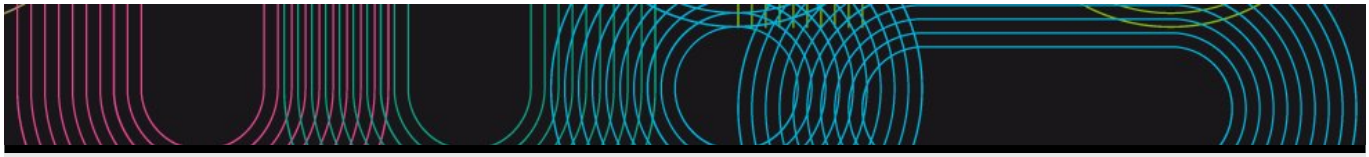

IDENTIFYING DATA				
Fluid mechanics				
Subject	Fluid mechanics			
Code	V09G290V01305			
Study programme	Degree in Energy Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	1st
Teaching language	Spanish English			
Department				
Coordinator	Conde Fontenla, Marcos			
Lecturers	Conde Fontenla, Marcos Molares Rodríguez, Alejandro			
E-mail	mfontenla@uvigo.es			
Web	http://faitic.uvigo.es/			
General description	Previous knowledge on differential equations, physics and mechanics is strongly recomended. The course is intended to acquire essential knowledge needed to analyze devices with fluid as a workingmaterial, such us hydraulic machinery, lubrication devices, heating and cooling systems, piping systems, pneumatic systems, aero and hydrodynamics devices, wind turbines, etc. The course includes stress and strain rate descriptions, fluid statics, differential and finite control volume analysis with continuity, momentum, and energy equations, Bernoulli and Euler equations, dimensional analysis, and laminar and turbulent one-dimensional pipe flow.			

Competencies	
Code	
C15	Knowledge of the principles of fluid mechanics and hydraulics.
D1	Capacity to interrelate all the acquired knowledge and interpret it as components in a body of knowledge with a clear structure and strong internal coherence
D2	Capacity to develop a complete project in any field included in this type of engineering, suitably combining acquired knowledge, accessing necessary information sources, undertaking the necessary enquiries and integrating into inter-disciplinary work teams.
D3	Propose and develop practical solutions, which develop suitable strategies based on theoretical knowledge, for problem phenomena and situations that arise as everyday realities in engineering
D4	Encourage work based on cooperation, communication skills, organization, planning and recognition of responsibility in a multilingual and multidisciplinary working environment that fosters education in equality, peace and respect for fundamental rights
D5	Know what sources are available for ongoing and continual updating of all the information required to undertake their work, with access to all the current and future tools for seeking information and adapting it in the light of technological and social changes
D10	Become aware of the need for training and continual improvement in quality, developing the values associated with scientific thinking and showing a flexible, open and ethical attitude towards diverse opinions and situations, particularly in matters of non-discrimination on the grounds of gender, race or religion, respect for fundamental rights, accessibility, etc

Learning outcomes		
Expected results from this subject	Training and Learning Results	
Understanding of the basic aspects of Fluid Mechanics and Hydraulics.	C15	D1 D3 D4
Capacity to apply that knowledge to solve fluid mechanics and hydraulics problems.	C15	D1 D2 D3 D4 D5

Knowledge of the most commonly used experimental processes when working with fluid flows.	C15	D3 D4 D5 D10
Mastery of current techniques available for analyzing fluid flows.	C15	D4 D5 D10
Acquisition of skills for the process of analyzing industrial problems where fluids are the means of work.	C15	D2 D5 D10

Contents

Topic	
I. FLUIDS FUNDAMENTALS	1. Shear stress 2. Continuum hypothesis 3. Fluid's characteristics 4. Viscosity 5. Forces on a fluid
II. GENERAL STUDY ABOUT FLUID FLOW	1. Velocity field 2. Stream lines 3. Flow types 4. Sytem and control volume definition 5. Reynolds transport theorem 6. Continuity equation 7. Momentum equation 8. Navier-poisson law 9. Energy equation
III. DIMENSIONLESS ANALYSIS AND SIMILARITY IN FLUID DYNAMICS	1. Dimensionless magnitudes 2. Basics on dimensionless analysis 3. Buckingham's Pi theorem 4. Important non-dimensional groups in Fluid Mechanics 5. Similarity
IV. LAMINAR FLOW	1. Introduction 2. One-directional, steady laminar flow of liquids 3. Finite pipe length effect 4. Head loss in laminar flow 5. Laminar flow stability
V. TURBULENT FLOW	1. Introduction 2. Head loss in turbulent flow 3. Empirical formulae for flow through pipes
VI. FLOW OF LIQUID THROUGH VARIABLE CROSS-SECTIONAL DUCTS	1. Introduction 2. Secondary losses 3. Pump-pipe system coupling 4. Piping systems 5. Piping arrangement: series 6. Piping arrangement: parallel 7. Piping network
VII. OPEN-CHANNEL STEADY-FLOW	1. Introcuction 2. Free surface flow classification 3. Common geometries 4. Equations for uniform flow 5. Most efficient section design 6. Energy approach analysis 7. Generalized cross section 8. Energy analysis for sub-critical, transitional and supercritical 9. Head loss 10. Flow measurement 11. Momentum equation 12. Hydraulic jump

