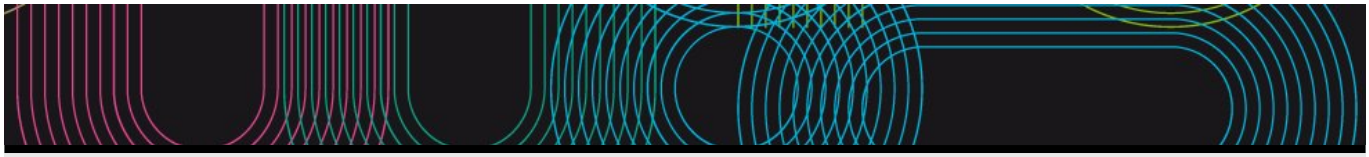

IDENTIFYING DATA				
Simulation Applied to Fluid Mechanics				
Subject	Simulation Applied to Fluid Mechanics			
Code	V09M148V01305			
Study programme	(*)Máster Universitario en Enxeñaría de Minas			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Martín Ortega, Elena Beatriz			
Lecturers	Martín Ortega, Elena Beatriz			
E-mail	emortega@uvigo.es			
Web	http://emortega.webs.uvigo.es/			
General description	This *asignatura presents like an introduction to the dynamics of computational fluids that, splitting of a knowledge of the equations of conservation of the fluids (already purchased by the students in *asignaturas previous) allow to the student realise simple simulations that *involucren to a fluid like half of work.			

Competencies	
Code	
A1	(*)Posuír e comprender coñecementos que acheguen unha base ou oportunidade de ser orixinais no desenvolvemento e/ou aplicación de ideas, adoito nun contexto de investigación.
A2	(*)Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en contornos novos ou pouco coñecidos dentro de contextos máis amplos (ou multidisciplinares) relacionados coa súa área de estudo.
B7	
C19	
C20	(*)Competencia Específica CA2. Coñecemento adecuado de aspectos científicos e tecnolóxicos de mecánica de fluídos, mecánica de medios continuos, cálculo de estruturas, xeotecnia, carboquímica e petroquímica.
D1	(*)Competencia Transversal CT1. Saber avaliar e seleccionar a teoría científica adecuada e a metodoloxía precisa dos seus campos de estudo para formular xuízos a partir de información incompleta ou limitada incluíndo, cando sexa preciso e pertinente, unha reflexión sobre a responsabilidade social ou ética ligada á solución que se propoña en cada caso.
D2	(*)Competencia Transvesal CT2. Ser capaz de predicir e controlar a evolución de situacións complexas mediante o desenvolvemento de novas e innovadoras metodoloxías de traballo adaptadas ao ámbito científico/investigador, tecnolóxico ou profesional concreto, en xeral multidisciplinar, no que se desenvolva a súa actividade.
D11	(*)Competencia Transversal CT11. Adquirir coñecementos avanzados e demostrar, nun contexto de investigación científica e tecnolóxica ou altamente especializado, unha comprensión detallada e fundamentada dos aspectos teóricos e prácticos e da metodoloxía de traballo nun ou máis campos de estudo.

Learning outcomes	
Expected results from this subject	Training and Learning Results
Possess the suitable knowledges of the scientific and technological appearances of fluid mechanics, in concrete of the methods advanced of numerical simulation in Fluid mechanics: Technical *CFD, flows of layer limit, models of turbulence, amongst other.	A1 A2 B7 C19 C20 D1 D2

Know analyse systems in which the fluid was the half of work by means of technicians of Dynamics of Computational Fluids.	A1 A2 B7 C19 C20 D1 D2 D11

Contents	
Topic	
1. Introduction to the dynamics of computational fluids. Equations and models.	1.1 general Equations of the movement of fluids. 1.1.To integral Notation 1.1.*b Differential notation 1.1.*c Compact notation 1.2 adimensional Numbers notable in fluid mechanics 1.2.To Examples of models limit 1.3 Peculiarities of the flows: Layers limit
2. Turbulent flows	2.1 Introduction 2.2 Scale of *Kolmogorov 2.3 *Inviabilidad of the direct numerical simulation 2.4 Models of turbulence 2.4.To Models *RANS: - Averages of *Reynolds and of *Favre - Equations *promediadas. Apparent efforts of *Reynolds. Problem of the closing - Hypothesis of *Boussinesq: algebraic models, of an equation and of two equations - Laws of wall. Models of high and low number of *Reynolds - Models of transport of apparent efforts of *Reynolds 2.4.*b Models THEM
3. Specific methods of resolution of the equations of *Navier-*Stokes.	3.1 Discretisation of the equations of fluids. 3.1.To Discretisation of the computational command 3.1.*b Equations *discretizadas in *FVM 3.1.*c Discretisation of the conditions of outline 3.1.*d Treatment of the layers limit 3.2 Flows *incompresibles. Equation of pressure 3.2.To Methods of artificial compressibility 3.2.*b Attachments pressure-speed
4. Introduction to the use of distinct software (*Comsol and *OpenFoam*) of numerical simulation of fluids. Practices in classroom *infromática *The use of this software will remain conditioned to the availability of licences of use by part of the centre as well as to the correct installation of the same in the computer classroom assigned	4.1 Flow around a stair. Flow *laminar and turbulent flow 4.2 aerodynamic Strengths on bodies. Example of calculation of the street of *Kármán after a cylinder of circular section 4.3 Example of the flow in the interior of a cavity 4.4 Example of a device *mezclador of currents 4.5 they will propose exercises of numerical simulation to be resolved of form more independent by the students. If the rhythm of class allows it will present additional simulations

