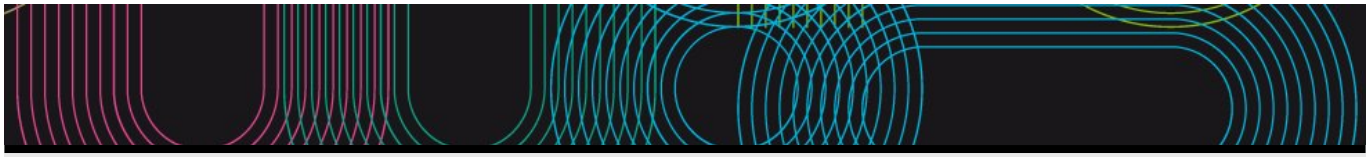

IDENTIFYING DATA				
Naval engines and machines				
Subject	Naval engines and machines			
Code	P52G381V01409			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	4th	2nd
Teaching language	Spanish			
Department				
Coordinator	Pérez Collazo, Carlos			
Lecturers	Álvarez Feijoo, Miguel Ángel Pérez Collazo, Carlos			
E-mail	carlos.perez.collazo@cud.uvigo.es			
Web	http://moovi.uvigo.gal/			
General description	This learning guide presents the information relative to the subject of Naval Engines and Machines of the 4th course of the Bachelor Degree in Mechanical Engineering. The guide collects the skills that the students have to acquire in this course, the calendar of planned educational activities, the contents and their temporal programme, an estimation of the student's volume of work and the specific criteria of evaluation. Naval Engines and Machines will cover the propulsion and auxiliary systems that can be find in the Navy ships. Besides, combustion engines thermal cycles will be studied, mainly Otto and Diesel; then Marine Diesel engines will be covered in a deeper way, studying the parts of the engines in existent engines in the laboratory, observing material and manufacturing processes of the different parts, realising the multidisciplinary aim of the subject. This subject of the Bachelor Degree in Mechanical Engineering showcases to the student the main types of naval engines, the configurations of the control and propulsion systems, and the auxiliary systems of heat pumps, water and waste treatment, etc.			

Training and Learning Results	
Code	
B3	Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of Industrial Engineering in Mechanical specialty.
B5	Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar works.
B6	Capacity for handling specifications, regulations and mandatory standards.
B7	Ability to analyze and assess the social and environmental impact of the technical solutions.
C35	CITN9/OPT5 Applied knowledge of energy systems and naval propulsion.
C36	CITN10/OPT6 Knowledge of naval equipment and naval auxiliary systems.
C37	CITN11/OPT7 Applied knowledge of naval electrical systems.
D1	Analysis and synthesis
D2	Problems resolution.
D3	Oral and written proficiency
D5	Information Management.
D7	Ability to organize and plan.
D8	Decision making.
D9	Apply knowledge.
D10	Self learning and work.
D15	Objectification, identification and organization.
D16	Critical thinking.
D17	Team working.
D20	Ability to communicate with people not expert in the field.

