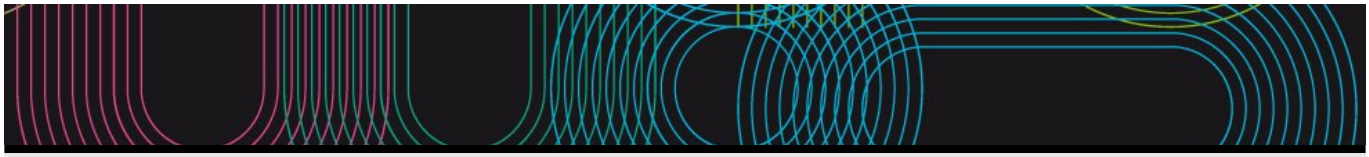

IDENTIFYING DATA				
Fluid mechanics				
Subject	Fluid mechanics			
Code	V12G360V01403			
Study programme	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Paz Penín, María Concepción			
Lecturers	Carrera Pérez, Gabriel Paz Penín, María Concepción Suárez Porto, Eduardo			
E-mail	cpaz@uvigo.es			
Web				
General description	(*)Nesta guía docente preséntase información relativa á materia Mecánica de Fluídos de 2º curso do grao en Tecnoloxías Industriais, no que se continúa de forma coordinada un achegamento ás directrices marcadas polo Espazo Europeo de Educación Superior. Neste documento recóllense as competencias xenéricas que se pretende que os alumnos adquiran neste curso, o calendario de actividades docentes previsto e a guía docente de materia. A Mecánica de Fluídos describe os fenómenos físicos relevantes do movemento dos fluídos, describindo as ecuacións xerais dos devanditos movementos. Este coñecemento proporciona os principios básicos necesarios para analizar calquera sistema no que o fluído sexa o medio de traballo. Estes principios requírense en: - Deseño de maquinaria hidráulica - Lubricación - Sistemas de calefacción e ventilación, calor e frío. - Deseño de sistemas de tubaxes - Medios de transporte: transmisión, climatización, sistema de escape, aerodinámica e hidrodinámica, refrixeración,etc - Aerodinámica de estruturas e edificios			

Competencies	
Code	
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
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		
Understand the basic principles of the fluid movement.	B4	C8	D9 D10

Capacity to calculate pipes and channels.	B5	C8	D2 D9 D10
Capacity to know and dominate the tools to solve the problems of fluids and flows.	B4 B5	C8	D2 D9 D10
Capacity to handle meassurementes of flow magnitudes	B5	C8	D9 D10

Contents	
Topic	
1. INTRODUCTION	1.1 Fundamental concepts 1.1.1 Shear stress. Newton Law 1.2 Continuous hypotesis 1.3 Viscosity 1.3.1 Newtonian and no newtonian fluids 1.4 Characteristics of the flows 1.4.1 Classes of flows 1.4.1.1 According to geometrical conditions 1.4.1.2 According to conditions quinemáticas 1.4.1.3 According to mechanical boundary conditions 1.4.1.4 According to compresibility 1.5 Efforts on a flow 1.5.1 Vectorial and tensor magnitudes 1.5.1.1 volumetric strengths 1.5.1.2 superficial strengths 1.5.1.3 The stress tensor. 1.5.1.4 Concept of pressure. Pressure in a point
2. BASICS OF FLUID MOVEMENT	2.1 FIELD OF SPEEDS 2.1.1 Eulerian and Lagrangian approach 2.1.2.Tensor speed gradient 2.2 STREAM LINES 2.3 SYSTEMS VOLUMES OF CONTROL 2.4 INTEGRALS EXTENDED TO FLOW VOLUMES 2.4.1 RTT Reynolds Transport Theorem 2.5 CONTINUITY EQUATION 2.5.1 Diverse expresions of the continuity equation of 2.5.2 Stream function 2.5.3 Volumetric flow 2.6 MOMENTUM EQUATION 2.6.1 Integral Form. Examples of application 2.6.2 Equation of conservation of the moment cinétic 2.6.3 Differential form of the C.C.M. 2.6.4 Equation of Euler 2.6.5 Equation of Bernouilli 2.7 NAVIER-POISSON LAW 2.7.1 Deformations and efforts in a real flow 2.7.1.1 Relations between them 2.7.1.2 Navier-Stokes Equation 2.8 ENERGY EQUATION 2.8.1 Integral form 2.8.2 Differential form 2.8.2.1 Equation of the mechanical energy 2.8.2.2 Equation of the internal energy. 2.8.3 Extension of the case of exterior works applied to volumes of control. Application to hydraulic machines

