

# **COURSE PROGRAM**

# Academic Year: 2019/2020

Identification and characteristics of the course									
Code	5010	501073 ECTS Credits 6							
Course name (English)	Fluid	Fluid Mechanics							
Course name (Spanish)	Mecá	lecánica de Fluidos							
Degree programs	Electi Electi	anical Engir rical Engine ronical Engi rials Engine	ering						
Faculty/School	Scho	School of Industrial Engineering							
Semester	5	5 Type of Obligatory course							
Module	Indus	Industrial Branch							
Matter	Therr	Thermodynamics and Fluid Mechanicas							
			Lecturer/s						
Name	e Office E-mail Web page								
José María Monta Fernández	osé María Montanero D0.6 jmm@unex.es								
Conrado Ferrera	Llera	lera D0.7 cfll@unex.es							
M <sup>a</sup> Guadalupe	a Guadalupe D0.5 mguadama@unex.es								
Cabezas Martín									
Subject Area	Fluid Mechanics								
Department	Department of Mechanical, Energy, and Materials Engineering								
Coordinating Lecturer (If more than one)	M <sup>a</sup> G	M <sup>a</sup> Guadalupe Cabezas Martín							



methods, boundary layer, flow in pipes, multiple-pipe systems and flows with free surfaces. Numerical methods in Fluid Mechanics. Course syllabus 0. Presentation of the course Name of lesson 1: Introduction Contents of lesson 1: Fluids. Continuum hypothesis. Description of the practical activities of lesson 1: Name of lesson 2: Lagrangian and Eulerian descriptions. Streamline and path Types of flows. Flow rate and mass flow rate. Description of the practical activities of lesson 2: Name of lesson 3: Equations for a fluid system Contents of lesson 3: Equations for a fluid system Contents of lesson 3: Introduction. Surface forces. Heat conduction. Mechanica equations for a fluid system. Description of the practical activities of lesson 3: Name of lesson 4: Equations for a control volume Contents of lesson 4: Equations for a control volume Contents of lesson 4: Equations for a control volume Contents of lesson 4: Systems and control volumes. Reynolds transport theorem Uniform approximation for the flux term. Continuity equation for a control volume Momentum equation for a control volume. Bernoulli equation. Energy equation for a control volume. Energy equation for a fluid machine. Description of the practical activities of lesson 4: 6 hours L1. Design, fabrication and experiment with a rocket model. L2. Experimental verification of the Bernoulli equation. Name of lesson 5: Dimensional Analysis Contents of lesson 5: Introduction, Buckingham • theorem, physical similarity.	<b>Competencies</b> * (see table at <u>http://bit.ly/competenciasGrados</u> )												
Reg         x         CC2         T2         x         CEPR2         CECR12         x         CETE2         CETE2         CETE3         CETE3 <thcete3< th=""> <thcete3< th="">         CETE3</thcete3<></thcete3<>		Basic Competences	Check With an "X"	General Competences	Check With an "X"	Transversal Competences	Check With an "X"	Specific Competences Basic Formation	Check With an "X"	Specific Competences Common to the Industrial Branch	Check With an "X"	Specific Competences Specific Technology	Check With an "X"
CPH         X         CCH         X         CTH         X         CCRNI					Х						Х		
CBS         X         CTS         X         CERS         CCOUS         CTTES           CGG         X         CT7         X         CFFB6         CCOUZ         CETEF         CCOUZ         CECENT         CCOUZ         CECENT         CECENT <td></td> <td></td> <th></th> <th></th> <th></th> <th></th> <td></td> <td></td> <td></td> <th></th> <th></th> <th></th> <th></th>													
CG7         X         CTR         X           CG9         CT9         X           CG10         CT10         X           CG11         X         CECR19         CETE9           CG11         X         CECR19         CETE9           CG11         X         CECR10         CETE9           CG11         X         CECR11         CETE9           CG11         X         CECR11         CETE9           CG11         X         CECR12         CETE9           CG11         X         CECR12         CETE9           CG11         X         CECR12         CETE9           CG11         X         CECR12         CETE9           CG12         CETE0         CECR12         CETE9           CG11         X         CECR12         CETE9           CG11         X         CECR12         CECR12           CECR12         CETE9         CECR12         CETE9           CG10         CECR12         CETE9         CECR12           CECR12         CETE9         CECR12         CETE9           CECR12         CECR12         CETE9         CECR12           CECR12         <				CG5				CEFB5		CECRI5		CETE5	
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<sup>\*</sup> The sections concerning competencies, course outline, educational activities, teaching methodologies, learning outcomes and assessment systems must conform to that included in the ANECA verified document of the degree program.



Name of lesson 6: Hydrostatics

Contents of lesson 6: Introduction. Reduction of a system of forces in hydrostatics. Forces and torques on flat surfaces. Forces and torques on submerged bodies.

Description of the practical activities of lesson 6: Name of lesson 7: Essentials of fluid dynamics

Contents of lesson 7: Introduction. The turbulence phenomenon. Boundary layer. Boundary layer separation.

