1. OVERVIEW

Subject area	Operating Systems
Degree	Bachelor's Degree in Computer Engineering
School/Faculty	Architecture, Engineering and Design
Year	Third
ECTS	6
Type	Compulsory
Language(s)	Spanish
Delivery mode	On campus / Online
Semester	Second semester
Year	2022-2023
Coordinating professor	Alfonso Vilchez de las Heras
Teacher	Alfonso Vilchez de las Heras

2. INTRODUCTION

"Operating Systems" is a subject area based on the rapid evolution of technologies in the field of computer science. This rapid evolution means it is quite common for new professionals to interact with computers without reaching the full power that a computer and its operating systems can provide. This module fills the gaps in this knowledge, giving the student an in-depth view of the operation of basic software (operating system) on which applications are built, enabling them to interact with it in an optimal way.

This subject is part of the "Operating Systems" module within the Degree in Computer Engineering and is worth 6 ECTS, just like the "Systems Programming" subject area which belongs to the same module. Taking the profile of the student studying a degree in computer science into account, this subject area prepares the student to solve problems related to the configuration, optimisation and use of the resources provided by a modern operating system to develop more efficient computer applications, applying concepts such as the concurrency of processes or virtualisation. Tools are also provided for the future professional to decide what kind of operating system is most useful in a given organisation according to technical and economic criteria.

In addition, this subject area provides knowledge on the organisation of an Operating System's different components and its influence on the development of computer systems. Therefore, the students acquire the skills that allow them to maximise their use of the tools and libraries of functions offered by an operating system, optimising the development of applications.

3. SKILLS AND LEARNING OUTCOMES

Basic skills (CB, by the acronym in Spanish):

- CB1. Students have demonstrated knowledge and understanding of a study area originating from general secondary school education, and are usually at the level where, with the support of more advanced textbooks, they may also demonstrate awareness of the latest developments in their field of study.
- CB2. Students can apply their knowledge to their work or vocation in a professional manner and possess the skills which are usually evident through the forming and defending of opinions and resolving problems within their study area.
- CB3. Students have the ability to gather and interpret relevant data (usually within their study area) to form opinions which include reflecting on relevant social, scientific or ethical matters.

Transversal skills (CT, by the acronym in Spanish):

- CT1. Independent Learning: Ability to choose the most effective strategies, tools and opportunities for independent learning and implementation of what has been learnt.
- CT3. Ability to adapt to new circumstances: Being able to evaluate and understand different points of view, taking different approaches to suit the situation.
- CT8. Information management: Ability to seek, choose, analyse and integrate information from diverse sources.
- CT10. Initiative and entrepreneurial spirit: Ability to undertake difficult or risky actions with resolve. Ability to anticipate problems, propose improvements and persevere to ensure they are implemented. Willingness to take on and carry out tasks.
- CT14. Innovation/Creativity: Ability to propose and invent new, original solutions that contribute towards improving problem situations, including ideas from other contexts.

General skills of the profession (CG, by the acronym in Spanish):

- CG3. Ability to design, develop, assess and ensure the accessibility, ergonomics, usability and security of systems, services and computer applications, as well as the information they manage.
- CG6. Ability to conceive and develop centralised or distributed computer systems or architectures, integrating hardware, software and networks.

Specific skills (CE, by the acronym in Spanish):

- CE11. Knowledge, administration and maintenance of systems, services and computer applications.
- CE16. Knowledge of the characteristics, functionalities and structure of Operating Systems, and to design and implement applications based on their services.

Learning outcomes (RA, by the acronym in Spanish):

- RA1. Explain how to organise the implementation of different programs on machines with one or more processors.
- RA2. Interpret the organisation and operation of some current operating systems, especially those from the Microsoft and Unix family.
- RA3. Plan the use of a given operating system in relation to the work context.
- RA4. Design software and utilities to support operating systems.

