITIES AND METHODOLOGY

### \*\* TEACHING ACTIVITIES \*\*

AF1.THEORETICAL-PRACTICAL CLASSES. [25 hours with 100% attendance]

Knowledge and concepts students must acquire. Student receive course notes and will have basic reference texts to facilitate following the classes and carrying out follow up work. Students partake in exercises to resolve practical problems and participate in workshops and an evaluation tests, all geared towards acquiring the necessary capabilities.

AF2.TUTORING SESSIONS. [28 hours with 25% attendance]

Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher.

AF3.STUDENT INDIVIDUAL WORK OR GROUP WORK. [74 hours with 0% attendance]

AF8.WORKSHOPS AND LABORATORY SESSIONS. [23,33 hours with 100% attendance]

### \*\* METHODOLOGIES \*\*

MD1.THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject's main concepts are developed, while providing material and bibliography to complement student learning.

MD2.PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group.

MD3.TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor.

MD6.LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

#### ASSESSMENT SYSTEM

Participation in class: 10%

Projects carried out individually or in groups: 70%

Knowledge evaluations during the course: 20%

**% end-of-term-examination:**

0

**% of continuous assessment (assignments, laboratory, practicals...):**

100