(*)Centro Universitario da Defensa da Escola Naval Militar de Marín

Grado en Ingeniería Mecánica

Subjects

Year 5th

Code	Name	Quadmester	Total Cr.
P52G381V01501	Technical Office	1st	6
P52G381V01502	Naval sensors	1st	6
P52G381V01503	Basics of computer networks	1st	6
P52G381V01504	Theory of the ship and shipbuilding	1st	6
P52G381V01505	Automobiles	1st	6
P52G381V01506	Complementary training	2nd	6
P52G381V01991	Final Year Dissertation	2nd	12

IDENTIFYING DATA

Technical Office

Subject	Technical Office
Code	P52G381V01501
Study programme	Grado en Ingeniería Mecánica

Descriptors	ECTS Credits		Choose	Year	Quadmester
	6		Mandatory	5th	1st

Teaching language	Spanish
Department	
Coordinator	Núñez Nieto, Xavier
Lecturers	Núñez Nieto, Xavier Rodríguez Rodríguez, Francisco Javier
E-mail	xnnieto@cud.uvigo.es
Web	http://moovi.uvigo.gal
General description	This course, common to the industrial branch, pursues to orient the student in the acquisition of the knowledge and the skills that enable them for the handle and application of methodologies and technical tools, regarding with the organisation and management of engineering projects and another technical documentation of usual use in a Technical Office. To achieve this mentioned aims there are applied a wide approach of the units composing the course, looking for the integration of the knowledge adquired along the degree and its application by means of a methodology, organisation and management of distinct modalities of technical works, as true essence of the profession of engineer, in the frame of his attributions and fields of activity. It promotes the development of the competences of the matter by means of active and technical methodologies of collaboration. In this way, the exposed contents in theoretical classes implement in the development of the practical activities, oriented to the industrial reality of the profession, assimilating the agile and precise employment of the distinct rule of application and of the professional best practices established, supporting in the new technologies to document, elaborate, manage and present the technical documentation that correspond.

Skills

Code	
B1	Skills for writing, signing and developing projects in the field of industrial engineering, whose purpose is, specializing in Mechanics, according to the knowledge acquired pursuant to paragraph 5 of this order, construction, alteration, repair, maintenance, demolition, manufacturing, installation, assembly or operation of: structures, mechanical equipments, energy facilities, electrical systems and electronic installations and industrial plants, and manufacturing processes and automation.
B2	Ability to manage the activities object of the engineering projects described in CG1.
C18	Knowledge and skills to organize and manage projects. To know the organizational structure and functions of a project office.
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.
D12	Research skills.
D14	Creativity.
D15	Objectification, identification and organization.
D17	Working as a team.
D20	Ability to communicate with people not expert in the field.

Learning outcomes

Expected results from this subject	Training and Learning Results

The students will be in conditions of:

- Identify the rights and guarantees of the taxpayers.

- #Analyze, synthesize and relate the bases of the procedures tributaries.

- Recognize tributes' application procedures and the infractions and sanctions tributaries.

- Recognize the mechanisms of juridical defence of the taxable subjects.

- Identify the central taxes of the local, regional and national tributary system and the essential elements of such taxes.

- Apply the rules of quantification and determination of the debt tributary concerning the central taxes of the tributary system.

- Integrate the Right national tributary with the international Right and the Right of the European Union.

- Identify and solve real problems, or fictitious, arguing *xurídicamente.

- Elaborate reports *jurídicos envelope question tributaries.

- Use specialized databases in the fiscal subject and other digital tools, obtaining helpful information stop the people specialists of the financial field and tributary.

Manage of methods, technics and tools of design, organisation and management of projects	B1 B2	C18	D3 D5 D7 D8 D9 D14 D15 D17 D20
Ability in the handle of information an communication systems in the industrial field.	B1 B2	C18	D3 D5 D7 D8 D9 D10 D14 D15 D17 D20
Ability to generate the documents of the project and other similar technical documents.	B1		D3 D5 D20
Ability in the facultative direction of projects in the field of the industrial engineering.	B2	C18	D5 D7 D8 D17 D20
Skills to communicate properly the knowledge, procedures, results of the field of the Industrial Engineering.	B1		D3 D20
ENAEE LEARNING OUTCOME: KNOWLEDGE And UNDERSTANDING: LO1.3.- Awareness of the wider multidisciplinary context of engineering (Level of achievement: Intermediate (2)).		C18	
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS: LO2.1.- Ability to analyse complex engineering products, processes and systems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to correctly interpret the outcomes of such analyses (Level of achievement: Intermediate (2)).	B1 B2		D2 D8 D9
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS: LO2.2.- Ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical societal, health and safety, environmental, economic and industrial constraints (level of achievement: Intermediate (2)).			D2 D8 D9 D14

