# 1. BASIC INFORMATION

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|---|---|
| **Course** | Fluid Mechanics II |
| **Degree program** | Degree in Aerospace Engineering of aircrafts |
| **School** | Arquitectura, Ingeniería y Diseño |
| **Year** | Third |
| **ECTS** | 6 |
| **Credit type** | Compulsory |
| **Language(s)** | English |
| **Delivery mode** | Face to face |
| **Semester** | First |
| **Academic year** | 2024-25 |
| **Coordinating professor** | Jose Omar Martinez Lucci |

# 2. PRESENTATION

This course belongs to the "Motopropulsion II" module:

- Mechanical and Graphic Design 6 ECTS (second year)
- Fluid Mechanics II 6 ECTS (third year)

In the Fluid Mechanics II subject the following topics are covered: External and internal flow, pressure distributions and forces on the aircraft, numerical simulation and computational fluid dynamics.
The objectives of the course are:

This is the second course of the fluid mechanics courses. Students must have knowledge of calculus, physics, fluid dynamics and thermodynamics,

-1. Learn deep knowledge of the behavior of the fluid inside the pipe.

-2. Learn and develop an intuitive understanding of the fluid mechanics when the inertial effect of the fluid is negligible compared with the term viscous term

-3. Acquire an intuitive knowledge of the physical phenomena that governs the forces of the dynamics of fluid around objects and understand the fundamentals of the flow on aerodynamic profiles and calculate the resistance forces and lifting forces of airfoils

-4. Predict the thickness and other properties of the boundary layer.

-5. Understand and analyze the phenomenon of the compressibility of fluids such as predict the occurrence of shock wave and the calculation of the change in properties through the shock wave.

-6. Learn by the practice of the simulation of external and internal fluid. Learn the use of CFD tool to solve complex problems of mechanics of fluids.

## 3. COMPETENCIES AND LEARNING OUTCOMES

Core competencies:

- CB2: That students can apply their knowledge to their work or vocation in a professional manner and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study.
- CB3: That students have the ability to gather and interpret relevant data (usually within their field of study) to make judgments that include reflection on relevant social, scientific or ethical
- CB5: That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy

Cross-curricular competencies:

- CT13: Ability to use tools to search for library resources or information (information retrieval).
- CT20: Take decisions, in advance, on what is need to be done, who should do it, and how it should be done.

Specific competencies:

- CE22: Adequate and applied knowledge to engineering field: Fluid mechanics fundamentals that describe the flow in all regimes to determine the pressure and force distributions on aircraft.

*Notes: UNIQUE LEVEL: Competence developed at one level. Level 1 (N1): awareness about the importance of competences and basic application of it to several situations. Level 2(N2): interiorization and skillful handling of competences. Level 3 (N3): Full interiorization and handling of competences at any needed situation.*

Learning outcomes:

- LO24: To propose and design a set of models, as input data to fluid dynamics simulators.
- LO20. To conduct studies by integrating the technologies and engineering procedures which are developed in the competencies of this modules

- LO21. From a series of requirements, and prior information, to conceptualize an engineering problem, proposes an approach to solve it, and obtain the better solution. All this related to the competencies of this module
- LO22. To transfer some parts of an engineering problem to the laboratory, and utilize this resource as support to resolve it.

The following table shows the relationship between the competencies developed during the course and the learning outcomes pursued:

| Competencies | Learning outcomes |
|---|---|
| CB5, CE22 | LO24 To propose and design a set of models, as input data to fluid dynamics simulators. |
| CB3, CT13, CE22 | LO20. To conduct studies by integrating the technologies and engineering procedures which are developed in the competencies of this modules |
| CB2, CB5, CE22 | LO21. From a series of requirements, and prior information, to conceptualize an engineering problem, proposes an approach to solve it, and obtain the better solution. All this related to the competencies of this module |
| CT20, CE22 | LO22. To transfer some parts of an engineering problem to the laboratory, and utilize this resource as support to resolve it. |

## 4. CONTENT

- FLUID-DYNAMIC LUBRICATION
- INTRODUCTION TO THE FLUIDS IN POROUS MEDIA
- GAS DYNAMICS
- LIQUIDS IN DUCTS
- LAMINAR AND TURBULENT BOUNDARY LAYER
- APPLICATION FOR THE DISTRIBUTION OF PRESSURES AND FORCES ON THE AIRCRAFT
- COMPUTATIONAL FLUID DYNAMICS. PRACTICE ADVANCED ON FLUID DYNAMICS SIMULATORS

## 5. TEACHING-LEARNING METHODOLOGIES

The types of teaching-learning methodologies used are indicated below:

- Lecture-based class
- Integration of team work
- Self-study
- Mentoring, academic monitoring and assessment

# 6. LEARNING ACTIVITIES

Listed below are the types of learning activities and the number of hours the student will spend on each one:

**Campus-based mode:**

| Type of educational activity | Number of hours |
|---|---|
| Lecture-based class | 20 h |
| Integration of team work | 60 h |
| Self-study | 50 h |
| Mentoring, academic monitoring and assessment | 20 h |
| **TOTAL** | **150 h** |

# 7. ASSESSMENT

Listed below are the assessment systems used and the weight each one carries towards the final course grade:

| Assessment criteria | Weight (%) |
|---|---|
| • 1. Exam, test and other type of assessment. | 30%-35% |
| • 2. Reports, articles and informs. | 15%-30% |
| • 3. Alternative system of assessment. | 15%-30% |
| • 4. Conferences, company-tour visit and experiences in situ | 10%-10% |
| • 6. Transversal skills (rubric) | 10%-15% |

When you access the course on the *Campus Virtual*, you'll find a description of the assessment activities you have to complete, as well as the delivery deadline and assessment procedure for each one.