Expected results from this subject			
Expected results from this subject	Training and Learning Results		
Get to know the technological base that supports internal combustion engines.	B3 B4 B5	C35 C36	D3 D5 D7 D8 D9 D10 D15 D17 D20
Get to know and understand the operation of a propulsion plant of the Navy Vessels.	B3 B4	C35 C36 C37	D1 D2 D3 D5 D7 D9 D10 D15 D17 D20
Get to know the main auxiliary systems that support the propeller plants on Navy vessels.	B3 B4 B6 B7	C35 C36 C37	D1 D2 D3 D5 D7 D9 D10 D15 D16 D17 D20
ENAEE learning outcomes: KNOWLEDGE AND UNDERSTANDING: LO1.3 - Be aware of the multidisciplinary context of the engineering. [Level of development (basic (1), intermediate (2) and advanced (3)) of this sub-result: intermediate (2)].		C35 C36 C37	
ENAEE learning outcomes: ANALYSIS IN ENGINEERING: LO2.2.- The capacity to identify, formulate and resolve problems of engineering in his speciality; choose and apply of suitable form analytical methods, of calculation and experimental already established; recognise the importance of the social restrictions, of health and security, environmental, economic and industrial. [Level of development (basic (1), intermediate (2) and advanced (3)) of this sub-result: Intermediate (2)].	B4		D1 D2 D8 D9 D16
ENAEE learning outcomes: PRACTICAL APPLICATION OF THE ENGINEERING: LO5.3.- Knowledge of application of materials, equipment and tools, technology and processes of engineering and its limitations in the field of its speciality. Level of development (basic (1), intermediate (2) and advanced (3)) of this sub-result: Intermediate (2)].		C35 C36 C37	D8 D9
ENAEE learning outcomes: PRACTICAL APPLICATION OF THE ENGINEERING: LO5.5.- Knowledge of the social implications, of health and safety, environmental, economic and industrial practice of the engineering. [Level of development (basic (1), intermediate (2) and advanced (3)) of this sub-result: Intermediate (2)].	B7		

Contents	
Topic	
Block 1: Engines of internal combustion.	T1.1. Review of thermal engines. T1.2. Diesel engines. - Classification of the diesel engines. - 2 and 4 strokes diesel engines. - Diagrams. - Otto-Diesel comparative. T1.3. Main components of marine diesel engines. T1.4. Refrigeration and lubrication systems. T1.5. Fuel injection system. T1.6. Marine gas turbines.

Block 2: Current marine propulsion systems.	T2.1. Introduction to marine propulsion systems. - Classification of the marine propulsion systems. - Types of propellers. T2.2. Conventional propulsion systems. - Propeller types. - Geometry of marine propellers. - Propulsion conditions. - Cavitation. T2.3. Power transfer systems. - Bearings. - Power transfer shafts. - Gear boxes. T2.4. Combined propulsion systems. - CODAD. - CODOG/CODAG. - COGAG. - CODEOG. T2.5. Electrical propulsion systems. T2.6. Azipodal propulsion. T2.7. Nuclear propulsion and propulsion in submarines. T2.8. Emissions control and future trends - The MARPOL agreement and the emissions reduction commitments. - Emission control systems. - Future trends in marine propulsion systems.
Block 3: Auxiliary systems.	T3.1. Vessel steering and stabilisation systems. - Electrohydraulic power transmission systems. - Electrohydraulic rudder servomotor. - Electromechanical power transmission. - Electromechanical rudder servomotor. - Basics of stabiliser fins. - Anti-balance tanks. - Gyro-stabilisers. - Stabiliser rudders. T3.2. Marine pumping systems. - Continuous flow and positive displacement pumps. T3.3. Marine air compressors. T3.4. Data acquisition systems. - Temperature, pressure and flow. - Level and angular velocity. T3.5. Water production systems. - Distillation. - Reverse osmosis. - Desalinated water production. T3.6: Water discharge systems. - Vacuum faecal plants. - Faecal water treatment. - Decantation and electrolytic cell treatment plants. - Separation of bilges by decantation. - Coalescent bilge separator. T3.7. Propulsion plant support systems. - Centrifugal treatment systems. - Fresh and salt water cooling systems. - Refrigeration systems for vessels. T3.8. Vessel electrical systems. - Electrical power plant of an F-100. - Integrated control platform system(SICP). - General diagram of the electrical power plant of an F-100 and working modes.
PL1: Combustion engines.	Study of the operation of combustion engines.
PL2: Diesel engines.	Study of the operation of marine diesel engines.
PL3: 2-stroke engines.	Study and analysis of the operation of 2-stroke engines. For this, students will work in groups disassembling 2-stroke engines with the available tools.
PL4: 4-stroke engines.	Study and analysis of the operation of 4-stroke engines. For this, students will work in groups disassembling 4-stroke engines with the available tools.
PL5: Gas turbines.	Parametric study and operation of gas turbines.