The following table shows how the skills developed in the subject area match up with the intended learning outcomes:

Skills	Learning outcomes
CB1, CT10, CT14, CE16	**RA1.** Explain how to organise the implementation of different programs on machines with one or more processors
CB2, CG3, CT3, CT8, CT14, CE11	**RA2.** Interpret the organisation and operation of some current operating systems, especially those from the Microsoft and Unix family
CB2, CB3, CG3, CG6, CT1, CT3, CT8, CT10, CT14, CE11	**RA3.** Plan the use of a given operating system in relation to the work context.
CB2, CB3, CG3, CG6 CT1, CT10, CT14, CE11, CE16	**RA3.** Design software and utilities to support operating systems.

4. CONTENTS

The subject aims to cover the following content:

- Introduction to the functions and structure of a modern operating system, and its fundamental software components.
- Concurrency processes and notions.
- System function calls using an appropriate programming language.
- Application programming interface (API).
- Process and performance planning,
- Main memory management,
- Input/output devices management and file system management. •
- Security in operating systems.

To teach this content, the subject is organised into six learning units which, in turn, are divided into topics (four or five topics depending on the unit):

Unit 1. Introduction

1.1. Definition and functions of operating systems
1.2. History and evolution of operating systems
1.3. Types of operating systems
1.4. Structure of operating systems
1.5. Function calls of operating systems API programming

Unit 2. Processes and Concurrency

2.1. Concept of a process
2.2. Processes and threads
2.3. Process planning
2.4. Types and organization of planners
2.5 Concurrency of processes
2.6 Communication and synchronisation between Unix processes

Unit 3. Memory Management

3.1. Memory hierarchy

3.2. Virtual Memory
3.3. Pagination
3.4. Segmentation

Unit 4. Interlocking and Input/Output Management
4.1. Interlocking
4.2. Conditions for Interlocking
4.3. Interlocking prevention
4.4. Interlocking detection and recovery

Unit 5. File Systems and Security in Operating Systems

5.1. Storage Systems
5.2. File Systems
5.3. Security Mechanisms in Operating Systems
5.4. Log File Analysis
Threat detection and system recovery

Unit 6. Virtualisation and Containers

6.1. Concept of Virtualisation
6.2. Types of Virtualisation
6.3 Virtual machines in public clouds
6.4. Containers
6.5 Service Orchestration

5. TEACHING/LEARNING METHODS

The types of teaching/learning methods are as follows:

- Survey on aims and interests
- Lectures, subjects of study and seminars.
- Laboratory work,
- Group research
- Practical case studies
- Fieldwork, conferences, visits to companies and institutions

6. LEARNING ACTIVITIES

The types of learning activities, plus the amount of time spent on each activity, are as follows:

On campus:

Learning activity (AF, by the acronym in Spanish)	Number of hours
Lectures, reading on main topics and complementary materials, implementation of activities carried out independently and collectively (including participation in collaborative learning forums).	50
Integrative group work, consisting of participation in debates and seminars, and group implementation of integrative application activities, mainly in the classroom.	25

Lectures, reading on main topics and complementary materials, implementation of activities carried out independently and collectively (including participation in collaborative learning forums).	50
Integrative group work, consisting of participation in debates and seminars, and group implementation of integrative application activities, mainly in the classroom.	25
TOTAL	**150**

Online:

Learning activity (AF, by the acronym in Spanish)	Number of hours
Independent working	50
Independent reading on complementary topics and materials and implementation of activities carried out independently. Subsequently, asynchronous group discussion on the Campus Virtual forum, and online seminars with the synchronous e-learning tools on the Campus Virtual.	50
Integrative group work, consisting of participation in debates and seminars, and group implementation of integrative activities. Carried out with the support of the Campus Virtual (the debates are held via forums, the seminars are online).	25
Tutorials, academic monitoring and assessment through the Campus Virtual. Some assessment tests (e.g. exams) will be carried out on-campus when necessary.	25
TOTAL	**150**

7.EVALUACIÓN

The assessment systems, plus their weighting in the final grade for the subject area, are as follows:

On campus:

