Teaching Guide					
Identifying Data					2022/23
Subject (*)	Fluid Mechanics			Code	631G03017
Study programme	Grao en Máquinas Navais				
Descriptors					
Cycle	Period	Year		Type	Credits
Graduate	2nd four-month period	Second		Obligatory	6
Language	SpanishGalician				
Teaching method	Face-to-face				
Prerequisites					
Department	Ciencias da Navegación e Enxeñaría Mariña				
Coordinador	Baaliña Insua, Alvaro		E-mail	alvaro.baalina@udc.es	
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Web	estudos.udc.es/es/subject/631G03V01/631G03017/2022				
General description	The objectives of Fluid Mechanics focus on the study of fluids at rest or in motion, as well as the corresponding effects on contours. The knowledge of the basic principles of fluid behaviour is essential when analyzing and designing an entire system that has an operating fluid, such as hydraulic equipment and machines. The study of the ship resistance and propeller deserves special attention. The student must have knowledge of Thermodynamics and Mechanics as well as a solid physical and mathematical foundation.				

Study programme competences	
Code	Study programme competences
A2	CE02 - Facer funcionar a maquinaria principal e auxiliar e os sistemas de control correspondentes.
A3	CE03 - Facer funcionar os sistemas de bombeo de combustible, lubricación, lastre e doutro tipo e os sistemas de control correspondentes.
A6	CE06 - Mantemento e reparación das máquinas e o equipo de a bordo.
A7	CE07 - Manter a navegabilidade do buque.
A9	CE09 - Emprego do inglés escrito e falado.
A73	CE73 - Modelizar situacións e resolver problemas con técnicas ou ferramentas físico-matemáticas.
A74	CE74 - Avaliar de forma cualitativa e cuantitativa os datos e resultados, así como a representación e interpretación matemáticas de resultados obtidos experimentalmente.
A79	CE79 - Adquirir coñecementos de mecánica de fluídos e a súa aplicación á resolución de problemas no campo da enxeñería.
A86	CE86 - Operar, reparar, manter e optimizar as instalacións auxiliares dos buques que transportan cargas especiais, tales como quimiqueros, LPG, LNG, petroleiros, cementeros, Ro- Ro, Pasaxe, botes rápidos, etc.
A89	CE89 - Poñer en marcha e operar novas instalacións en buques, instalacións marítimas e industriais.
A90	CE90 - Operar, reparar, manter e optimizar a nivel operacional as instalacións industriais relacionadas coa enxeñería mariña, como motores alternativos de combustión interna e subsistemas; turbinas de vapor e de gas, caldeiras e subsistemas asociados; ciclos combinados; equipos eléctricos, electrónicos, e de regulación e control; as instalacións auxiliares, tales como instalacións frigoríficas, instalacións de aire acondicionado, plantas potabilizadoras, grupos electrógenos, etc.
A94	CE94 - Realizar inspeccións, medicións, valoracións, taxacións, peritacións, estudos, informes, planos de labores e certificacións nas instalacións do ámbito da súa especialidade.
A96	CE96 - Realización de auditorías enerxéticas de instalacións marítimas.
A99	CE99 - Ter a capacidade para exercer como Oficial de Máquinas da Mariña Mercante, unha vez superados os requisitos esixidos pola Administración Marítima.
A100	CE100 - Ter a capacidade para exercer como oficial ETO da Mariña Mercante, unha vez superados os requisitos esixidos pola Administración Marítima.
B2	CB2 - Aplicar os coñecementos no seu traballo ou vocación dunha forma profesional e posuír competencias demostrables por medio da elaboración e defensa de argumentos e resolución de problemas dentro da área dos seus estudos