3. DIMENSIONLESS ANALYSIS AND FLUIDMECHANIC SIMILARITY. SIMILARITY IN FLUID POWER MACHINES	3.1 INTRODUCCION 3.3 PI-BUCKINGHAN THEOREM. APPLICATIONS 3.4 DIMENSIONLESS GROUPS IN FLUID MECHANICS 3.4.1. Physical meaning of the dimensionless numbers 3.5 SIMILARITY 3.5.1 Partial similarity 3.5.2 Scale effect
4. LAMINAR UNIDIRECTIONAL LIQUID MOVEMENT. LUBRICATION	4.1 INTRODUCTION 4.2.MOVEMENT LAMINAR PERMANENT 4.2.1 Hagen-Poiseuille 4.2.2 Pipes circular section 4.2.3 Other sections 4.3 EFFECT OF PIPE FINITE LENGTH 4.4 LOSS DE LOAD 4.4.1 Friction coefficient 4.5 LAMINAR STABILITY
5. TURBULENCE. UNIDIRECTIONAL MOVEMENTS	5.1 INTRODUCTION 5.2 LOSS DE LOAD EN MUDDY FLOWS EN PIPES 5.2.1 Diagram of Nikuradse 5.2.2 Diagram of Moody 5.2.3 Empirical Forms for flow in pipes
6. LIQUIDS MOVEMENT IN PIPES WITH VARIABLE SECTION. PIPES SYSTEMS	6.1 INTRODUCTION 6.2 LOCAL LOSSES 6.2.1 Loss to the entrance of a tube 6.2.2 Loss in a tube to exit 6.2.3 Loss by contracción 6.2.4 Loss by widen 6.2.5 Loss in elbows. 6.3 PIPES IN SERIES 6.4 PIPES IN PARALLEL 6.5 THREE DEPOSITS PROBLEM 6.6 NETS OFPIPES 6.7 TRANSITORY EN PIPES 6.7.1 Time of tank emptied 6.7.2 Establishment of the permanent regime in a pipe 6.7.3 Water hammer
7. PERMANENT FLOW IN CHANNELS	7.1 INTRODUCTION 7.2 UNIFORM MOVEMENT 7.2.1 Pipes closed used as channels 7.3 NO UNIFORM MOVEMENT 7.3.1 Highlight hydraulic 7.3.2 Fast transitions 7.3.3 Dump of thick wall 7.3.4 Gates 7.3.5 Section of control

8. EXPERIMENTATION WITH FLOWS. DISCHARGE MEASUREMENT. PRESSURE MEASUREMENT. SPEED MEASUREMENT.	8. 1 PRESSURE GAUGES 8.1.1 Simple pressure gauge 8.1.2 Bourdon pressure gauge 8.1.3 Transductor of pressure 8.2 SPEED MEASUREMENT 8.2.1 Pitot tube 8.2.2 Prandt tube 8.2.3 Rotative anemometer 8.2.4 Hot thread anemometer 8.2.5 Llaser-dopler anemometer 8.3 FLOW MEASSUREMENT 8.3.1 Differential pressure: diaphragm, venturi, nozzle. 8.3.2 Other types.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	32.5	70.5	103
Problem solving	5.6	15	20.6
Mentored work	5.8	0	5.8
Laboratory practical	12	0	12
Essay questions exam	1.5	0	1.5
Laboratory practice	5.6	0	5.6
Problem and/or exercise solving	1.5	0	1.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Explain the fundamentos of each subject with practical problems. That includes activities as: master lesson Readings bibliographic Review Summary Diagrams Solution of problems Conferences Presentations
Problem solving	Solve exercises and problems, employing the theoretical basics directly. Solve also problems of industrial application, more focused in real applications, close to practice of engineering.
Mentored work	Works of practical applications, projects, design, creative and novelty subjects of practical applications of fluid mechanics
Laboratory practical	Will apply the concepts developed of each subject to the realization of practices of laboratory. Fundamentally, we will do experimental activities: practical lessons Simulation Solution of problems Collaborative learning

