IDENTIFYING DATA				
Fluid mechanics				
Subject	Fluid mechanics			
Code	V12G363V01403			
Study programme	Degree in Industrial Technologies Engineering			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	English			
Department				
Coordinator	Meis Fernández, Marcos			
Lecturers	Meis Fernández, Marcos			
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General description	This syllabus presents information the Fluid mechanics course that belongs to the 2nd year of the degree in Industrial Technologies Engineering, 2019-2020, in accordance to the marked guidelines by the European Space of Upper Education. This is a first course in fluid mechanics, focusing on the topics that are relevant to Industrial Technologies 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.			

Competencies		
Code		Typology
CG4	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.	• know • Know How • Know be
CG5	CG5 Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.	• know • Know How • Know be
CE8	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.	• know • Know How • Know be
CT2	CT2 Problems resolution.	• know • Know How • Know be
CT9	CT9 Apply knowledge.	• know • Know How • Know be
CT10	CT10 Self learning and work.	• know • Know How • Know be

Learning outcomes	
Learning outcomes	Competences

Knowledge for the realisation of measurements, calculations, assessments, evaluations, studies, reports, plans of works and other analogous works	CG4 CG5 CE8 CT2 CT9 CT10
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	CG4 CG5 CE8 CT2 CT9 CT10
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	CG4 CG5 CE8 CT2 CT9 CT10
Resolution of problems	CG4 CG5 CE8 CT2 CT9 CT10

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 Losses6.2.1 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 6.3 Pipes in series 6.4 Pipes in parallel 6.5 The three-reservoir pipe junction problem 6.6 Pipings netwoks 6.7 Nonsteady effects in duct flows 6.7.1 Emptying time of a tank 6.7.2 Setting of the steady flow in a pipe 6.7.3 Water hammer
7. Open-Channel Flow	7.1 Introduction 7.2 Uniform Flow 7.2.1 Pipes used like channels 7.3 Non uniform flow 7.3.1 The hydarulic jump 7.3.2 Fast transitions 7.3.3 Flow over a gate 7.3.4 Flow under a gate 7.3.5 Section of control
8. Experimentation withFflows. Discharge Measurement. Pressure Measurement. Speed Measurement	8.1 Pressure Gauge 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 Prandtl tube 8.2.3 Rotative anemometer 8.2.4 Hot thread anemometer 8.2.5 Laser-doppler anemometer 8.3 Flow measurement 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
Objective questions exam	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	They explain the foundations of each subject needed to solve practical problems. It includes mainly lectures baut can also includes: Readings bibliographic Review Solution of problems Conferences Oral Presentations
Problem solving	They will apply the concepts tackled in the lectures. It includes activities such as: Readings Seminars Solution of problems Team working Study of practical cases
Mentored work	Works of practical applications, projects, design, creative and novelty subjects of practical applications of fluid mechanics
Laboratory practical	Fundamentally, they will consist on activities of experimentation, although they also can include: Practical cases Simulation Solution of problems Team working

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 (Faitic)
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 (Faitic)

Assessment

	Description	Qualification	Evaluated Competencess
Problem solving	Resolutions of practical problems related with the contained imparted in one specific topic of theory	8	CG4 CT2 CT9
Mentored work	Works of application and demonstration of basic principles of fluid mechanics	2	CG4 CT9
Essay questions exam	Proof written that it will be able to consist of: theoretical questions practical questions resolution of exercises/problems fear to develop	80	CG4 CG5 CE8 CT2 CT9 CT10
Laboratory practice	Practical realization in Laboratory. Report of the activities realized in the sessions of laboratory, results of the experimentation, etc.	5	CG4 CG5 CE8 CT2 CT9 CT10
Objective questions exam	Short written proofs, that can be of practical questions of laboratory or of conteptos of theor	5	CG4 CE8 CT9

Other comments on the Evaluation

Continuous evaluation: it represents 20% of the note. Except official indication from the center direction of the renunciation of the student to the continuous evaluation, the student follows the course in this modality.

Continuous evaluation is considered until July, so the qualifications achieved in all the activities previously carried out are kept until the July Final Exam. The exact percentages may deviate slightly from those indicated due to the management, or feasibility of carrying out the different practical tests, and attributing to the complementary activity (work and projects) a higher qualification and, may even exceed 10 as the maximum qualification achievable.

In any case, the weight of 80% of the long answer test will remain unchanged.

The student is expected to exhibit adequate ethical behaviour. 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 of the present academic course will be failed (0.0). The use of any electronic device during the evaluation tests will not be allowed unless expressly authorized. The fact of introducing an electronic device not authorized in the exam room will be considered a reason for not passing the subject in this present academic course and the global qualification will be failed (0.0).

Sources of information

Basic Bibliography

Frank M White, Mecánica de Fluidos/Fluid Mechanics, VI, McGraw-Hill

Robert L. Mott, Mecánica de fluidos, VI, México D.F. : Pearson Educación, 2006

Antonio Crespo, Mecánica de fluidos, Madrid : Universidad Politécnica, E.T.S. de Ingeni

Complementary Bibliography

Robert W. Fox, Alan T. McDonald, Introducción a la mecánica de fluidos, México ; Madrid [etc.] : McGraw-Hill, 1995

Merle C. Potter, David C. Wiggert ; con Miki Hondzo, Tom I.P. Shih, Mecánica de fluidos/Mechanics of Fluids, III, México D.F. : Thomson, cop. 2002

Victor L. Streeter, E. Benjamin Wylie, Keith W. Bedford, Mecánica de fluidos/Fluid Mechanics, IX, Santafé de Bogotá : McGraw-Hill, cop. 2000

Yunus A. Çengel, John M. Cimbala, Mecánica de fluidos : fundamentos y aplicaciones, México [etc.] : McGraw Hill, cop. 2006

Elena Martín Ortega, Concepción Paz Penín, Prácticas de laboratorio de mecánica de fluidos, Vigo : Universidad, Escuela Técnica Superior de In

Philip M. Gerhart, Richard J Gross, , Jonh I. Hochstein, FUNDAMENTOS DE MECANICA DE FLUIDOS, II, Adison-Wesley Iberoamericana

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

Other comments

Recommends to the student:
Attend to class
Spend the hours outside the classroom studying the subject