# ACADEMIC PROGRAM

## OPERATING SYSTEMS

## B.F.A. IN COMPUTER SCIENCE

*MODALITY: ON CAMPUS*

*ACADEMIC YEAR: 2022-2023*

| Name of the course: | **Operating Systems** | |
|---|---|---|
| Degree : | Computer Science | |
| Location: | Centro Universitario de Tecnología y Arte Digital | |
| Area: | Fundamentals of Computer Science | |
| Year: | 2º | |
| Teaching period: | 1 | |
| Type: | B | |
| ECTS credits: | 6 | |
| Teaching modality: | On campus | |
| Language: | English | |
| Lecturer / Email | - | |
| Web page: | http://www.u-tad.com/ | |

## SUBJECT DESCRIPTION

### Area description

This course belongs to the subject "Fundamentals of Computer Science", where thestudent acquires basic knowledge of the principles that underpin software engineering

### Subject description

The Operating Systems subject describes in detail the operation of this key piece of software engineering, using Linux and the xv6 teaching Operating System as vehicles for students to gain direct experience of how the kernel, process and memory management or the file system works. Systems programming is introduced and theoretical knowledge is strengthened with the development of two SW projects

## COMPETENCIES AND LEARNING OUTCOMES

### Competencies
BASIC AND GENERAL SKILLS

BC1: Students should demonstrate knowledge in an area of study that builds upon the foundation of general secondary education and goest beyond at a level that, while supported by advanced textbooks, also encompasses certain aspects derived from the cutting edge of their field of study.

BC2: Students should be able to apply their knowledge to their work or vocation in a professional manner, and they should possess the competencies typically demonstrated through the development and defence of arguments as well as problem-solving within their field of study.

BC3: Students must possess the ability to gather and interpret relevant data (usually within their field of study) in order to make judgments that involve reflection on socially, scientifically, or ethically significant issues.

BC4: Students should be capable of conveying information, ideas, problems, and solutions to both specialized and non-specialized audiences.

BC5: Students should have developed the learning skills necessary to pursue further studies with a high degree of autonomy.

CG1 - Ability to understand, plan and solve problems through the development of computing solutions.

GC3 - Knowledge of the scientific fundamentals applicable to the resolution of computing problems.

GC5 - Management of human and technological resources for the correct realization of computer science projects

GC9 - Ability to learn, modify and produce new computer technologies.


SPECIFIC COMPETENCES

CE3 - Knowledge of the relational algebra and the performance of queries in procedural languages for the design of standardized database schemas based on

database schemas based on entity-relational models.

CE9 - Knowledge of control structures, variables, programming syntax and memory usage management in an effective way in the development of a computer application.

in the development of a software application

CE11 - Knowledge of the architecture of the Operating Systems as well as the different mechanisms for the management of processes,

communication and synchronization of processes

CE13 - Knowledge of the fundamentals of computer networks, the different topologies and their communication protocols.

communication protocols

CE16 - Knowledge of the operation of computer systems.


**Learning outcomes**
Upon completion of the degree, the graduate will be able to:

- To understand the life cycle of an application using different programming languages

- To know how to debug a software application.

- To know and use markup languages (HTML)

- To build web pages using style sheets (CSS)

- To use the control version tool Git in collaborative development

- To know the fundamentals of Boolean Algebra

- To be able to handle logic gates and simple sequential circuits

- To handle the binary representation of different data types

- To understand von Neumann¿s model

- To understand the hardware architecture of a computer.

- To be able to coda basic programs in assembly language

- To know common network technologies (WiFi, BlueTooth, Ethernet¿)

- To know network topologies

- To understand computer communication using protocols such as ARP, IP, TCP, etc.

- To be able to set basic routing configurations.

- To be able to develop simple network applications

- To know the basic architecture of an Operating System

- To understand the principles of process scheduling

- To understand how the hierarchy of memory works

- To be able to develop a simple file system

- To be able to develop a toy driver

- To understand processes/threads communications and synchronization mechanisms

## CONTENTS

Architecture of Operating Systems

Process communication and synchronization

Memory manager

Input/Output manager

File system

Security measures

Special operating systems (real time, distributed)


## SUBJECT SYLLABUS

Topic1

Introduction

Topic 2.

Basic concepts of Operating Systems

Topic 3.

Process management

Topic 4.

Memory Management

Topic 5.

File Management6. I/O Management

Topic 7.

Process Synchronization and Communication

## TRAINING ACTIVITIES AND TEACHING METHODOLOGIES

### TRAINING ACTIVITIES

| LEARNING ACTIVITIES | Total hours | Hours of presence |
|---|---|---|
| *Theoretical / Expository classes* | 32,00 | 32,00 |
| *Practical classes* | 22,00 | 22,00 |
| *Tutorials* | 4,00 | 2,00 |
| *Independent study and autonomous work of the student* | 50,00 | 0,00 |
| *Elaboration of work (group or individual)* | 36,00 | 0,00 |
| *Evaluation Activities* | 6,00 | 6,00 |
| *TOTAL* | 150 | 62 |

### Teaching methodologies

Expository method or master lesson

Case learning

Learning based on problem solving

Cooperative or collaborative learning

inquiry learning

Flipped classroom methodology

Gamification

Just in time Teaching (JITT) or classroom on time

Expository method or master lesson

Case method

Learning based on problem solving

Cooperative or collaborative learning

inquiry learning

Flipped classroom methodology

Gamification

## TEMPORAL DEVELOPMENT

DIDACTIC UNITS / TOPICS TIME PERIOD

Presentation and Logistics Session 0 (each session is 2 hours)

