UNIVERSIDADE DA CORUÑA

Teaching Guide				
Identifying Data				2023/24
Subject (*)	Computational Hydrodynamics		Code	730496202
Study programme	Mestrado Universitario en Enxeñaría Naval e Oceánica (plan 2018)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	Second	Obligatory	6
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Naval e Industrial			
Coordinador	Fariñas Alvariño, Pablo	E-mail	pablo.farinas@udc.es	
Lecturers	Fariñas Alvariño, Pablo	E-mail	pablo.farinas@udc.es	
Web				
General description	Parametric design of ship propellers and forms. This subject will provide the necessary knowledge to study the ship´s hydrodynamics as well as the propeller design under a particular vessel wake. The hydrodynamics fundamentals are based on the potential field theory and the finite volume method.			

Study programme competences	
Code	Study programme competences
A3	A02 - Coñecemento avanzado da hidrodinámica naval para a súa aplicación á optimización de carenas, propulsores e apéndices.
B1	CB06 Posuír e comprender coñecementos que acheguen unha base ou oportunidade de ser orixinais no desenvolvemento e/ou aplicación de ideas, a miúdo nun contexto de investigación
B2	CB07 Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en ámbitos novos ou pouco coñecidos dentro de contextos máis amplos (ou multidisciplinares) relacionados coa súa área de estudo
B3	CB08 Que os estudantes sexan capaces de integrar coñecementos e enfrontarse á complexidade de formular xuízos a partir dunha información que, sendo incompleta ou limitada, inclúa reflexións sobre as responsabilidades sociais e éticas vinculadas á aplicación dos seus coñecementos e xuízos
B5	CB10 Que os estudantes posúan as habilidades de aprendizaxe que lles permitan continuar estudando dun modo que haberá de ser en boa medida autodirixido ou autónomo.
C2	C1 Capacidade pra desenrolar a actividade profesional nun entorno multilingue
C3	ABET (a) An ability to apply knowledge of mathematics, science, and engineering.
C4	ABET (b) An ability to design and conduct experiments, as well as to analyze and interpret data.
C7	ABET (e) An ability to identify, formulate, and solve engineering problems.
C12	ABET (j) A knowledge of contemporary issues.
C13	ABET (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Learning outcomes			
Learning outcomes	Study programme competences		
Technical skill on ships hydrodynamics	AJ2	BC1 BC2 BC3 BC5	CC2 CC3 CC4 CC7 CC12 CC13

Technical skill to develop computational hydrodynamic models in naval and ocean engineering environment.	AJ2	BC1 BC2 BC3 BC5	CC2 CC3 CC4 CC7 CC12 CC13

Contents	
Topic	**Sub-topic**
The blocks or the following contents develop the established topics in the "Memoria de Verifcación".	Finite Volume Method. CFD. Convective Interpolation Schemes. Free surface. P-V Coupling. Boundary layer and wake. Introduction to Hydrofoils Theory and application to marine propellers. Test cases in naval and ocean engineering
Conservation laws	Interpolation schemes for convective transport Non usual boundary conditions
Métodos de acoplamento presión velocidade	Methods SIMPLE/ER/C y PISO for staggered grid Methods SIMPLE/ER/C y PISO for collocated grids.
Transient problems	Explicit, implicit and fully implicit schemes for 1D transient diffusion problems. Extension to 3D cases. Transient convection diffusion problems. Transient P-V coupling. Test cases.
Mathematics background	Singular integrals Trigonometric functions Glauert integrals Hilbert transform
2D potential flow theory. Fundamentals.	Complex potential Stream function Potential function Source Sink Vortex
Thin foils theory	Thickness effect Angle of attack effect Camber effect Zero lift angle Ideal angle of attack
Thin foil theory correction in the near leading edge region	Flux arround the apex of a parabola Velocity correction in high curvature regions Velocity prediction along the full foil wall
Cavitation	Pressure coefficient Cavitation number Pressure coefficient along the whole foil wall Bucket diagrams
Tridimensional effects. Application to appendices and forward body.	Tridimensional potential field Velocity field induced by a 3D differential vortex element Free vortex vorticity Bound and free vorticity relation