ENAEE LEARNING OUTCOME: ENGINEERING DESIGN: LO3.1.- Ability to develop and design complex products (devices, artefacts, etc.), processes and systems in their field of study to meet established requirements, that can include an awareness of non-technical ☐ societal, health and safety, environmental, economic and industrial☐ considerations; to select and apply relevant design methodologies (level of achievement: Intermediate (2)).	C18	D2 D7 D9
ENAEE LEARNING OUTCOME: ENGINEERING DESIGN: LO3.2.- Ability to design using some awareness of the forefront of their engineering specialisation (level of achievement: Intermediate (2)).	B1 C18	D7 D9
ENAEE LEARNING OUTCOME: INVESTIGATIONS: LO.4.1.- Ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, to carry out simulation and analysis in order to pursue detailed investigations and research of technical issues in their field of study (level of achievement: Intermediate (2)).	C18	D5 D12
ENAEE LEARNING OUTCOME: INVESTIGATIONS: LO4.2.- Ability to consult and apply codes of practice and safety regulations in their field of study (level of achievement: Intermediate (2)).	C18	
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICE: LO5.2.- Practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study (level of achievement: Intermediate (2)).	C18	D2 D9 D12 D15
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICE: LO5.3.- Understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study (level of achievement: Intermediate (2)).		D8 D9
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICE: LO5.4.- Ability to apply norms of engineering practice in their field of study (level of achievement: Intermediate (2)).	C18	D9
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICE: LO5.5.- Awareness of non-technical - societal, health and safety, environmental, economic and industrial - implications of engineering practice (level of achievement Intermediate (2)).	C18	
ENAEE LEARNING OUTCOME: MAKING JUDGEMENTS: LO6.2.- Ability to manage complex technical or professional activities or projects in their field of study, taking responsibility for decision making (level of achievement: Intermediate (2)).	B1 B2 C18	
ENAEE LEARNING OUTCOME: COMMUNICATION AND TEAM-WORKING: LO7.1.- Ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large (level of achievement: Intermediate (2)).	B1	D3 D5 D20
ENAEE LEARNING OUTCOME: COMMUNICATION AND TEAM-WORKING: LO7.2.- Ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers (level of achievement: Intermediate (2)).	B1	D3 D5 D7 D8 D10 D17 D20

Contents

Topic	
Unit 1. The technical office	1.1 Concept of technical office 1.2 Functions and scope of work 1.3 Departmental infrastructure 1.4 Exercise of the engineer profession 1.5 Attributions and professional competences 1.6 Professional engineering associations
Unit 2. Stages of the project	2.1 Previous study 2.2 Preliminary engineering 2.3 Detail engineering 2.4 Material execution
Unit 3. Project management	3.1 Methodology 3.2 Organisation of the project 3.3 Planning procces 3.4 Management software
Unit 4. Documents of the project	4.1 Memory 4.2 Planes 4.3 Folder of Conditions 4.4 Budget 4.5 Own entity studies 4.6 Attachments
Unit 5. Transaction and contracting	5.1 Criteria and procedure rules 5.2 Licenses, authorizations and permits 5.3 Bidding and contracting

Unit 6. Facultative direction	6.1 Protagonists in the execution of a project
	6.2 Functions of the facultative direction
	6.3 Obligations and responsibilities
Unit 7. Legal framework	7.1 Legislative basis and scope of the project
	7.2 Specifications and technical standards
	7.3 Standardization, certification and homologation
	7.4 Standardization and certification entities
Laboratory: Engineering Project	Description:
	During the laboratory sessions, the group development of a traditional Mechanical Engineering project will be carried out, applying the knowledge acquired during the theoretical sessions, which will cover the overall content of the whole subject. This project will include all the technical documentation associated with the elaboration of its content, namely: Memory, Plans, Folder of Conditions and Budget.
	Objectives:
	Analysis of the problem, situation, conditioning characteristics and feasibility study.
	Preparation of the technical documentation associated with the project, including descriptive memory, measurements and calculations.
	Handling, scaling, plotting and folding of planes.
	Study and elaboration of the technical, optional, economic and legal specifications.
	Estimate of the material execution budget.
	Inclusion, when appropriate, of the pertinent own entity studies regarding the project: Health and Safety, Occupational Hygiene and Environmental Impact Assessment.
	Exhibition and public oral defence of the projected work.
	Duration:
	The students will have the practical laboratory sessions, under the supervision of the teachers, to carry out the development of the project, which will culminate with its defense and oral presentation.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	28	56
Laboratory practical	12	24	36
Seminars	20	17	37
Practices through ICT	6	6	12
Objective questions exam	6	0	6
Project	2	0	2
Problem and/or exercise solving	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