1 Introduction Session 1

2 Basic concepts Sessions 2-3

Practice: Docker + xv6 installation Session 4

3 Process Management (I) Session 5

Practice: trace tools Session 6

3 Process Management (II) Sessions 7-8

Practice: Planning, priorities with nice Session 9

4 Memory management (I) Session 10

Practice: Cache memory Session 11

4 Memory Management (II) Session 12

Practice: Virtual memory Session 13

4 Memory management (III) Sessions 14-15

Description and approach of the project I Session 16

5 File management Sessions 17-18

Practice: Files Session 19

6 Entry/Exit Management Session 20

Practice I/O Session 21

7 Synchronization and Communication Session 22

IPC Practice Session 23

Description Project II Session 24

Demo Project II Session 25

Session review exercises for exam Session 26

## EVALUATION SYSTEM

| ASSESSMENT SYSTEM | MINIMUM SCORE RESPECT TO THE FINAL ASSESSMENT (%) | MAXIMUM SCORE RESPECT TO THE FINAL ASSESSMENT (%) |
|---|---|---|
| *Assessment of participation in class, exercises or projects of the course* | 0 | 30 |
| *Assessment of assignments, projects, reports, memos* | 30 | 80 |
| *Objective test* | 10 | 60 |

## GRADING CRITERIA

| ASSESSMENT SYSTEM | ORDINARY EVALUATION | EXTRAORDINARY EVALUATION |
|---|---|---|
| *Assessment of participation in class, exercises or projects of the course* | 0 | 0 |
| *Assessment of assignments, projects, reports, memos* | 40 | 40 |
| *Objective test* | 60 | 60 |

**General comments on the evaluations/assessments**

• Throughout the course, two projects are proposed that must be delivered on the indicated date through the virtual platform. This work will be evaluated with a demonstration and will account for 40% of the grade.

The minimum average grade of the two deliveries must be 4.0 to be able to compensate with the other concepts. If it is passed, it is kept until the extraordinary call for the course (inclusive). Late deliveries are not accepted. If, due to a justified and validated major cause, late delivery is accepted, your grade will be significantly reduced.

• There will be online questionnaires at the end of the topics that account for 10% of the final grade.

• A partial exam will be held that can be graded with a grade:

o Greater than or equal to 4: It will be valued with 25% of the grade for the subject, releasing the subject examined.

o Less than 4: It will not be taken into account and the student in the ordinary exam must re-examine this part.

• Ordinary call:

o Those students who have obtained 4 or more in the partial exam:

▪ 0.40*projects+0.10*quizzes+0.25*partial 1 + 0.25 ordinary exam only for the second part

o Those students who have obtained less than a 4 in the partial exam

▪ 0.40*projects+0.10*questionnaires+0.25*regular exam part 2 + 0.25 ordinary exam part 1 (having to re-examine this first part)

To pass the subject in the ordinary call, it is essential that the final grade is at least 5.0 (out of 10).

It is mandatory that each of the exams (part 1 carried out in the partial or during the ordinary and part 2) have a minimum grade of 4 in order to apply the weighting. If this criterion is not met, the student's ordinary evaluation grade will be that of the exam with the lowest grade, and he or she must take the extraordinary evaluation with the complete syllabus.

• Extraordinary or unique call:

In extraordinary calls, 10% of the questionnaires on the different topics are not evaluated.

Students suspended in the ordinary session (exams or exams and projects) or students who have been granted the single session. There will be an exam that will account for 60% of the final grade. If the student did not exceed the minimum grade of 4.0 in projects or did not complete them, they will have the opportunity to present them.

Students with exams passed according to the ordinary call criteria, but with failed practice. The student will present a project again at the teacher's request with a weight of 40% of the grade and the remaining 60% applies the ordinary criterion (50% exams + 10% preserved questionnaires)

• No grades of any kind will be kept between different academic years.

• The use of mobile phones in the classroom is not allowed during the continuous evaluation period, unless expressly indicated otherwise by the teacher. Laptops may only be used for activities related to the subject.

The teacher may withdraw the right to use the computer from those students who use it for activities that are not related to the subject (checking emails, news or social networks, consulting or preparing activities for other subjects, etc.).

• Active participation will be required from the student, necessary for the development of the classes.

• The student will be required to behave well at all times during classes. Bad behavior that prevents the normal development of the class may lead to expulsion from the classroom for a period of time to be determined by the teacher.

## LIST OF REFERENCES (BOOKS, PUBLICATIONS, WEBSITES):

Basic bibliography (1-3 books)-

 "Operating Systems", Pedro de Miguel Anasagasti, Fernando PérezCostoya, UPM, 2016http://www.ieef.upm.es/moodle/pluginfile.php/3574/mod_resource/content/1/sistemasoperativosupm.pdf-

"Modern Operating Systems". 3rd Ed. A. Tanenbaum. Prentice Hall, 2017-

"xv6 a simple, Unix-like teaching operating system", Russ Cox, FransKaashoek, Robert Morris, CSAIL MIT, 2018https://pdos.csail.mit.edu/6.828/2018/xv6/book-rev11.pdf

Recommended bibliography (Max 10 books)-

"Fundamentals of Operating Systems", 7th Edition, Silberschatz, Galvin and Gagne.-

"Understanding the Linux Kernel", 3rd edition, 2006, Daniel Bovet, MarcoCesat

## REQUIRED MATERIALS, SOFTWARE AND TOOLS

**Type of classroom**
Theory classroom

Board and projection system

**Materials:**
Personal Computer

**Software:**
Oracle VM, Ubuntu Linux 20.04 o superior, xv6