Lifting line. Control surfaces (rudders).	Induced velocities over a tridimensional foil Prandtl lifting line equation
Application to ship propellers	The open water case Prandtl lifting line theory adaptation to the ship propeller design case Induction coefficients
Optimum propeller performance	Goldstein factors Betz diagram

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A3 B1 B2 B3 B5 C2 C3 C4 C7 C12 C13	50	0	50
Problem solving	A3 B1 B2 B3 B5 C2 C3 C4 C7 C12 C13	10	0	10
Supervised projects	A3 B1 B2 B3 B5 C2 C3 C4 C7 C12 C13	0	45	45
Case study	A3 B1 B2 B3 B5 C2 C3 C4 C7 C12 C13	0	43	43
Objective test	A3 B1 B2 B3 B5 C2 C3 C4 C7 C12 C13	1	0	1
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
Guest lecture / keynote speech	Lectures with multimedia support and introduction of some quesions to students, intended to provide the required knowledge and enhance their learning activities.
Problem solving	Technique where a specific complex situation must be solved, based on the knowledge that has been worked on, which can yield more than one possible solution.
Supervised projects	Methodology designed to promote the autonomous learning of students, under the advise of the professor and under varied scenarios (academic and professional). It is referred primarily to learning how to do things. It is an option based on the assumption by students of the responsibility for their own learning. This teaching system is based on two basic elements: the independent learning of the students and the monitoring of that learning by the professor.
Case study	Methodology where the subject faces the description of a specific situation that poses a problem that has to be understood, valued and solved by a group of people, through a process of discussion. The student is faced with a specific problem (case), which describes a real situation of professional life, and must be able to analyze a series of facts, referring to a particular field of knowledge or action, to reach a reasoned decision through a process of discussion in small work groups.
Objective test	Is the exam.

Personalized attention	
Methodologies	Description
Supervised projects	Is the support for the homework to be developed by the students. Class attendance is not compulsory and will not be scored. Therefore, there will be no differences between part/full time students. All of them will need to attain the same requirements to pass this subject. Students with "dispensa académica" will be constrained by the same requirements than full time students.

Assessment

Methodologies	Competencies	Description	Qualification
Objective test	A3 B1 B2 B3 B5 C2 C3 C4 C7 C12 C13	Is the exam, which shall be written or oral	60
Supervised projects	A3 B1 B2 B3 B5 C2 C3 C4 C7 C12 C13	It is compulsory, under professor demand, to deliver the proposed home tasks and simulations on time along this course. The delivered tasks and simulations will be assessed by the professor and will be considered for the final qualification.	40

Assessment comments
In order to pass this subject it is compulsory attain a qualification above four over ten in the exam. It is also necessary to deliver the required homework (EACH/ALL OF THE REQUIRED TASKS) in the correct manner and within the limiting established time. In case the homework be not delivered in the correct way and/or time the possibility to pass this subject will be lost. The students presence will not required and is not scored. Therefore there will be no difference between the partial time and full time students. All of them will develop the same work/requirements in order to pass the subject. The same requirements will be applied to students with "dispensa académica".

Sources of information	
Basic	- J. Kerwin (2001). Hydrofoils and propellers. MIT - J. E. Kerwin and J. B. Hadler (2010). Principles of naval arch. (Propulsion). SNAME - J.N. Newman (1977). Marine Hydrodynamics. MIT press - G. Pérez (). Detailed desighn of ships propellers. FEIN - Apuntes de clase (). . - Maliska, C.K. (1995). Transferencia de calor e mecánica de fluidos computacional.. LTC editora - Versteeg H.K.; Malalasekera W. (1995). Computational fluid dynamics, the finite volume method. Longmann - Hildebran F.B. (1976). Advanced calculus for applications. Prentice Hall
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Numerical Methods/730496215 Computational Continuous Media Mechanics/730496214
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments
In order to attain a sustainable environment and satisfy the action number five: ?Docencia e investigación saudable e sustentable ambiental e social? of the "Plan de Acción Green Campus Ferrol": All documents developed along this subject will: 1.- Be developed in electronic format. 2.- Be released through the Moodle platform, and avoiding printed documents. In case the paper format be necessary: 1.- Plastics will be avoided. 2.- Both faces of paper will be used. 3.- Recycled paper will be used. 4.- Avoid printed test drafts. A sustainable use of resources and facilities must be considered in order to avoid negative impacts over the natural environment.

(*)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.