PL6: Propulsion plants.	Study and analysis of the configuration and operation of propulsion plants in warships.
PL7: Vessel auxiliary systems.	Parameterization and operation of various auxiliary systems on ships. For example, analysing the configuration and operation of the electrical installations in warships, as well as the process of connection and disconnection to ground current.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	28	56
Laboratory practical	14	7	21
Project based learning	3	20	23
Problem solving	4	0	4
Seminars	15	15	30
Essay questions exam	16	0	16
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	The lecturer presents the fundamental contents of the matter object of study, on a theoretical basis and/or the guidelines for a personal work, exercise or project to develop by the student.
Laboratory practical	Activities of application of the knowledge to concrete situations and of acquisition of basic skills and procedures related with the matter object of study. To be developed in special spaces with specialised equipment (laboratories, computer classrooms, etc.).
Project based learning	Method in which the students develop a project over a fix period to resolve a problem or tackle a task by means of the planning, design and completion of a series of activities.
Problem solving	Activity in which problems and/or exercises related with the subject are proposed. The student has to develop the suitable or correct solutions by means of the application of routines, equations or algorithms, the application of procedures of transformation of the available information and the interpretation of the results. To be used as suport of lectures.
Seminars	Intensive course of 15 hours for those students who did not pass the subject in the ordinary announcement, previous to the examination in second announcement. These will involve group tutorials with the lecturer.

Personalized assistance	
Methodologies	**Description**
Lecturing	The tutorial action distinguishes actions of academic attention as well as personalised attention. In the first one, students will have available attention hours in which they can ask any question related with the contents, organisation and planning of the subject. In the personalised attention, each student, in an individual way, would be able to comment with the lecturer any problem that may prevents him to make a suitable follow-up of the subject, aiming to find between both some type of solution. Bringing together both types of attention, aims to compensate the different learning rhythms by means of the attention to the diversity. The lecturers of the subject will answer the questions and queries of the students in a synchronous form in physical or virtual offices under the modality of a previous appointment or asynchronous by online means (email, forums of MOOVI, etc.).

Assessment				
	Description	Qualification	Training and Learning Results	
Lecturing	Written assessments: theoretical questions and problems. The written assessments have the aim of evaluating the learning of all the theoretical contents of the subject. These must consist in questions where conceptual and logical reasoning should prevail, to verify the intellectual maturity of the students by obtaining conclusions from the notions or the exposed theories in class.	25	B3 C35 D1 B4 C36 D2 B5 C37 D7 B6 D9 B7 D15 D16	

Laboratory practical	The evaluation of the labs will involve laboratory reports (MP) which the student will have to submit.	10	B3 B4 B5 B6 B7	C35 C36 C37	D1 D2 D3 D7 D9 D10 D15 D16 D17 D20
Project based learning	The project will consist in a work in groups of students. This will be evaluated in a way that individual work is assessed, together with the positive independence (i.e., each member of the group should have to had participated and collaborated to the final version of the project).	25	B3 B4 B5 B6	C35 C36 C37	D3 D5 D7 D8 D9 D10 D15 D16 D17 D20
Essay questions exam	Final assessment of the continuous evaluation (assess all the contents of the matter).	40	B3 B4 B7	C35 C36 C37	D1 D2 D7 D9 D15 D16

Other comments on the Evaluation

The final assessment will have to the following characteristic. In the first place, it has to be complete, that is to say, will cover all given matter, since it judges what the student knows of a subject, no of a single part of it. Second, it has to contain problems and questions, to verify the intellectual maturity of the students to obtain conclusions from the notions and exposed theories in class. In third place, has to provide a greater weight to that part of the matter that has not been already evaluated in the previous continuous evaluation. In fourth place, the assessment will consist on two different parts, one covering the contents of Part (1) and the second one for Parts (2 and 3). It will be carried out during the assessment week and will be marked over 10 points.