Personalized assistance	
Methodologies	**Description**
Laboratory practical	Before the start of the course the official office hours will be published in the virtual platform, Faitic.
Lecturing	Before the start of the course the official office hours will be published in the virtual platform, Faitic. Provisional schedules (Eduardo Suárez Port. Desp.327): Wednesdays: 17:30-20:30

Assessment				
	Description	Qualification	Training and Learning Results	
Problem solving	Resolutions of practical problems related with the contained imparted in one fear particular of theory.	8	B4	D2 D9
Mentored work	Works of application and demonstration of the principles fundamentáis of the mecánico of fluidos.	2	B4	D9

Essay questions exam	Write proof that will be able to feature of: theoretical questions practical questions resolution of exercises/problems subject to develop	80	B4 B5	C8	D2 D9 D10
Laboratory practice	Practical realization in Laboratory. Report of the activities realized in the sessions of laboratory, results of the experimentation, etc.	5	B4 B5	C8	D2 D9 D10
Problem and/or exercise solving	Short escrito proofs, that can be of practical questions of laboratory or of conteptos of theory.	5	B4	C8	D9

Other comments on the Evaluation

The continuous evaluation considered until July, pole that the calificacións managed in all the activities realized previously will keep tie the announcement of July.

The exact percentages can divert slightly of the indicated because of the management, or factibilidade of realization of the different practical proofs, and when attributing him to the complementary activity (Work and projects) an upper assessment, being able to even surpass the 10 how maximum qualification alcadable.

Anyway the weight of a 80% of the proof of long answer will keep invariable.It expects that the present student an ethical behaviour appropriate. In case to detect a no ethical behaviour (copy, plaxio, utilization of electronic devices no authorized, for example), will consider that the student does not gather the necessary requirements to surpass the subject. Depending of the type of behaviour no ethical detected, be able to conclude that the student did not achieve the necessary competitions.
It will not allow the utilization of any electronic device during them test of evaluation except autorización expresses. The fact to enter an electronic device no authorized in the classroom of exame will be considered reason of no superación of the subject in the present academic course and the global qualification will be of suspenso (0.0).

Sources of information

Basic Bibliography

Frank M White, **Mecánica de Fluidos**, 6ª, McGraw-Hill Interamericana de España S.L, 2008

Robert L. Mott, **Mecánica de fluidos**, 7ª, Pearson, 2015

Antonio Crespo, **Mecánica de fluidos**, 1ª, Thomson, 2006

Complementary Bibliography

Robert W. Fox, Alan T. McDonald, **Introducción a la mecánica de fluidos**, 2ª, McGraw-Hill, 1995

Merle C. Potter, David C. Wiggert, **Mecánica de fluidos**, 3ª, Thomson, 2002

Victor L. Streeter, E. Benjamin Wylie, Keith W. Bedford, **Mecánica de fluidos**, 9ª, McGraw-Hill, 2000

Yunus A. Çengel, John M.Mecánica de fluidos : fundamentos y aplicaciones Cimbala, **Mecánica de fluidos: fundamentos y aplicaciones**, 2ª, McGraw-Hill Interamericana de España S.L, 2006

Elena Martín Ortega, Concepción Paz Penín, **Prácticas de laboratorio de mecánica de fluidos**, 1ª, Gallega de Mecanización, 2006

Philip M. Gerhart, Richard J Gross, , Jonh I. Hochstein, **FUNDAMENTOS DE MECANICA DE FLUIDOS**, 2ª, Adison-Wesley Iberoamericana, 1995

Recommendations

Subjects that continue the syllabus

Hydraulic turbomachines/V12G360V01504
Final Year Dissertation/V12G360V01991

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

Other comments

Recommends to the student:
Assistance to class
Dedication of the autonomous personal work hours to the subject