B3	CB3 - Ter a capacidade de reunir e interpretar datos relevantes para emitir xuicios que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética
B5	CB5 - Ter desenvolvido aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores con un alto grao de autonomía.
B7	CG02 - Resolver problemas de forma efectiva.
B12	CG07 - Capacidade para interpretar, seleccionar e valorar conceptos adquiridos noutras disciplinas do ámbito mariño, mediante fundamentos físico-matemáticos.
B13	CG08 - Capacidade para a aprendizaxe de novos métodos e teorías, que lle doten dunha gran versatilidade para adaptarse a novas situacións.
B15	CG10 - Capacidade para resolver problemas con iniciativa, toma de decisións, creatividade, razoamento crítico e de comunicar e transmitir coñecementos habilidades e destrezas.
B16	CG11 - Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C3	CT03 - 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.
C7	CT07 - Desenvolver a capacidade de traballar en equipos interdisciplinares ou transdisciplinares, para ofrecer propostas que contribúan a un desenvolvemento sostible ambiental, económico, político e social.

Learning outcomes			
Learning outcomes	Study programme competences		
Recognize the basic properties of fluids.	A2	B2	C3
Static and dynamic analysis. Pressure and velocity fields.	A3	B3	C7
Ability to determine energy losses in fluid systems.	A6	B5	
Ability to solve fluid problems applying precise hypotheses and appropriate physical models.	A7	B7	
Planning and decision making when managing an industrial fluid handling facility.	A9	B12	
Ability to understand the processes that occur in hydraulic machinery.	A73	B13	
	A74	B15	
	A79	B16	
	A86		
	A89		
	A90		
	A94		
	A96		
	A99		
	A100		

Ability to reason and understand energy interactions in	A2	B2	C3
various fluid systems	A3	B3	C7
Ability to solve problems and perform maintenance and optimization actions for fluid systems.	A6	B5	
Planning and making decisions regarding fluid management in industrial facilities.	A7	B7	
Critical Thinking About Applicable Physical Models	A9	B12	
Study habit and structuring of information through tables and	A73	B13	
diagrams.	A74	B15	
The following competencies are included in Table A-III / 1 of the STCW Code as amended by Manila; Function: Naval	A79	B16	
machinery, at the operational level	A86		
-1.1 Carry out a safe machinery watch	A89		
-1.2 Operate the main and auxiliary machinery and the corresponding control systems.	A90		
	A94		
	A96		
	A99		
	A100		

Contents	
Topic	**Sub-topic**
PART I.- BASIC CONCEPTS AND KINEMATICS. LESSON 1.- PRESENTATION.	1.1.- DEFINITIONS AND MAGNITUDES 1.2.- FORCES FIELD IN FLUIDS. MOTION EQUATION 1.3.- VELOCITY FIELD. 1.4.- DIFFERENTIATION AND INTEGRATION IN THE FLUID FIELD
PART II.- STATICS. LESSON 2.- FLUID STATICS.	2.1.- FLUID STATICS 2.2.- FLUID DYNAMICS 2.3.- PRESSURE DISTRIBUTION IN SOLID RIGID MOTION
PART III.- DYNAMICS. LESSON 3.- INTEGRAL ANALYSIS OF CONTROL VOLUMES.	3.1.- CONSERVATION LAWS IN A CONTROL VOLUME. 3.2.- CONTINUITY EQUATION. 3.3.- CONSERVATION OF MOMENTUM. 3.4.- CONSERVATION OF ANGULAR MOMENTUM. 3.5.- CONSERVATION OF ENERGY. BERNOULLI EQUATION.
LESSON 4.- DIFFERENTIAL ANALYSIS OF CONTROL VOLUMES.	4.1.- WAYS TO OBTAIN THE GENERAL DIFFERENTIAL EQUATIONS. 4.2.- DIFFERENTIAL EQUATION OF CONTINUITY. 4.3.- DIFFERENTIAL EQUATION OF MOMENTUM. 4.4.- DIFFERENTIAL EQUATION OF ENERGY.
LESSON 5.- DIMENSIONAL ANALYSIS. SIMILITUDE.	5.1.- INTRODUCTION. BUCKINGHAM PI THEOREM. 5.2.- SIGNIFICANT DIMENSIONLESS GROUPS. SIMILARITY LAWS.
LESSON 6.- INTERNAL INCOMPRESSIBLE VISCOUS FLOW	6.1.- INTERNAL LAMINAR FLOW. 6.2.- FULLY DEVELOPED LAMINAR FLOW. 6.3.- FULLY DEVELOPED TURBULENT FLOW. 6.4.- FLOW IN PIPES AND DUCTS.
PART IV.- FLUID MACHINERY. LESSON 7.- TURBOMACHINERY.	7.1.- CLASSIFICATION OF FLUID MACHINERY. 7.2.- EULER EQUATION OF TURBOMACHINERY. 7.3.- PUMPS. PERFORMANCE CHARACTERISTICS. 7.4.- DIMENSIONLESS GROUPS OF PUMPS. 7.5.- CAVITATION AND NPSH. 7.6.- APPLICATION TO FLUID SYSTEMS.

