Universidade Vigo

IDENTIFYING DATA				
Fluid mechanics				
Subject	Fluid mechanics			
Code	V12G380V01405			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	López Veloso, Marcos Gil Pereira, Christian			
Lecturers	Gil Pereira, Christian López Veloso, Marcos Molares Rodríguez, Alejandro			
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General description	This syllabus presents information about the Fluid mechanics course during the 2nd year of the degree in Mechanical Engineering, 2019-2020, in accordance to the guidelines by the European Space of Upper Education. This is a first course in fluid mechanics, focusing on the topics that are relevant to Mechanical Engineering applications. The course is intended to acquire essential knowledge needed to analyze devices with fluid as a working material, such us hydraulic machinery, lubrication devices, heating and cooling systems, pipes systems, pneumatic systems, aero and hydrodynamics devices, windturbines, etc. It includes stress and strain rate descriptions, fluid statics, use of differential and finite control volume analysis with continuity, momentum, and energy equations, Bernoulli and Euler equations, incompressible viscous flow using Navier-Stokes equations, dimensional analysis, laminar and turbulent pipe flow.			

Skills	
Code	
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering in Mechanical specialty.
B5	CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
C8	CE8 Knowledge of the basic principles of fluid mechanics and their application to solving problems in the field of engineering. Calculation of pipes, channels and fluid systems.
D2	CT2 Problems resolution.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
CG5 Knowledge for the realisation of measurements, calculations, assessments, evaluations, studies, reports, plans of works and other analogous works.	B4 B5	C8	D2 D9 D10
CG4 Capacity to: solve problems with initiative and creativity, take decisions, develope critical reasoning and capacity to communicate and transmit knowledge and skills in the field of the industrial engineering.	B4 B5	C8	D2 D9 D10

RI2 Knowledge of the basic principles of the fluid mechanics and his application to the resolution of problems in the field of the engineering. Intended learning outcomes are, understanding of the basics of flow behaviour in engineering systems, awareness of the physical laws that govern fluid motion and development of analytical skills for simple flow systems, e.g. calculation of pipes, channels and fluid systems	B4 B5	C8	D2 D9 D10
CT2 Resolution of problems.	B4 B5	C8	D2 D9 D10

Contents	
Topic	
1. Introduction	1.1 Fundamental Concepts: 1.1.1 Stress tensor. Newton Law 1.2 The Fluid as a Continuum 1.3 Viscosity:1.3.1 Newtonian Fluids and non Newtonian fluids 1.4 Characteristics of the flows: 1.4.1 Different types of flows: 1.4.1.1 Geometrical conditions, 1.4.1.2 Kinematic conditions, 1.4.1.3 Mechanical conditions, 1.4.1.4 Compressibility 1.5 Stresses on a fluid: 1.5.1 Tensorial and vectorial magnitudes, 1.5.1.2 Volumetric Forces, 1.5.2.2 Surface Forces, 1.5.2.3 The stress tensor, 1.5.2.4 Concept of pressure
2. Basic Physical Laws of Fluid Mechanics	2.1 Velocity field 2.2 Streamlines and pathlines 2.3 Systems and Control volumes 2.4 Integrals extended to Fluid volumes. The Reynolds Transport Theorem 2.5 Conservation of Mass. Integral and Differential Equation 2.6 The Linear Momentum Equation. Integral and Differential Equation. 2.7 Navier-Poisson Law 2.8 The Energy Equation. Integral and Differential Equation. Frictionless Flow: The Bernoulli Equation
3. Dimensional Analysis. Similarity concepts	3.1 Introduction 3.2 The Pi Theorem 3.3 Applications 3.4 Fundamental Nondimensional Numbers in Fluid Mechanics: 3.4.1 Physical meaning of the nondimensional numbers 3.5 Similarity in Fluid dynamics: 3.5.1 Partial Similarity, 3.5.2 Scaling effect
4. Laminar viscous flow	4.1 Introduction 4.2. Fully developed flow: 4.2.1 Hagen-Poiseuille Flow, 4.2.2 Viscous flow in circular ducts, 4.2.3 Flow in Noncircular Ducts 4.3 Entrance region effect 4.4 Losses in Pipe Systems: 4.4.1 Friction coefficient 4.5 Stability of laminar flow
5. Turbulent Flow in ducts	5.1 Introduction 5.2 Pipe-head Loss in turbulent regime: 5.2.1 Nikuradse chart, 5.2.2 Moody chart, 5.2.3 Empirical Formulas for flow in circular ducts. Hydraulic diameter
6. Minor Losses in Pipe Systems	6.1 Introduction 6.2 Minor Losses: 6.2.1 Loss at the entrance of a pipe, 6.2.2 Loss at the exit of a pipe, 6.2.3 Loss at contractions, 6.2.4 Loss at expansions, 6.2.5 Loss at elbows, 6.2.6 Losses at bends, elbows, tees and valves
7. Pipe systems	7.1 Pipes in series 7.2 Pipes in parallel 7.3 The three-reservoir pipe junction problem 7.4 Pipings netwoks 7.5 Nonsteady effects in duct flows: 7.5.1 Emptying time of a tank, 7.5.2 Setting of the steady flow in a pipe, 7.5.3 Water hammer
8. Open-Channel Flow	8.1 Introduction 8.2 Uniform Flow: 8.2.1 Pipes used like channels 8.3 Non uniform flow: 8.3.1 The hydraulic jump, 8.3.2 Fast transitions, 8.3.3 Flow over a gate, 8.3.4 Flow under a gate, 8.3.5 Section of control
LABORATORY	1. Measurements of head and minor losses in a pipe system. Minor losses measuremens in a venturi device. Minor losses measurents in a holed-plate. Friction coefficients measurements. Losses in elbows, bends, tees and valves

