



Teaching Guide				
Identifying Data				2016/17
Subject (*)	Métodos de Cálculo Numérico	Code	730112620	
Study programme	Enxeñeiro Naval e Oceánico			
Descriptors				
Cycle	Period	Year	Type	Credits
First and Second Cycle	2nd four-month period	Fourth-Fifth	Optativa	3.5
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Naval e Oceánica			
Coordinador	Fariñas Alvariño, Pablo	E-mail	pablo.farinas@udc.es	
Lecturers	Fariñas Alvariño, Pablo	E-mail	pablo.farinas@udc.es	
Web				
General description	In this subject the fundamentals and theoretical background of computational naval hydrodynamics, as well as its applicability are studied. The course is based on the finite volume method and the main objective is to allow the pupils to acquire a knowledge level which permits them to develop their own basic naval models.			

Study programme competences	
Code	Study programme competences
A1	Aplicar os fundamentos da Enxeñaría Naval e Oceánica.
A2	Modelar matematicamente sistemas e procesos complexos de todos os ámbitos da Enxeñaría Naval e Oceánica.
A3	Desenvolver, programar e aplicar métodos analíticos e numéricos para a análise de modelos lineais e non lineais de todos os ámbitos da Enxeñaría Naval e Oceánica.
A4	Participación en proxectos de investigación.
A5	Modelizar matemática e computación en centros tecnolóxicos e de enxeñaría naval e oceánica.
A6	Participación en proxectos multidisciplinares de enxeñaría naval e oceánica.
A7	Proxectos e cálculo de produtos, procesos, instalacións e factorías navais en todos os ámbitos do sector naval e marítimo.
A8	Investigación, desenvolvemento e innovación en produtos, procesos e métodos relacionados co sector naval e marítimo.
B1	Aprender a aprender.
B2	Resolver problemas de forma efectiva.
B3	Aplicar un pensamento crítico, lóxico e creativo.
B5	Traballar de forma colaborativa.
B10	Actitude orientada á análise.
B12	Capacidade para encontrar e manexar a información.
B14	Manexo de sistemas asistidos por ordenador.
B15	Concepción espacial.
B17	Analizar e descompoñer procesos.
B18	Capacidade de abstracción, comprensión e simplificación de problemas complexos.
C2	Dominar a expresión e a comprensión de forma oral e escrita dun idioma estranxeiro.
C3	Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
C4	Desenvolverse para o exercicio dunha cidadanía aberta, culta, crítica, comprometida, democrática e solidaria, capaz de analizar a realidade, diagnosticar problemas, formular e implantar solucións baseadas no coñecemento e orientadas ao ben común.
C5	Entender a importancia da cultura emprendedora e coñecer os medios ao alcance das persoas emprendedoras.
C6	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C7	Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.
C8	Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.



Learning outcomes			
Learning outcomes	Study programme competences		
Knowing and understanding the numerical model based on the fundamental equations.	A1	B1	C2
Modelling and understanding the fundamental phenomenologies which govern the naval hydrodynamics.	A2	B2	C3
Analyzing the computational results, from a general perspective, in complex ship hydrodynamic cases.	A3	B3	C4
	A4	B5	C5
	A5	B10	C6
	A6	B12	C7
	A7	B14	C8
	A8	B15	
		B17	
		B18	

Contents	
Topic	Sub-topic
Remembering conservation laws:	Conservation laws (mass and momentum). Partial differential equations (elliptic, parabolic and hyperbolic). Discretization methods (FVM, FEM, FD).
Pure diffusion:	Discretization for the one dimensional case. Extension for 2D and 3D cases. Implementing cases.
Combined diffusion and advection:	Discretization approach and different interpolation schemes families Classical interpolation schemes family. Power law interpolation schemes family. Normalized variable diagram interpolation schemes family. Total variation diminishing interpolation schemes family. Implementing cases.
Pressure velocity coupling algorithms:	Introduction to the closure problem. Numerical versus physical incompressibility. Staggered grids. SIMPLE/ER/C and PISO methods for staggered grids. SIMPLE/ER/C and PISO methods for collocated grids. Implementing cases.
Linear equations systems:	Sparse matrix systems. Point to point, line to line and plane to plane methods. High and low frequency errors. Multigrid methods. Conjugate gradient method. Implementing cases
Unsteady problems:	Explicit, implicit and fully implicit schemes in 1D transient pure diffusive case. Extension to 3D case. Combined advection diffusion transient case. Transient pressure velocity coupling. Implementing cases.
Special Boundaries:	Remembering Dirichlet and von Neumann boundaries. Combined boundary conditions. Wall laws. Special boundaries. Free surface.
Cases over commercial software:	Proposed cases by the professor.



Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Case study	A1 A2 A3 A4 A5 A6 A7 A8 B1 B2 B3 B5 B10 B12 B14 B15 B17 B18 C2 C3 C4 C5 C6 C7 C8	0	82.5	82.5
Objective test	A1 A2 A3 A4 A5 A6 A7 A8 B1 B2 B3 B5 B10 B12 B14 B15 B17 B18 C2 C3 C4 C5 C6 C7 C8	4	0	4
Personalized attention		1	0	1

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

Methodologies	
Methodologies	Description
Case study	Cases resolutions solved as autonomous homework
Objective test	Is the exam.

Personalized attention	
Methodologies	Description
Case study	

Assessment			
Methodologies	Competencies	Description	Qualification
Objective test	A1 A2 A3 A4 A5 A6 A7 A8 B1 B2 B3 B5 B10 B12 B14 B15 B17 B18 C2 C3 C4 C5 C6 C7 C8	Is the exam.	100

Assessment comments
Para aprobar a materia é necesario obter un cinco sobre 10 no exame.

Sources of information	
<b>Basic</b>	<ul style="list-style-type: none"> <li>- Hildebrand F.B. (1976). Advanced calculus for applications. Prentice hall</li> <li>- Versteeg H.K. &amp; Malalasekera W. (1995). Computational fluid dynamics, the finite volume method.. Longmann</li> <li>- Maliska C.R. (1995). Transferencia de calor e mecánica de fluidos computacional.. LTC editora</li> <li>- Pablo Fariñas (2013). Apuntes de clase.</li> </ul>
<b>Complementary</b>	

Recommendations
Subjects that it is recommended to have taken before



CALCULUS/730G01101  
PHYSICS I/730G01102  
ENGINEERING DRAWING/730G01103  
LINEAR ALGEBRA/730G01106  
PHYSICS II/730G01107  
INTRODUCTION TO COMPUTER SCIENCE AND PROGRAMMING/730G01109  
DIFFERENTIAL EQUATIONS/730G01110  
THERMODYNAMICS/730G01115  
MECHANICS/730G01118  
STATISTICS/730G01111  
ELASTICITY AND STRENGTH OF MATERIALS/730G01117  
FLUID MECHANICS/730G01119  
SHIP'S HYDROSTATIC AND STABILITY/730G01122  
NAVAL STRUCTURES 1/730G01125  
NAVAL STRUCTURES 2/730G01126  
MARINE HYDRODINAMIC/730G01127

**Subjects that are recommended to be taken simultaneously**

SHIP NOISE AND VIBRATIONS/730G01121  
3D MODEL OF HULL AND SHIP STRUCTURE /730G01166

**Subjects that continue the syllabus**

**Other comments**

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.