Description of the practical activities of lesson 7:

L4. Measurement of the liquid viscosity

Name of lesson 8: Hydraulics

Contents of lesson 8: Introduction. Flow in pipes. Local losses. Multiple-pipe systems. Multiple-pipe systems with pumps.

Description of the practical activities of lesson 8:

L5. Measurement of the coefficient of friction of a pipe

Name of lesson 9: Open channels, weirs and sluicegates

Contents of lesson 9: Introduction. Open flow in channels. Weirs and sluicegates Description of the practical activities of lesson 9:

Educational activities \*

Student worklows hours by lessorLecturesPresentationMonitoring activityMoneworklows activityLessonTotalLHILABCOMSEMSGTPSCourse presentation11IIIIIIIIII121III									
Course presentation         1         1         1         0         0           1         2         1         1         1         1         1           2         9.5         4.5         1         5         5           3         8.5         4.5         1         4           4 + Practical         29         10         6         13           Activities L1 y L2         1         1         6         13           ECTS (1-4)         3.5         0         1.5         2           Midterm exam (1-4)         7         1         6         6           5 + Practical         14         3         4         7           Activity L3         7         1         6         8           7 + Practical         10.5         2.5         3         5           Activity L4         7         2         11         11           Activity L5         7         2         3         3           FCTS (Units 5-8)         3.5         0         1.5         2           9         5         2         3         20            45         0         15<			Lectures	F	Practical	activitie		Homework	
presentation         Image: second secon	Lesson	Total	L	HI	LAB	СОМ	SEM	SGT	PS
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L: Lectures (100 students) HI: Hospital internships (7 students) LAB: Laboratory or field practices (15 students)		22	2						20
HI: Hospital internships (7 students) LAB: Laboratory or field practices (15 students)	TOTAL	150	45	0	15	0	0	3	87
LAB: Laboratory or field practices (15 students)									
COM: Computer room or language laboratory practices (30 students)									
	COM: Computer r	oom or l	language la	borator	y practic	es (30 s	tudents)		

SEM: Problem classes or seminars or case studies (40 students)

SGT: Scheduled group tutorials (educational monitoring, ECTS type tutorials)

PS: Personal study, individual or group work and reading of bibliography

<sup>\*\*</sup> Indicate the total number of evaluation hours of this subject.



## **Teaching Methodologies\***

Among the teaching methodologies included in the formative program, in this course the following are used:

Teaching methodology	Check with an "X" the ones used
1. Explanation and discussion of contents	Х
2. Solution, analysis and discussion of examples and exercises	Х
3. Oral presentation of assignments	Х
4. Development of practical cases in labs, computer rooms, seminars, etc.	Х
5. Attention to the student and advice of the assignments in small groups	Х
6. Search of information prior to the explanation of the contents of an unit or search of complementary information once the activities of a unit have been developed	Х
7. Elaboration of assignments either individually or in groups	Х
8. Study of each unit: study of contents, preparation of exercises or cases, preparation of the final exam, etc.	Х

#### Learning outcomes \*

The students will learn: how to predict the behavior of a fluid system from the conservation laws for the mechanical quantities; how to determine the dominant factors in fluid dynamics to predict the behavior of a fluid system in complex situations; how to apply the knowledge and skills acquired over the course to the theoretical solution of hydrostatic and hydrodynamics problems; the essential aspects of the interaction between a machine and the fluid processed by that machine; how to predict the behavior of a fluid-mechanic machine from the conservation laws for the mechanical quantities; and how to design and calculate hydraulic facilities of diverse types (multiple-pipe systems, tanks, pumping systems, channels, ...).

#### Assessment systems \*

<u>Assessment criteria</u>

CE1. To demonstrate the understanding of the concepts involved in the course. Related to the competences CB1-CB5, CT1, CT4, CT6, CT7, CG1, CG3-CG7, CG11, CECRI2

CE2. To know the most important data and results related to the course. Related to the competences CT1, CT4, CT6, CG3, CG5, CG6, CECRI2

CE3. To solve practical problems by applying theoretical results and experimental data. Related to the competences CB1, CB2, CT2, CT4, CT6, CT7, CT9, CT10,CG1, CG3, CG4, CG5, CECRI2

CE4. To expose clearly the obtained results. Related to the competences *CB1, CB2,CB3, CB4, CT3, CT5-CT10, CG1, CG4, CG5, CG7 CECRI2* 

As can be seen, we give greater emphasis to understanding of the contents involved in the course rather than to learning data, results, equations, etc. The resolution of practical problems and cases is also essential too.