The interim assessments (2) aims to better follow the matter by the student, and in these part of the contents will be assessed. Each one of the interim assessments will have a proportional weight (12,5%).
The project based learning will be carried out in groups of students, and will represent the 25% of the final mark. The project will have to be evaluated so that it guarantees the individual requirements and a positive independence, this means that all the members of the group have to have worked and contributed to the final product and have to dominate, up to a minimum, all the aspects of the project. All have to show, therefore, a deep knowledge of the product delivered, independently of the part in which they had centred their efforts.
The evaluation of the labs will be carried out by means of reports, where the knowledge acquired by the students during the laboratory classes will be assessed. This will represent the 10% of the total mark.
The overall final mark of the student will represent the sum of the marks awarded to each one of the before commented parts, being the continuous evaluation mark (NEC). To pass the matter by Continuous Evaluation, the final mark (NEC) will have to be greater or the same to 5, and will be calculated in the following way:
NEC = 0,40*PF + 0,25*PI + 0,25*EBP + 0,10*MP
If the NEC is lower than 5, the student will have to go to the ordinary examination of all the contents of the subject, that will represent 100% of the mark. Besides, the student will have to go to the ordinary examination in the following assumptions:

- The no realisation or delivery of any of the previous interim assessments.
- To obtain at least a mark of 4 over 10 in the final written assessment of the continuous evaluation.

In any one of these assumptions, the mark of continuous evaluation will be calculated as:

NEC FINAL = min (4, NEC)
Furthermore, all those students that wish to improve their mark obtained at the continuous evaluation will be able to attend the ordinary examination.
In both, the ordinary call as well as in the extraordinary (July call) all the competencies of the subject will be assessed.**ACADEMIC INTEGRITY:**
Students are expected to show adequate ethical behaviour, committing to act honestly. Based on article 42.1 of the *Regulation on the evaluation, qualification and quality of teaching and the student learning process of*

***the University of Vigo*, as well as point 6 of the fifth rule of *Order DEF/711/2022, of July 18th, which establishes the requirements for evaluation, progress, and ongoing enrolment in military educational training centres for incorporation into the ranks of the Armed Forces,* any violation of academic integrity in the assessment process, as well as the cooperation in it will result in the assignment of a failing grade to the student (zero) for the entire course in the corresponding assessment opportunity, regardless of the percentage of importance that the test in question had in the overall continuous assessment and independently of other disciplinary actions that may be applied.**

Sources of information

Basic Bibliography

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Manzarredo Beutel, L., **Evolución de la propulsión naval mecánica**, Fondo editorial de ingeniería naval, 1992

Delgado Lallemand, L., **De proa a popa. Tomo 2: Equipos del barco**, Thomson, 2007

Monografías ENM, **Aparatos y servicios auxiliares**,

Complementary Bibliography

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Morán, M.J. y Shapiro, H.M., **Fundamentos de Termodinámica Técnica**, Reverté, 1999

Muñoz, M. y Payri, F., **Motores de combustión interna alternativos.**, Servicio de Publicaciones de la UP Valencia, 1984

Cabronero Mesas y Payri F., **Motores de combustión interna alternativos**, 2ª Ed, Servicio de Publicaciones de la Universidad de Val, 1992

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Taylor, D.A., **Introduction to Marine engineering**, Butterworth-Heinemann, 1996

McGeorge, H.D., **Marine Auxiliary Machinery**, Butterworth-Heinemann, 1995

Borstlap, R. y Katen, H.T., **Ship Electrical Systems**, Witherbys, 2022

Yakimchuk, A., **Troubleshooting Marine Switchgears and Controls**, Witherbys, 2018

Recommendations

Subjects that it is recommended to have taken before

Thermal engineering I/P52G381V01403

Other comments

The subject Machines and Naval Engines constitutes the culmination of the studies of thermal and energetic systems already initiated in Thermodynamics and Heat Transfer, and continued in Thermal Engineering I. This discipline requires of a necessary conceptual base for its correct understanding.

Besides, the student has to possess:

- Capacity of written and oral understanding very developed.
- Capacity of abstraction, basic calculation and synthesis of the information.
- Skills for group work and for public speaking.