	Description
Lecturing	Master class. Each thematic unit will be presented by the lecturer, complemented with the comments of the students with base in the bibliography assigned or another pertinent. In these sessions, there will be explained in detail the basic theoretical contents of the program, exposing explanatory examples from which deepen in the understanding of the subject. They will be used computer presentations and the blackboard, especially to transmit information like definitions, charts and so on. Whenever is possible, there will be provided a copy of the slides to the students before the exhibition, focusing the effort of the lecturer and the student on the exposure and understanding of the knowledge. Anyway, the reproductions in paper of the slides never have to be considered like substitutes of the texts or notes, but like complementary material.
Laboratory practical	It will be proposed a project of realisation in group that will cover the knowledge and the total length of the course. For the realisation of that task there will be employed the methodology of project-based learning. It will be provided the needed material for the realisation of the work. Finally there will be carried out a public exhibition of the project.
Seminars	An intensive review course will be held, aimed at students who fail to pass the subject in the first call.

Practices through ICT	There will be proposed exercises that will be solved in group or individually. By means of this methodology and the suitable software of project management, there will be carried out diverse activities, whose final result will suppose the whole planning process corresponding to a constructive project considering all its stages. There will be proposed several activities, using the appropriate software for project management, related to the planning process of an engineering project throughout its different stages.			

Personalized assistance

Methodologies	Description
Seminars	The teaching staff of the subject will answer the doubts and queries of the students in a face to face and telematic way (email, videoconference, virtual forums, etc.), during the tutoring schedule available on the website of the center.

Assessment

	Description	Qualification	Training and Learning Results		
Objective questions exam	There will be carried out two written exams with questions test type and/or of development on the theoretical sessions: One Intermediate Exam (PI) with an average weight of 20% on the grade of the course and a Final Exam (PF) with an average weight on the grade of the matter of 40%.	60	B1	C18	D5 D8 D14 D15
Project	Project report and defence by means of oral presentation.	30	B1 B2	C18	D2 D3 D5 D7 D8 D9 D10 D12 D14 D15 D17 D20
Problem and/or exercise solving	Questionnaire that will cover all the sessions in this regard.	10	B2	C18	D2 D5 D7 D8 D9 D15 D17

Other comments on the Evaluation

The final evaluation will be the sum of the punctuation awarded to each one of the before commented parts, being the Note of Final Continuous Evaluation (FCE):

FCE = 0,6 * THEORY + 0,3 * PROJECT + 0,1 * QUESTIONNAIRE

In addition to reaching a final qualification of at least 5 points on 10 (FCE ≥ 5), to surpass the matter by continuous evaluation there will be demanded some minimum requirements, that guarantee the balance between all the types of skills. These requirements are the following:

- To obtain a note of at least 4 points on 10 in the continuous evaluation final exam (PF).

In case of not surpassing the matter by continuous evaluation, the students will have to attend the ordinary examination of first call. Likewise, in the particular supposition of not to fulfil the minimum requirements established, the qualification of the continuous evaluation will be calculated as follows: FCE FINAL = min (4, FCE). On the other hand, the students that surpass the matter by continuous evaluation will be able to attend to the ordinary examination of first call to improve their qualification.

Both, in the ordinary examination of first call and the extraordinary (second call), will be evaluated all the skills of the

course, including those referred to the theoretical sessions, practical, seminars and to the realisation of the group project.

The detection of academic fraud during the development of the continuous evaluation will suppose automatically the impossibility to surpass the matter by means of the mentioned modality and will imply a qualification of 0 points in that. The detection of academic fraud, either in ordinary announcement or extraordinary, will imply automatically a qualification of 0 points in both cases.

Sources of information

Basic Bibliography

Brusola Simón, Fernando, **OFICINA TÉCNICA Y PROYECTOS**, Servicio de Publicación de la Universidad Politécnica de Valencia, 1ª Edición, 2011

Santos Sabrás, Fernando, **INGENIERÍA DE PROYECTOS**, Eunsa, 2ª Edición, 2002

Complementary Bibliography

Cano, J.L., **MANUAL DE GESTIÓN DE PROYECTOS**, Asociación Española de Ingeniería de Proyectos (AEIPRO), 1ª Edición, 2003

De Cos Castillo, Manuel, **TEORIA GENERAL DEL PROYECTO I: GESTIÓN DE PROYECTOS**, Síntesis, 4ª Edición, 1997