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	25	50	75
Autonomous problem solving	0	37	37
Laboratory practical	2	5.5	7.5
Studies excursion	3	0	3

Problem solving	20	0	20
Essay questions exam	2.5	0	2.5
Report of practices, practicum and external practices	0	5	5

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Mainly lectures, but can also include: Readings Literature Review Solution of problems Conferences Oral Presentations Class notes will be previously given to the students in order to ask any doubt during class time.
Autonomous problem solving	To fix the concepts tackled in lectures, including activities such as: Readings Seminars Solution of problems Team working Study of actual cases
Laboratory practical	Experimental activities with actual facilities and/or computer models
Studies excursion	The realization of the formative activity Studies excursion, will be organized by the School board, according to the porposal of the teaching staff about the type of facility or company to visit.
Problem solving	Exercises are previously given to the students, bringing them a try to solve by themselves. Later, some of them will be solved in class by the students and/or the teacher

Personalized assistance

Methodologies	Description
Autonomous problem solving	Personalized attention will be given to the students during class (throughout the possible questions that could arise) and during the specific timetable of the teacher for tutorships. Updated information of the tutorships timetables will be given to the students during first week of class. Tutorshiping will take place both in face-to-face or distance modes, by means of the e-learning applications offered by the University of Vigo or equivalent methods. The tutorial sessions will be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement, in all teaching modalities.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	Each practical lesson will be assessed by means of a brief quiz or a written report. The weigth of this part in the final grade will be 10% maximum. LEARNING OUTCOMES: Understanding of the basic aspects of Fluid Mechanics and Hydraulics. Capacity to apply that knowledge to solve fluid mechanics and hydraulics problems. Knowledge of the most commonly used experimental processes when working with fluid flows. Mastery of current techniques available for analyzing fluid flows. Acquisition of skills for the process of analyzing industrial problems where fluids are the means of work.	10	C15 D1 D2 D3 D4 D5 D10
Essay questions exam	This test will represent the final exam to be done at the end of the couurse, according to the official course schedule. It will cover the 80% of the final grade (maximum). LEARNING OUTCOMES: Understanding of the basic aspects of Fluid Mechanics and Hydraulics. Capacity to apply that knowledge to solve fluid mechanics and hydraulics problems. Knowledge of the most commonly used experimental processes when working with fluid flows. Mastery of current techniques available for analyzing fluid flows. Acquisition of skills for the process of analyzing industrial problems where fluids are the means of work.	90	C15 D1 D2 D3 D4 D5 D10
Report of practices, practicum and external practices		0	

Other comments on the Evaluation

- There will be two continuous assessment quizzes, each of them assessed from 0 to 1 points (2 points maximum). [C_pec]

- There will be two lab sessions, with handed over labwork and report, each of them assessed up to 0.5 points (1 point maximum).[C_lab]- There will be a final exam, to be graded from 0 to 10points. [C_ex]To compute the final grade (C_actas), the followingformula will be used, where C_actas has to equal 5 or above to pass the course:Continuous assessment mode: C_actas = (C_pec + C_lab) +C_ex * (1 - (C_pec + C_lab)/10)Non-attendance mode (officially aproved): C_actas = C_ex

The same assessment methodology will apply in summer exam.

Exam Timetable: Exam dates and rooms must be verified in the official webpage of the school:

http://minaseenerxia.uvigo.es/es/docencia/examenes

Sources of information

Basic Bibliography

White, Frank M., **Mecánica de fluidos**, 6ª ed., McGraw-Hill, 2009

White, Frank M., **Fluid Mechanics**, 6ª ed., McGraw-Hill, 2009

Crespo Martinez, Antonio, **Mecánica de fluidos**, 1ª ed., Thomson, 2006

Complementary Bibliography

Streeter, Victor L. et al., **Fluid Mechanics**, 9ª ed., McGraw-Hill, 2000

Heras, Salvador de las, **Mecánica de fluidos en ingeniería**, 1ª ed., Iniciativa Digital Politècnica, 2012

