



Teaching Guide

Teaching Guide				
Identifying Data				2020/21
Subject (*)	Energy Techniques Applied to Ship		Code	631G02453
Study programme	Grao en Tecnoloxías Mariñas			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	1st four-month period	Fourth	Optional	6
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Ciencias da Navegación e Enxeñaría Mariña			
Coordinador	Romero Gómez, Manuel	E-mail	m.romero.gomez@udc.es	
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Web				
General description	In this subject, the acquired prior knowledge is developed for the study of most of the processes linked to energy in a facility, both on board a ship and on land. As an example, it allows to know, analyze and optimize the operation of an internal combustion engine, a boiler or a turbine and recovery processes of residual heat. It is essential to carry out the processes of energy optimization in steam and gas turbines, internal combustion engines, auxiliary systems of the ship, steam generators and heat transfer, combustion processes and formation of pollutants, cold techniques, etc. . It is a basic matter for compliance with the STCW regulations, regarding energy efficiency in ships (SEEMP), and the fight against environmental pollution. To take the course, it is advisable to have previous knowledge of physics, mathematics, chemistry, thermodynamics, fluid mechanics, internal combustion engines, steam and gas turbines, refrigeration systems, etc.			
Contingency plan	1. Modifications to the contents 2. Methodologies *Teaching methodologies that are maintained *Teaching methodologies that are modified 3. Mechanisms for personalized attention to students 4. Modifications in the evaluation *Evaluation observations: 5. Modifications to the bibliography or webgraphy			

Study programme competences

Code	Study programme competences
A1	CE1 - Capacidade para a realización de inspeccións, medicións, valoracións, taxacións, peritacións, estudos, informes, planos de labores e certificacións nas instalacións do ámbito da súa especialidade.
A2	CE2 - Capacidade para a dirección, organización e operación das actividades obxecto das instalacións marítimas no ámbito da súa especialidade.
A3	CE3 - Capacidade para o manexo de especificacións, regulamentos e normas de obrigado cumprimento.
A6	CE6 - Coñecementos e capacidade para a realización de auditorías enerxéticas de instalacións marítimas.



A14	CE14 - Avaliación cualitativa e cuantitativa de datos e resultados, así como a representación e interpretación matemáticas de resultados obtidos experimentalmente.
A17	CE17 - Modelizar situacións e resolver problemas con técnicas ou ferramentas físico-matemáticas.
A18	CE18 - Redacción e interpretación de documentación técnica.
A21	CE37 - Capacidad para exercer como Oficial de Máquinas de la Marina Mercante, una vez superados los requisitos exigidos por la Administración Marítima.
A30	CE42 - Operar, reparar, manter, reformar, optimizar a nivel operacional as instalacións industriais relacionadas coa enxeñaría mariña, como motores alternativos de combustión interna e subsistemas; turbinas de vapor, caldeiras e subsistemas asociados; ciclos combinados; propulsión eléctrica e propulsión con turbinas de gas; equipos eléctricos, electrónicos, e de regulación e control do buque; as instalacións auxiliares do buque, tales como instalacións frigoríficas, sistemas de goberno, instalacións de aire acondicionado, plantas potabilizadoras, separadores de sentinas, grupos electrógenos, etc.
A31	CE43 - Operar, reparar, manter e optimizar as instalacións auxiliares dos buques que transportan cargas especiais, tales como quimiqueiros, LPG, LNG, petroleiros, cementeiros, Ro-Ro, Pasaxe, botes rápidos, etc.
A32	CE44 - Coñecer o balance enerxético xeral, que inclúe o balance termo-eléctrico do buque, ou sistema de mantemento da carga, así como a xestión eficiente da enerxía respectando o medio.
B4	CT4 - Traballar de forma autónoma con iniciativa.
B5	CT5 - Traballar de forma colaboradora.
B7	CT7 - Capacidade para interpretar, seleccionar e valorar conceptos adquiridos noutras disciplinas do ámbito marítimo, mediante fundamentos físico-matemáticos.
B9	CT9 - Capacidade para a aprendizaxe de novos métodos e teorías, que lle doten dunha gran versatilidade para adaptarse a novas situacións.
B10	CT10 - Comunicar por escrito e oralmente os coñecementos procedentes da linguaxe científica.
B11	CT11 - Capacidade para resolver problemas con iniciativa, toma de decisións, creatividade, razoamento crítico e de comunicar e transmitir coñecementos habilidades e destrezas.
C3	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.
C7	C7 - Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.
C8	C8 - Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.
C9	CB1 - Demostrar que posúen e comprenden coñecementos na área de estudo que parte da base da educación secundaria xeneral, e que inclúe coñecementos procedentes da vangardía do seu campo de estudo
C10	CB2 - Aplicar os coñecementos no seu traballo ou vocación dunha forma profesional e poseer competencias demostrables por medio da elaboración e defensa de argumentos e resolución de problemas dentro da área dos seus estudos
C11	CB3 - Ter a capacidade de reunir e interpretar datos relevantes para emitir xuícos que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética
C12	CB4 - Poder transmitir información, ideas, problemas e solucións a un público tanto especializado como non especializado.
C13	CB5 - Ter desenvolvido aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores con un alto grao de autonomía.