## 7.1. First exam period

- Exams, tests and other test and alternative techniques of assessment 35%
- Writing of articles, reports and project and Transversal skills 35% of the final grade
- Homework 30% of the final grade

To pass the course in the first exam period, you must obtain a final course grade of at least 5 out of 10 (weighted average). Minimums needed to pass:

- To obtain 5 points over 10 points of the final exam.
- To obtain 5 points over 10 points of the final project.
- To obtain 5 points over 10 points of the homework.
- In order to be evaluated you must have a minimum of 50% attendance

Students must evaluate the classmates of the project group. In case the student fails to submit the peer-to-peer assessment, the student will fail the project and must work in an a new project for July exam period.

The failed assignments, homework or lab reports during academic year can be submitted on extraordinary session. To pass the course, each assignment shall have, at least, five points out of ten. In order to pass the course, it is mandatory to pass all assignments, activities and exams. If the student fails or does not submit any of the activities, theses will not be considered for the average of the final grade.

In the case, the student does not reach the minimum grade of 5 out 10 in any evaluable activity. The final grade will be 4.

The grade will be considered as NP (Not Presented) when the student has not delivered any evaluable activity of which they are part of the weighted average.

### 7.2. Second exam period

Assessment activities:

- Realization of different tasks, problems and practical exercises, individually 20%
- Realization of laboratory practices and report 10%
- Realization of a project 20%
- Oral presentations presentation of the project 15%.
- Final exam 35%

To pass the course in the second exam period, you must obtain a final grade of at least 5 out of 10 (weighted average).

In the case, the student does not reach the minimum grade of 5 out 10 in any evaluable activity. The final grade will be 4.

The grade will be considered as NP (Not Presented) when the student has not delivered any evaluable activity of which they are part of the weighted average.

## 8. SCHEDULE

This table shows the delivery deadline for each assessable activity in the course:

| Assessable activities | Deadline |
|---|---|
| Activity 1 .Self-study – Creeping Motion_ Sotkes´Flow | Week 3-4 |

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|---|---|
| Activity 2 Self-study - Porous media | Week 6-7 |
| Activity 3 Self-study- Gas dynamics-liquids in ducts-Laminar and turbulent boundary layer | Week 9-10 |
| Activity 4 Integration of team work and Mentoring, academic monitoring and assessment - laboratories and team project | Week 13 |
| Activity 5 Final exam | Last week |
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This schedule may be subject to changes for logistical reasons relating to the activities. The student will be notified of any change as and when appropriate.

# 9. BIBLIOGRAPHY


1. Fluid Mechanics Fundamentals and Applications. Yunus A. Çengel and John M. Cimbala, First edition, editorial Mc Graw Hill, 2006
2. Viscous Fluid Flow, Frank m. White. Third edition, editorial Mc Graw Hill, 2006
3. Computational Fluid Dynamics, the basics with applications, John Anderson, Jr., First edition, editorial Mc Graw Hill, 1995.
4. Fundamentals of turbulence Modellig, Ching Chen, Shenq-Yuh Jaw. First edition, editorial Taylor and Francis Ltd. 1998.
5. Dynamics of Fluids in Porous Media, Jacob Bear. First edition, editorial Dover publications, 1988.


# 10. EDUCATIONAL GUIDANCE AND DIVERSITY UNIT

From the Educational Guidance and Diversity Unit we offer support to our students throughout their university life to help them reach their academic achievements. Other main actions are the students inclusions with specific educational needs, universal accessibility on the different campuses of the university and equal opportunities.

From this unit we offer to our students:

1. Accompaniment and follow-up by means of counselling and personalized plans for students who need to improve their academic performance.
2. In terms of attention to diversity, non-significant curricular adjustments are made in terms of methodology and assessment for those students with specific educational needs, pursuing an equal opportunities for all students.
3. We offer students different extracurricular resources to develop different competences that will encourage their personal and professional development.
4. Vocational guidance through the provision of tools and counselling to students with vocational doubts or who believe they have made a mistake in their choice of degree.

Students in need of educational support can write to us at:
orientacioneducativa@universidadeuropea.es

# 11. ONLINE SURVEYS

Your opinion matters!

The Universidad Europea encourages you to participate in several surveys which help identify the strengths and areas we need to improve regarding professors, degree programs and the teaching-learning process.

The surveys will be made available in the “surveys” section in virtual campus or via e-mail.

Your assessment is necessary for us to improve.

Thank you very much for your participation.