LESSON 8. SHIP RESISTANCE AND PROPULSION	8.1.- DIMENSIONAL ANALYSIS. 8.2.- TYPES OF RESISTANCE. 8.3.- TYPES OF PROPELLERS. GEOMETRIC FEATURES. 8.4.- PROPELLER PERFORMANCE. COEFICIENTES AND EFFICIENCIES. 8.5.- PROPELLER AND PROPULSIVE SYSTEM SELECTION.
STCW The development and overcoming of these contents, together with those corresponding to other subjects that include the acquisition of specific competencies of the degree, guarantees the knowledge, comprehension and sufficiency of the competencies contained in Table AIII / 2, of the STCW Convention, related to the level of management of First Engineer Officer of the Merchant Navy, on ships without power limitation of the main propulsion machinery and Chief Engineer officer of the Merchant Navy up to a maximum of 3000 kW.	Table A-III / 2 of the STCW Convention. Specification of the minimum standard of competence for Chief Engineer Officers and First Engineer Officers on ships powered by main propulsion machinery of 3000 kW or more.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A2 A3 A6 A7 A9 A73 A74 A79 A86 A89 A90 A94 A96 A99 A100 B2 B3 B5 B12 B13 B16 C3	30	56	86
Problem solving	A73 B7 B15	19	25	44
Supervised projects	A2 A3 A6 A7 A9 A73 A79 A86 A89 A90 A94 A96 A99 A100 B2 B3 B5 B7 B12 B13 B15 B16 C3 C7	0	15	15
Objective test	A2 A3 A6 A7 A9 A73 A74 A79 A86 A89 A90 A94 A96 A99 A100 B2 B3 B5 B7 B12 B13 B15 B16 C3 C7	3	0	3
Personalized attention		2	0	2
(*)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	There will be a detailed explanation of the contents of the subject distributed in topics. The student will have at all times a typed copy of the topic to be discussed in each lesson speech. Class participation is encouraged through comments that relate the theoretical content to real life experiences.
Problem solving	The collections of exercises proposed for each topic will be solved, allowing the application of the most appropriate mathematical models to each case, including handling of tables, application of the most appropriate hypotheses, relationship with the theoretical content developed in the lectures and with the professional exercise. Real equipment related to the subject will be displayed both in the classroom and in the workshop.

Supervised projects	Solution of problems not completed in-class sessions, with generic instructions from the teacher for their resolution and/ or presentation of topics or problems of calculation and design of special relevance.
Objective test	3 partial written tests will be carried out, with the possibility of recovering material from the previous test. It will consist of a theoretical part and a practical part, in such a way that both count for 50% of the grade. The ordinary and extraordinary exams will be governed by the same format.

Personalized attention	
Methodologies	**Description**
Guest lecture / keynote speech Problem solving Supervised projects	The student will be helped in those questions related to the subject taught that are particularly difficult for their understanding. Corresponding exam reviews are also included. The information and contact channels will be the Virtual Faculty, individualized tutorials that take place for six hours throughout the week and videoconference sessions.