De Cos Castillo, Manuel, **TEORIA GENERAL DEL PROYECTO II: INGENIERIA DE PROYECTOS**, Síntesis, 3ª Edición, 1997

Díaz Martín, Ángel, **EL ARTE DE DIRIGIR PROYECTOS**, Servicio de Publicación de la Universidad Politécnica de Valencia, 3ª Edición, 2010

Gómez-Senent Martínez, Eliseo; González Cruz, Mª Carmen, **TEORÍA Y METODOLOGÍA DEL PROYECTO**, Servicio de Publicación de la Universidad Politécnica de Valencia, 1ª Edición, 2008

Martínez de Pisón Ascacíbar, Francisco Javier, et al., **LA OFICINA TÉCNICA Y LOS PROYECTOS INDUSTRIALES**, Asociación Española de Ingeniería de Proyectos (AEIPRO), 1ª Edición, 2002

Serer Figueroa, Marcos, **GESTIÓN INTEGRADA DE PROYECTOS**, Ediciones UPC, 3ª Edición, 2010

Canito Lobo, José Luis, **Autodesk Inventor 2017**, Anaya, 1ª Edición,

Chatfield, Carl, Johnson, Tymothy, **MICROSOFT PROJECT 2013: STEP BY STEP**, Microsoft Press, 4ª Edición, 2013

Hervo, Corinne, **MICROSOFT OFFICE 2013: WORD, EXCEL POWERPOINT Y OUTLOOK 2013: FUNCIONES BÁSICAS**, Ediciones ENI, 1ª Edición, 2014

Leach, James A., **AUTOCAD 2016 INSTRUCTOR**, SDC Publications, 1ª Edición, 2016

Reyes Rodríguez, Antonio Manuel, **AUTOCAD 2016**, Anaya, 1ª Edición, 2015

Recommendations

Subjects that continue the syllabus

Final Year Dissertation/P52G381V01991

Subjects that it is recommended to have taken before

Graphic engineering/P52G381V01304

Other comments

For the successfull development of this subject it is recommended to possess a personal profile in which they are present the following qualities and skills:

- Capacity of written and oral understanding.
- Autonomous capacity for research and information compilation.
- Skills for the work in group.
- Basic notions related with the field of the design in the engineering, the calculation of installations and the industrial construction.

Naval sensors

Subject	Naval sensors
Code	P52G381V01502
Study programme	Grado en Ingeniería Mecánica

Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	5th	1st

Teaching language	Spanish
Department	
Coordinator	Núñez Ortuño, José María
Lecturers	Nocelo López, Rubén Núñez Ortuño, José María
E-mail	jnunez@cud.uvigo.es
Web	http://moovi.uvigo.gal
General description	This subject gets framed into the Intensification in Naval Technology, and its goal is to provide the student with a theoretical and practical training over the basic operation of radar, sonar and optoelectronic sensors in naval and terrestrial environments. Along this subject, students learn the concept of naval sensor and will acknowledge the most usual sensors in their operative environment. The main concepts for all remote sensing system will be provided, so the student understand the multidisciplinary character of this subject, applying different knowledge from previous subjects, such as radiocommunication systems, electronic circuits and filters, automatic control, electrotechnics of physics (electromagnetic fields). It will be mainly focused on radar sensors, both continuous and pulsed wave systems, analysing the parameters that limit the radar range, the probability of detection and of false alarm, the concept of radar cross section, clutter, etc. We will also analyse the basic and most common techniques for radar signal processing, most of them used in other remote sensing systems (such as sonar), emphasizing the multidisciplinary nature of the subject. The student will be able to understand the proper acoustic characterisation of the underwater environment, and the propagation issues associated, such as noise and reverberation. The architecture and characterisation of the active and passive sonar systems will also be studied, along with their acoustics tranducers. Lastly, the optical spectrum and the classification of the existing emitting sources will be analysed, understanding the operation of the distinct types of optoelectronic sensors and their main characteristics.

Skills

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.
C30	CITN5/OPT1 To understand the principles that govern the operation of communications systems and naval sensors.
D1	Analysis and synthesis
D2	Problems resolution.
D5	Information Management.
D8	Decision making.
D9	Apply knowledge.
D10	Self learning and work.
D16	Critical thinking.

Learning outcomes

Expected results from this subject	Training and Learning Results

Upon completion of the course, the student will be able to:
1. Identify the main issues that the economy of the sector deals with
public.
2. Recognize what activities the public sector carries out and how they are organized.
3. Identify and anticipate all the consequences of public activities.
4. Describe the main reasons for disagreement among economists on the
measures to be taken by governments.
5. Analyze the different points of view on the economic role of the State.
6. Evaluate the different possible measures to achieve the objectives of the policy
governmental.
7. Become aware of public goods in order to achieve a society
fairer and more equitable.
8. Commit to social welfare issues.

