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**Academic Year: ( 2023 / 2024 )****Review date: 28-04-2023**

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**Department assigned to the subject: Telematic Engineering Department****Coordinating teacher: MORENO MARCOS, PEDRO MANUEL****Type: Compulsory ECTS Credits : 6.0****Year : 2 Semester : 1**

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

Programming, Systems Programming and Digital electronics.

## OBJECTIVES

1. The student must be able to design a software system containing non-trivial data structures, dynamic memory management, processes and interprocess communication techniques and using engineering techniques to translate a set of given high level constraints, derived from a hypothetical industrial setting, into a robust application.
2. The student must be able to understand the process and thread concepts, and understand different concurrency problems and apply the suitable synchronization mechanisms.
3. The student must be able to use proficiently the following industry-category tools: a compiler with different options to generate debugging information and to analyze the diagnostics produced while developing the application, a version controlled system to handle regular development flows, and profiling tools to analyze memory behavior in a software application.
4. The student must be able to: work effectively individually or in a team, learn autonomously, manage different information sources, generate and value concise information about the tasks accomplished, manage the time of personal work, and present effectively the results derived from the process.

## DESCRIPTION OF CONTENTS: PROGRAMME

1. The C programming language
  - Basic data types and flow constructions
  - Structure of a C application. The pre-processor, division in files, creating an executable.
  - Functions (with several parameters, variadic functions)
  - Pointer manipulation and pointers to functions.
  - File I/O
2. Dynamic memory management in C
  - Dynamic data structures
  - Memory leaks
  - Tools for detecting memory leaks
3. Operating Systems
  - Processes and threads.
  - Creation of processes.
  - Interprocess communication: signal, pipes.
  - Concurrency mechanisms: locks, semaphores, monitors
4. Design of an application
  - Analysis of requirements

- Ascending decomposition
- Descending design

## LEARNING ACTIVITIES AND METHODOLOGY

The activities used to underpin the competences and the skills in the course are:

- Exercises covering the following topics: design the most appropriate data structure for a functionality in a mobile application, write code fragments to manipulate data structures, read/write fields, process data, creation of processes and threads, interprocess communication, etc, calculate the amount of memory occupied by different data structures.
- During the lab sessions code fragments are written, compiled, linked and executed using different compiler options and detect, analyze and correct these programs using the debugger.
- During the lab sessions code fragments are written to create, destroy and manipulate data structures using dynamic memory. Students are also requested to divide a given functionality into functions and write their code.
- During the lab sessions, requirements derived from the specifications provided in exercises will be analyzed and the design of the solution will be worked on.
- Students are requested in several activities throughout the course to search for auxiliary documents to support the information studied in a topic.
- Use of the following tools: Virtual machines, compiler and version control in multiple laboratory sessions.

During these activities the teaching staff reviews the student work in the class, supervises the lab sessions, answers questions of the students, maintains at least one hour a week of office hours and calls for plenary office hours upon demand.

## ASSESSMENT SYSTEM

<b>% end-of-term-examination:</b>	50
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	50

Due to the large percentage of the skills that directly depend on the objectives of the first year courses "Programming" and "Systems Programming", unless both of them have been passed, taking Systems Architecture is NOT recommended.

The course assessment is performed with the following techniques:

\*\*\*Continuous evaluation (50%): It consists of midterms, in which the student must individually demonstrate the overall knowledge (theory and problems) for several units. Among this knowledge, students must demonstrate that they have done and understood the programming activities carried out in the practical classes.

First midterm exam (25%)

Second midterm exam (25%)

\*\*\*Final exam (50%). It serves to demonstrate the overall knowledge of the student for the whole course

A minimum grade of 3.5 on the final exam is required to pass the course.

Student's participation may also be considered in the final mark for the course.

## BASIC BIBLIOGRAPHY

- Abraham Silberschatz Operating system concepts, John Wiley & Sons, 2002

- C. Michael Pilato, Ben Collins-Sussman y Brian W. Fitzpatrick Version Control with Subversion, 2nd Edition, O'Reilly Media, Inc., 2008

- David Griffiths y Dawn Griffiths Head First C, O'Reilly Media, Inc., 2012
- Michael Kerrisk The Linux Programming Interface, No Starch Press, 2010
- Richard Reese Understanding and Using C Pointers, O'Reilly Media, Inc., 2013
- Stephen G. Kochan Programming in C, Fourth Edition, Addison-Wesley Professional, 2014

#### ADDITIONAL BIBLIOGRAPHY

- Brian W. Kernighan, Dennis M. Ritchie The C programming language, Prentice Hall, 1988
- Daniel Leuck, Patrick Niemeyer Learning Java, O'Reilly Media, Inc., 2013
- Félix García Carballeira et al. El lenguaje de programación C : diseño e implementación de programas, Pearson, 2001
- Jesús Carretero Perez, Felix García Carballeira et al. Problemas resueltos de programación en lenguaje C, Paraninfo, 2004
- Joost Visser; Sylvan Rigal, Gijs Wijnholds y Zeeger Lubsen Building Software Teams, O'Reilly Media, Inc., 2016
- Steve McConnell Code Complete, Second Edition, Microsoft Press, 2004

#### BASIC ELECTRONIC RESOURCES

- Instructors . Aula Global: <https://aulaglobal.uc3m.es>
- Instructors . Aula Virtual: <https://aulavirtual.uc3m.es/>