Learning outcomes			
Learning outcomes		Study programme competences	
Knowing and analyzing the thermodynamic processes that take place in the thermal engines		A1	B4
		A3	B5
		A14	B7
		A17	B9
			B10
			B11
		C3	C7
		C8	C9
		C10	



Performing energy balances of thermal installations. Making decisions from the point of view of energy optimization	A1	B4	C3
	A2	B5	C8
	A3	B10	C11
	A6	B11	C12
	A14		C13
	A17		
	A18		
	A21		
	A30		
	A31		
	A32		
Calculating the components involved in marine thermal installations	A6	B4	C3
	A14	B5	C7
	A17	B7	C8
	A18	B9	
	A21	B11	
	A30		
	A31		
	A32		
Planning and energy organization of marine thermal installations.	A1	B4	C3
	A2	B5	C7
	A3	B7	C8
	A6	B9	
	A14	B11	
	A17		
	A18		
	A32		

Contents	
Topic	Sub-topic
1.ENERGY AND EXERCETICAL ANALYSIS OF THERMAL INSTALLATIONS	1.1. Introduction.
	1.2. Thermodynamics. Development of energy balance.
	1.3. Fundamentals of the concept of exergy.
	1.4. Balance of energy and exergy at steady state.
	1.5. Application of energetic and exergetic analysis to nozzles, diffusers, turbines, compressors, pumps, heat exchangers and throttling devices.
	1.6. Analysis of transitory conditions.
2. MASS TRANSFER PROCESSES	2.1. Introduction.
	2.2. Fundamentals of the transfer of matter.
	2.3. Principles of diffusion.
	2.4. Non-diffusing stationary diffusion.
	2.5. DiffusioN in mixtures of several components. Turbulent diffusion.
	2.6. Transfer of mass by convection.
	2.7. Absorption with chemical reaction.