Planning			
	Class hours	Hours outside the classroom	Total hours
Master Session	12	27.5	39.5
Troubleshooting and / or exercises	4	14	18
Practice in computer rooms	8	5	13
Multiple choice tests	1.5	0	1.5

Case studies / analysis of situations	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
Master Session	Exhibition by part of the professor of the contents on the matter object of study, theoretical bases and/or guidelines of a work, exercise or project to develop by the student.
Troubleshooting and / or exercises	Activity in which they formulate problem and/or exercises related with the *asignatura. The student has to develop the suitable or correct solutions by means of the *ejercitación of routines, the application of formulas or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. It is used to use as I complement of the lesson *magistral.
Practice in computer rooms	Activities of application of knowledges to concrete situations, and of acquisition of basic skills and *procedimentales related with the matter object of study, that realise in classrooms of computing.

Personalized attention

Methodologies	Description
Master Session	It will attend of personalised form to the student in the session of questions that will formulate during the sessions *magistrales, as well as in the computer practices Likewise it will attend to the student of personalised form in the sessions of *tutorias of the *asignatura
Troubleshooting and / or exercises	It will attend of personalised form to the student in the session of questions that will formulate during the sessions *magistrales, as well as in the computer practices Likewise it will attend to the student of personalised form in the sessions of *tutorias of the *asignatura
Practice in computer rooms	It will attend of personalised form to the student in the session of questions that will formulate during the sessions *magistrales, as well as in the computer practices Likewise it will attend to the student of personalised form in the sessions of *tutorias of the *asignatura

Assessment

	Description	Qualification	Training and Learning Results		
Multiple choice tests	Proofs for evaluation of the competitions purchased that include enclosed questions with different alternative of answer (true/false, multiple election, *emparejamiento of elements...). The students select an answer between a number limited of possibilities. These proofs evaluate the result of following learning: "Possess the suitable knowledges of the scientific and technological appearances of fluid mechanics, in concrete of the methods advanced of numerical simulation in Fluid mechanics: Technical *CFD, flows of layer limit, models of turbulence, amongst other"	50	B7	C19 C20	D1
Case studies / analysis of situations	Proof in that it poses a situation or problematic already given or that it can give, splitting of the different factors *involucrados, the analysis of the antecedents, conditions, of the situation, etc. This proof evaluates the result of following learning: "Know analyse systems in which the fluid was the half of work by means of technicians of Dynamics of Computational Fluids."	50	A1 A2	C19	D1 D2 D11

Other comments on the Evaluation

Final examination: *Ponderación of 70% of the final note of the *asignatura. Will be able to carry out to cape a test of evaluation of the exposed knowledges in the sessions *magistrales and will be able to pose likewise problems or Studies of cases to resolve. It will be necessary to obtain a minimum note (of 2.5 on 10) in each part of the examination (test and resolution of problems/study of cases) to be able to do halfcontinuous Evaluation: *Ponderación of 30% on the final note of the *asignatura. Will carry out a test and/or exercise. They valued the exercises of numerical simulation realised during the practices of the courseThe methodology of the proofs of the second announcement will be of the same type that of the ones of the first announcementThe dates of evaluation for the academic
course 2017-2018 can consult in the page web of the School

Sources of information

Basic Bibliography

BLAZEK, J., **Computacional Fluid Dynamics: Principles and Applications**, Elsevier,

BARRERO & PÉREZ-SABORID, **Fundamentos y aplicaciones de la Mecánica de Fluidos**, Mc Graw Hill,

CRESPO, A., **Mecánica de fluidos**, Ed. Thomson,

Complementary Bibliography

SCHLICHTING, H, **Teoría de la capa límite**, Ediciones Urmo,
WILCOX, **Turbulence Modeling**, DCW Industries,
Davidson, P. A, **Turbulence, an Introduction for Scientist and Engineers**, Oxford Univ. Press,
FERZIGER, J., MILOVAN, P., **Computational Methods for fluid Dynamics**, 2ª edición, Springer,
CHUNG, **Computational fluid Dynamics**, Cambridge University Press,
HOMSY et al., **Mecánica de Fluidos Multimedia**, Cambridge University Press,
COMSOL Multiphysics®, **Comsol Multiphysics User Guide**, COMSOL AB.,
http://www.comsol.com/,
www.openfoam.com,
Greenshields, C. J., **OpenFOAM The Open Source CFD Toolbox. User Guide**, OpenFOAM Foundation Ltd.,

Recommendations

Subjects that are recommended to be taken simultaneously

Simulation Applied to Solid Mechanics/V09M148V01301

Subjects that it is recommended to have taken before

Advanced Mathematics/V09M148V01205

Other comments

Devote the time indicated of personal work assigned, as well as resort to *tutorías personal with the professor to resolve the possible doubts that arise during the personal work of the student.

It recommends a total follow-up of the matter as well as an active attitude in the classes.