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	60.5	93
Problem solving	14	33	47
Laboratory practical	4	0	4
Mentored work	0	0	0
Essay questions exam	3	0	3
Problem and/or exercise solving	3	0	3

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

Methodologies

	Description
Lecturing	The foundations of each subject that are needed to solve practical problems, are explained. It includes mainly lectures but it can also includes: Readings Bibliographic Review Solution of problems Conferences Oral Presentations
Problem solving	Application of the concepts tackled in the lectures. It includes activities such as: Readings Seminars Solution of problems Team working Study of practical cases
Laboratory practical	Fundamentally, they will consist on activities of experimentation, although they also can include: Practical cases Simulation Solution of problems Team working
Mentored work	Optionally, students can join this activity and carry out a mentored project by groups.

Personalized assistance

Methodologies	Description
Lecturing	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
Laboratory practical	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
Mentored work	The questions and inquiries of the students will be attended in the professors´s office. The tutorships timetables will be published in the teaching platform and/or given to the students in class.

Assessment

	Description	Qualification	Training and Learning Results		
Mentored work	The professors will assess the students based on the dedication, the results and the quality of the work. The specific criteria will be published in the definition of the work at the beginning of the course. MarkMW (Mentored Work)	Up to 5	B4 B5	C8	D2 D9 D10
Essay questions exam	Written exam consisting of: theoretical questions practical questions resolution of exercises/problems short covering of a topic MarkEX (Exam)	Between 75 and 100	B4 B5	C8	D2 D9 D10
Problem and/or exercise solving	Problem and exercise solving that might include: - Weakly delivery - Delivery of problems solved during the practical lessons - Reports describing the development of the experimental and lab activities. - Written tests, online tests, questions, etc. MarkCA (Continuous assessment)	Up to 20	B4 B5	C8	D2 D9 D10

Other comments on the Evaluation

The final mark will be obtain based on the formula: Mark = MarkCA+MarkMW+MarkEX·[1-(MarkCA+MarkMW)/10]. Where:

Mentored Work (MarkMW): value between 0 and 0.5 points, representing a maximum of 5% of the total mark. The mark of the mentored work will not be kept from the previous year to the students that are repeating the course.

Continuous assessment (MarkCA): value between 0 and 2 points, representing a maximum of 20% of the total mark. The mark of the continuous assessment will not be kept from the previous year to the students that are repeating the course.

Final exam (MarkEX): value between 0 and 10, representing between 75 and 100% the total mark, based on the results of the mentored work and the continuous assessment. The weight of this mark will be calculated using the expression: 1-(MarkCA+MarkMW)/10. Example: if a student gets 1.5 out of 2 points in the continuous assessment and 0.3 out of 0.5 points in the mentored work, the mark of the final exam will be weigthed by the factor 1-(1.5+0.3)/10=0.82, that is, the mark of the final exam will represent 82% of the total mark.

Continuous assessment and mentored work grading is not saved year after year

Summer final exam: the same criteria as in 1st call will be applied;
Ethical Commitment: In case of noticing a non ethical behaviour (copy, plagiarism, utilisation of unauthorised electronic devices, and others) it will be considered that the student does not gather the necessary requirements to pass the course. In this case, the global qualification iof the present academic course will be failed (0.0).

Sources of information

Basic Bibliography

Frank M White, **Mecánica de Fluidos/Fluid Mechanics**, VI,

Antonio Crespo, **Mecánica de fluidos**,

Complementary Bibliography

Philip M. Gerhart, Richard J Gross, , Jonh I. Hochstein, **FUNDAMENTOS DE MECANICA DE FLUIDOS**, II,

Yunus A. Çengel, John M. Cimbala, **Mecánica de fluidos : fundamentos y aplicaciones**,

Elena Martín Ortega, Concepción Paz Penín, **Prácticas de laboratorio de mecánica de fluidos**,

A. Liñán Martínez, M. Rodríguez Fernández, F.J. Higuera Antón, **Mecánica de fluidos**,

Victor L. Streeter, E. Benjamin Wylie, Keith W. Bedford, **Mecánica de fluidos/Fluid Mechanics**, IX,

Robert W. Fox, Alan T. McDonald, **Introducción a la mecánica de fluidos**,

Robert L. Mott, **Mecánica de fluidos**, VI,

Merle C. Potter, David C. Wiggert ; con Miki Hondzo, Tom I.P. Shih, **Mecánica de fluidos/Mechanics of Fluids**, III,

Pijush K. Kundu , Ira M. Cohen, **Fluid Mechanics**, 4th Edition,

G. M. Homsy et al., **Multi-media Fluid Mechanics**,

Recommendations

Subjects that are recommended to be taken simultaneously

Thermodynamics and heat transfer/V12G380V01302

Subjects that it is recommended to have taken before

Physics: Physics I/V12G380V01102
Physics: Physics II/V12G380V01202
Mathematics: Algebra and statistics/V12G380V01103
Mathematics: Calculus I/V12G380V01104
Mathematics: Calculus II and differential equations/V12G380V01204