3. STUDY OF COMBUSTION PROCESSES	3.1. Introducción. 3.2. O servizo de combustible nos buques. 3.2.1. Propiedades físicas e químicas dos combustibles. 3.3. O proceso de combustión. 3.4. Reaccións de combustión. 3.5. Composición dos gases producidos na combustión. 3.6. Punto de orballo dos gases. 3.7. Optimización do proceso de combustión. 3.8. Diagnose da combustión. 3.9. Aspectos enerxéticos da combustión.
4. PROCESSES WITH HEAT TRANSFER	4.1. Introduction. 4.2. Thermotransmission. 4.3. Balance of energy on a surface. 4.4. Analysis of heat transfer problems. Methodology. 4.5. Boiling and condensation. 4.6. Heat exchangers. 4.7. Simultaneous heat and mass transfer
5. ENERGY ANALYSIS OF PROPULSION SYSTEMS	5.1. Introduction. 5.2. Thermal cycles 5.3. Thermal performance and thermal balance of marine installations. 5.4. Propulsion with nuclear energy 5.5. Balances in marine cogeneration facilities. 5.6. Balances in marine refrigeration and air conditioning installations. 5.7. Exergetic analysis of the facilities.
6. ALTERNATIVE SYSTEMS OF ENERGETIC USE	6.1. Introduction. 6.2. Fuel cells. 6.3. Residues of biomass. 6.4. Wind systems for propulsion and energy use. 6.5. Solar energy utilization systems. 6.6. Use of residual energies 6.7. Recovery of VOCs 6.8. Reforming
7. AUDIT, PLANNING AND ENERGY ORGANIZATION OF THERMAL FACILITIES	7.1. Introduction. 7.2. Use of energy 7.3. Material means for the energy audit. 7.4. The data collection and calculations. 7.5. Improvement of the performance and maintenance of the optimal operating conditions of the energy equipment. 7.6. Inspection and review of equipment
8. ENERGY EFFICIENCY IN SHIPS	8.1. Introduction. 8.2. Energy Efficiency Management Plan for ships (SEEMP). 8.3. Energy Efficiency Index design. 8.4. Operational Indicator of Energy Efficiency. 8.5. Application regulations

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student's personal work hours	Total hours
Guest lecture / keynote speech	A1 A2 A3 B7 B9 B10 B11 C3 C12	24	36	60



Case study	A6 A14 A17 A18 A21 A30 A31 A32 B4 B5	24	48	72
Objective test	A1 A2 A3 A6 A14 A17 A18 A21 A30 A31 A32 B4 C7 C8 C9 C10 C11 C13	4	0	4
Personalized attention		14	0	14
(*)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	Being will make the detailed explanation of the contents of the subject that are destruyen in subjects, or the student will have bibliographic material of the subject to treat in each master session. The participation of the student in class, through comments, that will encourage to relate the theoretical contents with real experience will be encouraged.
Case study	Proposal of practical cases, resolution and criticism.
Objective test	Written tests will be conducted consisting of theoretical and practical questions.

Personalized attention	
Methodologies	Description
Guest lecture / keynote speech	GUEST LECTURE: Personalized attention in the classroom to the doubts.
Case study	CASE STUDY: Attention in the office or classroom for the resolution of analysis works.
Objective test	OBJECTIVE TEST: Supervision of the test.
	CUSTOMIZED ATTENTION: It will be done at tutoring times established at the beginning of the course and shown on the bulletin board of the office.

Assessment			
Methodologies	Competencies	Description	Qualification
Case study	A6 A14 A17 A18 A21 A30 A31 A32 B4 B5	Realización e discusión dos casos propostos	10
Objective test	A1 A2 A3 A6 A14 A17 A18 A21 A30 A31 A32 B4 C7 C8 C9 C10 C11 C13	Realización de proba individual. A proba obxetiva consistirá nun exame dividido en dúas partes. 1- Parte teórica: 50% da nota final. 2- Parte práctica: 40% da nota final. Para superar a materia, haberá que superar as dúas partes.	90

Assessment comments



The evaluation criteria referred to in Tables A-III/1 and A-III/3 of the STCW Code, and included in the Quality Assurance System, will be taken into account to design and to carry out the evaluation.

GUEST LECTURE: A32, A50, A53, A54, A55, C4, C5

CASE STUDY: A1, A3, A7, A14, A17, A18, A24, A29, A30, A31, A50, B9, B10, B11, C3, A2, A4, A5, A6, A20, A21, A58, B3, B5, B7, B8, C8

OBJECTIVE TEST: B2, B4, C6, C7

Students with recognition of part-time dedication and academic exemption of attendance exemption, according to the "NORM THAT REGULATES THE REGIME OF DEDICATION TO THE STUDY OF GRADUATE STUDENTS IN THE UDC (Arts 2.3, 3.b; 4.3 e 7.5) (04/05/2017):

- Attendance / participation in minimum class activities: 30%.