Assessment			
Methodologies	**Competencies**	**Description**	**Qualification**
Guest lecture / keynote speech	A2 A3 A6 A7 A9 A73 A74 A79 A86 A89 A90 A94 A96 A99 A100 B2 B3 B5 B12 B13 B16 C3	Attendance at the sessions will count to a maximum of 10 % as part of the final grade providing that such attendance is not less than 90 % of the whole lessons. The student must sign a sheet of attendance to every lecture as evidence for the assessment of this methodology.	10
Objective test	A2 A3 A6 A7 A9 A73 A74 A79 A86 A89 A90 A94 A96 A99 A100 B2 B3 B5 B7 B12 B13 B15 B16 C3 C7	The student will demonstrate proficiency in the theoretical and practical learning of the issues.	70
Supervised projects	A2 A3 A6 A7 A9 A73 A79 A86 A89 A90 A94 A96 A99 A100 B2 B3 B5 B7 B12 B13 B15 B16 C3 C7	Presentation and defence of the work. It will be valued structure, neatness, originality and expository method. This is an optional methodology. For students who don't do the project, the qualification percentage of this methodology will be added to the objective test.	20

Assessment comments

The official tests of the first opportunity, will include the different evaluation methodologies and must be completed by those students who have not passed the continuous evaluation as a whole. This test will be designed in such a way that the student can examine the objective test, where they have not reached at least 30% of the total grade.
Students obliged to attend the official "second chance" tests will keep the grade achieved in all methodologies, with the exception of the one obtained in the objective tests of the 1st opportunity, which will be replaced by that of the 2nd. In the same way, the students will only be eligible for honors if the maximum number of these for the corresponding course is not covered in its entirety at the "first opportunity".
For students with recognition of part-time dedication and academic exemption from attendance, the grade obtained in the activities associated with the personalized tutoring system will correspond to the evaluation of the problem-solving methodology and objective tests, with a weighting of 30 and 70%, respectively.
Fraudulent performance of the tests or evaluation activities, once verified, will directly imply a failing grade "0" in the subject and in the corresponding call, besides invalidating any grade obtained in either evaluation activity for the extraordinary call.
The evaluation system meets the competency evaluation criteria set out in Column 4 of the following Tables of the STCW Convention, modified by Manila 2010:
1.- Table A-III / 1 of Specification of the minimum standards of competence applicable to officers in charge of the watch in a permanently manned engine-room and those appointed to serve in an unmanned engine-room.
Function: Naval machinery, at the operational levelCompetencies:
-1.1 Carry out a safe machinery watch
-1.2 Operate the main and auxiliary machinery and the corresponding control systems.

Sources of information	
Basic	- Streeter, V. L. et al. (1998) (1998). Fluid Mechanics. McGraw-Hill, USA - (). . Streeter, V. L. et al. (1998). Fluid Mechanics. McGraw-Hill, USA Kundu, P. K. y Cohen, I. M. (2002). Fluid Mechanics. Academic Press, New York White, F. M. (1995). Mecánica de Fluidos. McGraw-Hill, Madrid Robert L. Mott (6ª Edición). Mecánica de Fluidos. Prentice Hall.Agüera, J. S. (1996). Mecánica de Fluidos Incompresibles y Turbomáquinas Hidráulicas. Ciencia, Madrid
Complementary	Munson, B. R. et al. (1999). Fundamentos de Mecánica de Fluidos. Limusa-Wiley, México Fox, R. W. y McDonald, A. T. (1998). Introduction to Fluid Mechanics . Wiley, USA

Recommendations
Subjects that it is recommended to have taken before
Mathematics I/631G03001 Mathematics II/631G03006 Physics I/631G03003 Physics II/631G03008
Subjects that are recommended to be taken simultaneously
Ship Systems Operation with Simulator/631G03043 Ship Energy Efficiency/631G03040
Subjects that continue the syllabus
Ship Propulsion and Resistance/631G03045 Hydraulic and Neumatic Systems/631G03025 Auxiliary Equipment for Ships/631G03023
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.