Assessment system	Weighting
Exams and tests	30%
Development of articles, reports or design briefs	30%
Alternative assessment methods with mind maps, diaries, debates, portfolios, peer assessment	15%
Fieldwork, conferences, visits to companies and institutions will be evaluated based on the student's participation in a discussion forum	10%
Exercises, problems, case studies, designs, simulations and research	15%

Online:

Assessment system	Weighting
Exams and tests	60%
Development of articles, reports or design briefs	20%
Fieldwork, conferences, visits to companies and institutions will be evaluated based on the student's participation in a discussion forum	5%
Exercises, problems, case studies, designs, simulations and research	15%

On the Campus Virtual, when you open the subject area, you will find all the details of your assessable tasks and the deadlines and assessment procedures for each task.

7.1. Ordinary exam period

To pass the subject area in the ordinary exam period, you will need a final grade of at least 5.0 out of 10.0 (weighted average) for the subject area.

In any case, you will need a grade of at least 4.0 in the final test for it to be included in the weighting with the other activities.

7.2. Extraordinary exam period (resits)

To pass the subject area in the ordinary exam period, you will need a final grade of at least 5.0 out of 10.0 (weighted average) for the subject area.

In any case, you will need a grade of at least 4.0 in the final test for it to be included in the weighting with the other activities.

Activities not passed in the ordinary exam period, or those not submitted, must be submitted after receiving the relevant corrections and feedback from the lecturer.

8.CRONOGRAMA

The timeline with submission dates for the assessable tasks in this subject area will be indicated in this section:

Online:

Assessable tasks	Date
Activity 1. Operating Systems/Computational Power Research Project Timeline	Weeks 1-2
Activity 2. Exercise Planning	Week 3
Activity 3. Lab. Basic Linux commands	Week 4
Activity 4. Lab. Basic C/C++ Programming in Linux environment	Week 5
Activity 5. Lab. API development Processes and concurrency in Linux.	Weeks 6–7
Activity 6. Memory Management Exercises	Week 8
Activity 6. First Midterm Exam	Week 9
Activity 8. Memory Management in Linux	Week 10
Activity 9. Interlocking Exercises	Weeks 11–12
Activity 10. File System Exercises	Week 13
Activity 11. - Security in Linux	Weeks 14–15
Activity 12. - Virtualisation and Containers	Weeks 16–17
Activity 14. Final test	Week 18

Online:

Assessable tasks	Date
Activity 1. Research project	Weeks 1-2

Timeline of Operating Systems/Computational Power	
Activity 2. Exercise Planning	Week 3
Activity 3. Lab. Basic Linux commands	Week 4
Activity 4. Lab. Basic C/C++ Programming in Linux environment	Week 5
Activity 5. Lab. API development Processes and concurrency in Linux.	Weeks 6–7
Activity 6. Memory Management Exercises	Week 8
Activity 6. First Midterm Exam	Week 9
Activity 8. Memory Management in Linux	Week 10
Activity 9. Interlocking Exercises	Weeks 11–12
Activity 10. File System Exercises	Week 13
Activity 11. - Security in Linux	Weeks 14–15
Activity 12. - Virtualisation and Containers	Weeks 16–17
Activity 14. Final test	Week 18

The timeline may be subject to change for logistical reasons related to the activities. Students will be informed of any changes in due time and course.

9. BIBLIOGRAPHY

The recommended bibliography is indicated below:

10. DIVERSITY AWARENESS UNIT

Students with special educational needs:

To ensure equal opportunities, curricular adaptations or adjustments for students with special educational needs will be outlined by the Diversity Awareness Unit (UAD, Spanish acronym).

As an essential requirement, students with special educational needs must obtain a report about the curricular adaptations/adjustments from the Diversity Awareness Unit by contacting unidad.diversidad@universidadeuropea.es at the beginning of each semester.

11. SATISFACTION SURVEYS

Your opinion matters!

Universidad Europea encourages you to complete our satisfaction surveys to identify strengths and areas for improvement for staff, degrees and the learning process.

These surveys will be available in the survey area of your campus virtual or by email.

Your opinion is essential to improve the quality of the degree.

Many thanks for taking part.