- Qualification:

a) Elaboration of works: up to 80%

c) Problem solving: up to 80%

b) Written exam on the contents of the subject: up to 100%

d) Other methodologies considered: up to 100%

Sources of information

Basic	- J. Carbia; J.A. Orosa (2010). Apuntes de la materia. - Santiago Sabulal García (2006). Centrales térmicas de ciclo combinado . España. Ed. Díaz de Santos - Haywood (2000). Ciclos termodinámicos de potencia y refrigeración . Méjico. Limusa - José M^a. Sala Lizarraga (1999). Cogeneración . Bilbao. Servicio Editorial UNIVERSIDAD DEL PAIS VASCO - F. J. Barclay (1995). Combined Power and Process-an Exergy Approach . - José M^a. De Juana (2003). Energías Renovables para el desarrollo . Méjico. Thomson-Paraninfo. S.A. - M. J. M., and H. N. S. (1995). Fundamentals of Enginnering Thermodynamics . Wiley - M.J. Morán; H.N. Shapiro (2003). Fundamentos de Termodinámica Técnica . Barcelona. Edit. Reverté - J. R. Welty (1999). Fundamentos de Tranferencia de Momento, Calor y Masa . Méjico. Limusa - Frank P. Incropera (1999). Fundamentos de transferencia de calor . Méjico. Prentice Hall - Marta Muñoz Domínguez; Antonio José Rovira de Antonio (2006). Ingeniería Térmica . Madrid. UNED - Juan A. López Sastre (2004). La pila de combustible . Valladolid. Secretariado de Publicaciones e Intercambio. Universidad de Valladolid - Robert E. Treybal (1988). Operaciones de transferencia de masa . Méjico. Macgraw-Hill - Çengel-Boles (2003). Termodinámica. Méjico. McGraw-Hill - Orosa García, José A. (2008). Termodinámica aplicada con EES . España. Tórculo Edicións - J.L. Gómez Ribelles (2002). Termodinámica Técnica . Valencia. Edit. de la UPV - P. Hambling (1991). Turbines, Generators and Associated Plant . Pergamon Press - Claudio Mataix (2000). Turbomáquinas Térmicas . Madrid. Editirial DOSSAT, S.A
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Complementary	- S. Kabac (1995). Boilers, Evaporators and Condensers . J. Wiley & Sons - Ernest J. Henley (2002). Cálculo de Balances de Materia y Energía . Barcelona. Edit. Reverté. S.A. - Manuel Marquez (2005). Combustión y Quemadores . España. Marcombo - Mario Ortega Rodríguez (1999). Energías Renovables . Madrid. Thomson-Paraninfo - Antonio Creus Solé (2004). Energías Renovables . Barcelona. Edic. Ceysa - H. A. Sorensen (1983). Energy Conversion Systems . Wiley - Román Monasterio Larrinaga (1993). La Bomba de Calor. Fundamentos, Técnicas y Aplicaciones . Madrid. McGraw-Hill - K. W. Li (1985). Power Plant System Desing . Wiley - Kreit/Bohn (2002). Principios de Transferencia de Calor . Madrid. Thomson - M. Meckler (1994). Retrofitting Buildings for Energy Conservation . The Fairmont Press - Merle C. Potter y Craig W. Somerton (2004). Termodinámica para Ingenieros . Madrid. McGraw-Hill - A. Bejan (1998). Thermodynamics Optimization of Complex Energy Systems . NATO Sciences
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Recommendations

Subjects that it is recommended to have taken before

Maritime Installations and Propulsion Systems/631G02354
 Thermodynamics and Engineering Thermodynamics/631G02254
 Fluid Mechanics/631G02258
 Internal Combustion Engines/631G02351
 Steam and Gas Turbines/631G02352
 Air Conditioning and Cooling Techniques/631G02355
 Energy Techniques Applied to Ship/631G02453

Subjects that are recommended to be taken simultaneously

Engineering Office-Projects./631G02452
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Subjects that continue the syllabus

Maritime Installations and Propulsion Systems/631G02354
 Thermodynamics and Engineering Thermodynamics/631G02254
 Fluid Mechanics/631G02258
 Internal Combustion Engines/631G02351
 Steam and Gas Turbines/631G02352
 Air Conditioning and Cooling Techniques/631G02355

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.