## Assessment activities

Among the assessment activities included in the formative program, in this course the following are used:

	Range	Ordinary	Extraordinary	Global
	fixed	call	call	assessment
<ol> <li>Final exam and/or partial examinations.</li> </ol>	0%–80%	80%	80%	80%
<ol> <li>Practical activities in: classroom, lab, computers room, visits, etc.</li> </ol>	0%–50%	20%	20%	20%
<ol> <li>Solution and submission of activities (cases, exercises, assignments, projects, etc.), individually and/or in groups.</li> </ol>	0%–50%	0%	0%	0%
4. Active participation in the learning activities.	0%–10%	0%	0%	
5. Attendance to the learning activities.	0%–10%	0%	0%	

#### **Description of the assessment activities**

#### AE1. Midterm Exam

The student will take a midterm exam about Units 1-4, which will consist of (i) a test of 5 items with four possible answers and (ii) a practical problem. The student will have at his/her disposal the lecture notes to solve the practical problem. Both the test and the practical problem will be graded between 0 and 10. In the test, the errors will be penalized according to the proportion "3 wrong answers cancel out 1 right answer". If the grades of both the test and the practical exercise are equal to or greater than 2.5, the midterm exam global grade will be the mean value. Otherwise, the grade will be either 2.5 or the mean value if the latter is less than 2.5.

This assessment activity is ELIMINATORY for those students who obtain a grade equal to or greater than 6. This means that those students do not have to take the corresponding part in the final exam.

This assessment activity is RECOVERABLE. This means that all the students can take the corresponding part in the final exam. In this case, the grade obtained in that part will replace that obtained in the midterm exam.

#### AE2. Final Exam

The Final Exam will consist of (i) a test of items with four possible answers and (ii) a practical exercise with several problems. The test will consist of 15 items for those taking the whole exam, and 10 for those taking only the part corresponding to Units 5-9. The practical exercise will consist of 3 problems for those taking the whole exam, and 2 problems for those taking only the part corresponding to Units 5-9.

The student will have at his/her disposal the lecture notes to solve the practical exercise. Both the test and the practical exercise will be graded between 0 and 10. In the test, the errors will be penalized according to the proportion "3 wrong answers cancel out 1 right answer". If the marks of both the test and the practical exercise are equal to or greater than 2.5, the final exam grade will be the mean value. Otherwise, the grade will be either 2.5 or the mean value if the latter is less than 2.5.

This assessment activity is RECOVERABLE in the extraordinary call.

#### AE3. Practical activities

This activity will be conducted IN GROUPS. Each group will perform 5 practical activities in the laboratory, and will write the corresponding report. The practical activities will be graded with a single mark between 0 and 10, taking into account the accuracy of the measurements, the proper justification and analysis of the results, as well as the quality of the report writing.

This assessment activity is NOT RECOVERABLE during the academic course; i.e., it cannot be conducted again in the extraordinary call. In addition, if the student decides so, the mark may be maintained for two additional academic years.

#### AE4. Practical activities exam

This is an exam taken individually to evaluate the degree of individual achievement of the practical activities. It will consist of one or several problems similar to those solved in the practical activities conducted in the laboratory. It will be graded between 0 and 10.

This assessment activity is NOT RECOVERABLE during the academic course; i.e., it cannot be conducted again in the extraordinary call.

The final grade of the course will be calculated according to the following formulae:

If the student passes the midterm exam and does not take the corresponding part in the final exam:

$$C = 0.8 \left[ \frac{1}{3} CAE1 + \frac{2}{3} CAE2 \right] + 0.1 CAE3 + 0.1 CAE4$$

If the student takes the whole final exam:

#### C = 0.8 CAE2 + 0.1 CAE3 + 0.1 CAE4

C=Final Mark; CAE1= global mark of the partial exam; CAE2= global mark of the final exam; CAE3=mark of the practical activities; CAE4=mark of the practical activities exam.

The global assessment will be held the same day scheduled for the final exam of each call. It will consist of the following parts:

#### AE2. Final Exam

The Final Exam will consist of a test of 15 items with four possible answers and 3 practical problems. The student will have at his/her disposal the lecture notes to solve the practical exercise. Both the test and the practical exercise will be graded between 0 and 10. In the test, the errors will be penalized according to the proportion "3 wrong answers cancel out 1 right answer". If the grades of the test and the practical exercise are equal to or greater than 2.5, the final exam grade will be the mean value. Otherwise, the grade will be either 2.5 or the mean value if the latter is less than 2.5

This assessment activity is RECOVERABLE in the extraordinary call.

#### AE4. Practical activities exam

This is an individual exam consisting of one or several problems similar to those solved in the practical activities conducted in the laboratory. It will be graded between 0 and 10.

This assessment activity is NOT RECOVERABLE during the academic course; i.e., it cannot be conducted in the extraordinary call.

The final grade of the subject will be calculated according to the following formula:

## C = 0.8 CAE2 + 0.2 CAE4

C=Final Mark; CAE2= global mark of the final exam; CAE4=mark of the practical activities exam.



# **Bibliography (basic and complementary)**

## **Basic bibliography**

B1. Lecture notes

## **Complementary bibliography**

C1. White, F. M. (1983 or latter). Fluid Mechanics. McGraw-Hill. C2. Fox, R. y McDonald, A. T. (1995 or latter). Introduction to Fluid Mechanics. McGraw-Hill.

## Other resources and complementary educational materials

## Web pages

W1. Virtual Campus of the Universidad de Extremadura http://campusvirtual.unex.es W2. National Committee for Fluid Mechanics Films http://web.mit.edu/hml/ncfmf.html