Barrero Ripoll, Antonio et al., **Fundamentos y Aplicaciones de la Mecánica de Fluidos**, 1ª ed., McGraw-Hill, 2005

Batchelor, G. K., **An introduction to fluid dynamics**, Cambridge Mathematical Library edition, Cambridge University Press, 2000

Hernández Krahe, J. M., **Mecánica de Fluidos y Máquinas Hidráulicas**, 1ª ed., Servicio de publicaciones de la UNED, 2000

Agüera Soriano, José, **Mecánica de fluidos incompresibles y turbomáquinas hidráulicas**, 1ª ed., Ciencia 3, 1996

Fox, Robert W.; McDonald, Alan T., **Introducción a la Mecánica de Fluidos**, 2ª ed., Interamericana - Mc-Graw Hill, 1995

Recommendations

Subjects that continue the syllabus

Hydraulic resources, installations and hydro-power plants/V09G290V01601
Fluid dynamical alternative energies/V09G290V01704

Subjects that it is recommended to have taken before

Mechanical engineering/V09G290V01405

Contingency plan

Description

Considering the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University establishes an extraordinary planning that will be activated when the administrations and the institution determine it. It is based on safety, health and responsibility, and it guarantees teaching in an online or semi-presential modalities. These already planned measures will guarantee, at the required time, the development of teaching in a more agile and effective way, because they will be known in advance by students and teachers through the standardized tool for teaching guides DOCNET.

1. Semi-presential modality
Once the semi-presential teaching is required, it would mean a reduction of the capacity of the teaching spaces used in the face-to-face modality. Therefore, as the first measure of the centre, the capacity of the teaching spaces would be reformulated and informed to the teachers, in order to proceed to reorganize the formative activities for the rest of the semester. It should be noted that the reorganization will depend on the moment throughout the semester in which this semi-presential modality is activated. For the reorganization of the teaching activities, the following guidelines would be followed:

Through the FaiTIC platform, all the students will be informed about the new conditions under which the formative activities and assessment tests will be carried out at the end of the semester.

The tutorial sessions will be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement.

Once some of the students have carried out experimental or computer laboratory practices in the face-to-face modality, if it is possible, the rest of the students will have the possibility to perform the same or equivalent activities in the same modality.

For the rest of the activities until the end of the semester, it should be done a proper identification of those formative activities which can be done under face-to-face modality and those which will be carried out remotely.

Regarding the potential tools to be applied for the formative activities during the online mode, CampusRemoto and the FaiTIC platform will be used.

2. Online modality
In the event that the non-face-to-face teaching modality is required (suspension of all face-to-face formative and assessment activities), the tools currently available at the University of Vigo, CampusRemoto and the FaiTIC platform will be used. The reorganization will depend on the moment throughout the semester in which this online modality is activated. In the reorganization of the teaching activities, the following guidelines would be followed:

2.1. Communication
Through the FaiTIC platform, all the students will be informed about the new conditions under which the formative activities and assessment tests will be carried out at the end of the semester.

2.2. Adaptation and / or modification of teaching methodologies
As the teaching methodologies have been conceived for the face-to-face teaching modality, the teaching methodologies that would be kept and those which would be modified or replaced in the online modality are indicated below.

The teaching methodologies that would be kept, since they can be used in face-to-face and online teaching mode

Conventional lectures, practicum and seminars will be substituted by virtual ones, in the UVigo e-learning system. Practicum lessons contents will be adapted to allow the development of the self-tasks in common computers. New activities will focus in algorithms development and knowledge application to common tasks, basic skill adquisition and know-how adquisition, closely related with the main topics of the course. Tasks under evaluation will be performed at home, using GNU software or licensed software to the student available at the university at no extra charge.

2.3. Adaptation of tutorial sessions and personalized attention
The tutorial sessions may be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement

2.4. Evaluation
The same weights for the different parts of the course will remain unchanged.
All the remaining tests and quizzes will be developed in the e-learnig platform of the UVigo (Moodle and so).

2.5. Bibliography or additional material to facilitate self-learning
Additional references (students self-learning improvement)
Mastering VBA for Microsoft Office 365 - Autor: Richard Mansfield; 944 páginas, Editor: John Wiley & Sons Inc; Edición: 2019; ISBN-10: 1119579333; ISBN-13: 978-1119579335)
Introducción a la programación en Matlab: para ingenieros civiles y mecánicos Autor: Luis E. Suarez; 168 páginas; Publisher: CreateSpace Independent Publishing Platform; 1 edition; ISBN-10: 1490482393; ISBN-13: 978-1490482392)