Universidad Europea

1. BASIC INFORMATION

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	2019-20
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 (ATTENDANCE IS VALID ONLY REGISTERED IN THE GRP SYSTEM)

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 and it is mandatory to pass all assignments, activities and exams. If the student fails or does not submit some activities these activities will not be considered for the average of the final grade.

In the case, when the student do not reached the minimum required to pass any evaluable activity. The final grade will be:

• The mean average when the mean value is less than or equal to 4

• 4 if the value of the mean average is greater than 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, when the student do not reached the minimum required to pass any evaluable activity. The final grade will be:

• The mean average when the mean value is less than or equal to 4
• 4 if the value of the mean average is greater than 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
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

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. DIVERSITY MANAGEMENT UNIT

Students with specific learning support needs:

Curricular adaptations and adjustments for students with specific learning support needs, in order to guarantee equal opportunities, will be overseen by the Diversity Management Unit (UAD: Unidad de Atención a la Diversidad).

It is compulsory for this Unit to issue a curricular adaptation/adjustment report, and therefore students with specific learning support needs should contact the Unit at unidad.diversidad@universidadeuropea.es at the beginning of each semester.

Universidad Europea

WORK PLAN OF THE SUBJECT

HOW TO COMMUNICATE WITH YOUR PROFESSOR

Whenever you have a question about the content or activities, don't forget to post it to your course forum so that your classmates can read it.

You might not be the only one with the same question!

If you have a question that you only want to ask your professor, you can send him/her a private message from the Campus Virtual. And if you need to discuss something in more detail, you can arrange an advisory session with your professor.

It's a good idea to check the course forum on a regular basis and read the messages posted by your classmates and professors, as this can be another way to learn.

DESCRIPTION OF THE ASSESSEABLE ACTIVITIES

Activity 1.Self-study – Creeping Motion_ Sotkes´Flow:

Understand and comprehend fluids in low Reynolds number regimes. Lubrication fluid dynamics.

Activity 2. Self-study - Porous media.

Understand the behavior of fluids in porous media, calculate the porosity of the medium, the permeability.

Activity 3. Self-study- Gas dynamics-liquids in ducts-Laminar and turbulent boundary layer

Appreciate the consequences of the compressibility in gas flow. Understand why a nozzle must have a diverging section to accelerate a gas to supersonic speeds. Predict the occurrence of shock waves and calculate the property changes across a shock wave. Understand the effects of friction and heat transfer on compressible flows.

Have a deeper understanding of laminar and turbulent flow in pipes and the analysis of fully developed flow. Calculate the major and minor losses associated with pipe flow in piping networks and determine the pumping power requirements. Understand the different velocity and flow rate measurement techniques and learn their advantages and disadvantages.

Appreciate why approximations are necessary to solve many fluid flow problems, and know when and where such approximations are appropriate. Predict boundary layer thickness and other boundary layer properties. Understand superposition as a method of solving potential flow problems.

Activity 4. Integration of team work and Mentoring, academic monitoring and assessment - laboratories and team project

Have an intuitive understanding of various physical phenomena such as drag, friction and pressure drag, drag reduction and lift. Understand the effects of flow regime on the drag coefficients associated with flow over cylinders, spheres and airfoils

Understand the importance of a high-quality, good resolution mesh. Apply appropriate boundary conditions to computational domains. Understand how to apply CFD to basic engineering problems and

how to determine whether the output is physically meaningful. Realize that you need much further study and practice to use CFD successfully

Activity5. Final exam –

RUBRICS OF THE ASSESSING ACTIVITIES

Activity 4. Oral presentation and report of the team Project.

In relation to collaborative activities. The rubric used for the assessment of this activity is exposed in this section.

Type of activity: Individual and group evaluation. Peer to peer evaluation. The members of your group will evaluate your contribution in the project.

This activity computes 35% of the total amount of the subject. The percentage of this activity is divided in 20% oral presentation and 80% written report.

When do you have to submit the activity? You have submit the final report and oral presentation at the end of the course.

How the activity is assessed? The activity is assessed by using the following rubrics.

Rubric 1- Oral presentation

Oral presentation of the work done.	**0 to 0.25 points**	**0.25 to 0.5 points**	**0.5 to 1 points**	**1 to 1.5 points**
	The information is not clearly stated, the content is read, it is very difficult to follow the oral presentation, and / or the presentation time exceeds the planned. The choice of words is not adequate (to the topic, to the audience or to the objectives of the work).	Understanding the presentation, or to follow it at certain times, is difficult. The presentation time exceeds the planned one. The choice of words is not adequate (to the topic, to the public or to the objectives of the work).	Good presentation (easy to follow, in time) sometimes lack enthusiasm and / or captivate the listener. No adequate support means are used.	Clear, original and enthusiastic presentation that captures the listener from beginning to end, using the appropriate means.
Answer to the	**0 to 0.725 points**	**0.75 to 1.475 points**	**1.5 to 1.975 points**	**2 to 2.5 points**

questions posed	The student doesn't correctly answer to none of the posed questions.	The student just answers correctly to some of the posed questions, or he doesn't do it clearly and well explained.	The student answers correctly, clearly and well justified to most of the posed questions, convincing the audience.	The student answers correctly, clearly and well justified to all the posed questions, convincing the audience.
Planning and teamwork	**0 to 0.25 points**	**0.25 to 0.5 points**	**0.5 to 0.75 points**	**0.75 to 1 points**
	It is late, does not respect deadlines or late delivery. It does not plan its objectives. His attitude in the group is very individualistic.	He delivers it almost on time. The student has planned his goals, but some of his goals is not realistic. Although his attitude is individualistic, he tries to participate appropriately in the group.	He delivers it on time. The student has planned his objectives. Mobilize and unite the group appropriately.	It anticipates the deadlines of the task carried out, in order to facilitate revisions and to be able to face possible contingencies. The student has planned his objectives setting goals.

Rubric 2. Final Project report

Criteria	Bad	Not too bad	Competent	Very Competent
Structure of the Report: format, writing, organization of information	**0 to 0.5 points**	**0.5 to 1.25 points**	**1.25 to 2 points**	**2 to 2.5 points**
	Poor structure Missing relevant chapters (index, bibliographical references, etc.). The information is not organized in a coherent manner and / or insufficient synthesis capacity.	It contains all the parts of a report, but it lacks rigor. Low synthesis capacity and / or the information is not written clearly, and / or the information is not related correctly. It does not contain references.	Meets all points of the content of a report correctly. Good classification of the information, although the organization and / or synthesis of it could be improved.	The report is well structured, and the documentation provided is relevant and well assigned. High capacity for synthesis and organization of information.
Analysis of the	**0 to 0.5 points**	**0.5 to 1.25 points**	**1.25 to 2 points**	**2 to 2.5 points**

information necessary to justify the results of the proposed examples. Results explanations and simulations.	There is no analysis of the information or it is incorrect (It does not support the results obtained).	Unsupported or insufficient analysis. It includes, but does not adequately explain the aerodynamics characteristics of the airfoils and the simulation results are Insufficient bibliography. Does not support the theory exposed.	There is sufficient analysis of information related to the topic and endorse the results. It does Include, but explains only superficially, the results of the simulations. Correct Bibliography. The results of the simulations are good.	An analysis of all the required information on the subject of work is carried out. It includes and adequately explains the results of the simulations. Supports all the results obtained. Relevant and updated bibliography. The result of the simulations is good.