COURSE PROGRAM

Academic Year: 2019/2020

Identification and characteristics of the course				
Code	501073		ECTS Credits	6
Course name (English)	Fluid Mechanics			
Course name (Spanish)	Mecánica de Fluidos			
Degree programs	Mechanical Engineering Electrical Engineering Electronical Engineering Materials Engineering			
Faculty/School	School of Industrial Engineering			
Semester	5	Type of course	Obligatory	
Module	Industrial Branch			
Matter	Thermodynamics and Fluid Mechanicas			
Lecturer/s				
Name		Office	E-mail	Web page
José María Montanero Fernández		D0.6	jmm@unex.es	
Conrado Ferrera Llera		D0.7	cfll@unex.es	
Mª Guadalupe Cabezas Martín		D0.5	mguadama@unex.es	
Subject Area	Fluid Mechanics			
Department	Department of Mechanical, Energy, and Materials Engineering			
Coordinating Lecturer (If more than one)	Mª Guadalupe Cabezas Martín			

Competencies* (see table at http://bit.ly/competenciasGrados)

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"
CB1	X	CG1	X	CT1	X	CEFB1		CECRI1		CETE1	
CB2	X	CG2		CT2	X	CEFB2		CECRI2	X	CETE2	
CB3	X	CG3	X	CT3	X	CEFB3		CECRI3		CETE3	
CB4	X	CG4	X	CT4	X	CEFB4		CECRI4		CETE4	
CB5	X	CG5	X	CT5	X	CEFB5		CECRI5		CETE5	
		CG6	X	CT6	X	CEFB6		CECRI6		CETE6	
		CG7	X	CT7	X			CECRI7		CETE7	
		CG8		CT8	X			CECRI8		CETE8	
		CG9		CT9	X			CECRI9		CETE9	
		CG10		CT10	X			CECRI10		CETE10	
		CG11	X					CECRI11		CETE11	
		CG12						CECRI12		CETFG	

Contents

Course outline*

Fluid properties, general integral equations, fluid dynamics, hydrostatics, experimental 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: Kinematics
Contents 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: Introduction. Surface forces. Heat conduction. Mechanical 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: 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.
Description of the practical activities of lesson 5: 4 hours
L3. Measurement of the drag coefficient of a car.

* 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 workload in hours by lesson		**Lectures**	**Practical activities**				**Monitoring activity**	**Homework**
Lesson	**Total**	**L**	**HI**	**LAB**	**COM**	**SEM**	**SGT**	**PS**
Course presentation	1	1						0
1	2	1						1
2	9.5	4.5						5
3	8.5	4.5						4
4 + Practical Activities L1 y L2	29	10		6				13
ECTS (1-4)	3.5	0					1.5	2
Midterm exam (1-4)	7	1						6
5 + Practical Activity L3	14	3		4				7
6	14	6						8
7 + Practical Activity L4	10.5	2.5		3				5
8 + Practical Activity L5	20	7		2				11
ECTS (Units 5-8)	3.5	0					1.5	2
9	5	2						3
Practical Activities Exam	0.5	0.5						0
Assessment **	22	2						20
TOTAL	150	45	0	15	0	0	3	87

L: Lectures (100 students)
HI: Hospital internships (7 students)
LAB: Laboratory or field practices (15 students)
COM: Computer room or language laboratory practices (30 students)
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

** 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	X
2. Solution, analysis and discussion of examples and exercises	X
3. Oral presentation of assignments	X
4. Development of practical cases in labs, computer rooms, seminars, etc.	X
5. Attention to the student and advice of the assignments in small groups	X
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	X
7. Elaboration of assignments either individually or in groups	X
8. Study of each unit: study of contents, preparation of exercises or cases, preparation of the final exam, etc.	X

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 *

Assessment criteria

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 fixed	Ordinary call	Extraordinary call	Global assessment
1. Final exam and/or partial examinations.	0%–80%	80%	80%	80%
2. Practical activities in: classroom, lab, computers room, visits, etc.	0%–50%	20%	20%	20%
3. Solution and submission of activities (cases, exercises, assignments, projects, etc.), individually and/or in groups.	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:

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

If the student takes the whole final exam:

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

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:

$$C = 0.8CAE2 + 0.2CAE4$$

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