To know the technological basis supporting naval sensors.	B3	C30	D1 D5 D10
To understand the basic operation of naval sensors.	B3	C30	D1 D2 D8 D9 D10 D16
ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING LO 1.2 Knowledge and understanding of the engineering disciplines of their specialty, at the proper level to acquire the rest of the competences of the degree, including notions of the latest advances. (level of development of this sub-learning outcome: Medium (2))	B3		
ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING LO 1.3 Be aware of the multidisciplinary context of engineering. (Medium (2))		C30	
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS LO 2.2 Ability to identify, formulate and solve engineering problems within an specialty; choose and apply properly analytical methodologies; recognize the importance of social, health and safety, environmental, economic and industrial restrictions. (Medium (2))			D1 D2 D8 D9 D16
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICAL APPLICATION LO 5.15.1 Understanding the applicable techniques and methods for analysis, planning and research and their limitations in the field of their specialty. (Medium (2))			D9
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICAL APPLICATION LO 5.3 Application knowledge on materials, equipment and tools, technology and engineering processes and their limitations within the field of their specialty. (Medium (2))		C30	D8 D9
ENAEE LEARNING OUTCOME: CONTINUOUS EDUCATION LO 8.1 Ability to realize the need for continuous training and undertake this activity throughout their professional life on their own. (Basic (1))			D8 D10

Contents

Topic

Chapter 1. Introduction to Naval Sensors	1.1 Basic concepts of naval sensors. 1.2 Frequency bands. 1.3 Introduction to radar systems. 1.4 Fundamental parameters of radar systems: PRF/PRI, range resolution, angular resolution, maximum non-ambiguous range, time of observation, ... 1.5 Monostatic, bistatic and multistatic radar systems 1.6 Pulsed wave and continuous wave radar systems. 1.7 Radar cross section (RCS) and simplified radar range equation. 1.8 Simplified block diagram of a radar system.

Chapter 2. Pulsed wave radar systems	2.1 Introduction 2.2 Signal-to-noise ratio and probability of detection. 2.3 Pulse integration techniques. 2.4 Attenuation losses in radar range equation: 2.4.1 Fluctuating targets. 2.4.2 Propagation losses. 2.4.3 Atmospherical losses. 2.4.4 Interferences: clutter, jamming, ... 2.5 Radar Cross Section (RCS) and stealth technologies.
Chapter 3. Continuous wave radar systems	3.1 Introduction: 3.1.1 Doppler effect. 3.1.2 Pulsed wave (PW) radar vs. continuous wave (CW) radar systems. 3.2 CW radars modulated in frequency (CWFM). 3.2.1 With sawtooth modulation (CHIRP). 3.2.2 With triangular modulation. 3.3 Radar range equation for CW radar systems. 3.4 Advantages and disadvantages of CW radar systems.
Chapter 4. Digital signal processing	4.1 Pulse compression techniques. 4.1.1 Frequency pulse compression. 4.1.2 Phase pulse compression. 4.2 MTI systems and pulse-Doppler systems. 4.3 PRF Staggering
Chapter 5. Optoelectronical sensors	5.1 Optical spectrum. 5.2 Infrared sensors (thermal, medium-IR) 5.3 Night-vision sensors (near-IR). 5.4 Optoelectronic emitters: Laser vs. LED. 5.5 Optoelectronic sensors: photodetectors. 5.6 Other sensors and applications: laser telemeter, luxometer, etc.
Chapter 6. Acoustic sensors and sonar systems	6.1 Introduction. 6.2 Acoustic oceanography. 6.3 Underwater signal propagation. 6.4 Active and passive sonar systems. 6.5 Noise and reverberation.
Chapter 7. Specific purpose radar systems	7.1 Multifunction radars. 7.2 Secondary radar (IFF). 7.3 LPI radars. 7.4 Sinthetic aperture radars (SAR).
Lab session 1: Introduction to remote sensing and radar systems	The goal of this practice is introducing the basic concepts of remote sensing and radar systems analysed in the theoretical classes. By means of short Matlab scripts, the influence of each one of the parameters in the simplified radar range equation will be illustrated. The relationship between resolution and pulse spreading for a target conformed by several primary scatterers will be analysed. Students will be able to check whether some common techniques (such as pulse integration) effectively improve the probability of detection.
Lab session 2: Pulsed wave radars (PW radars)	This practice enhances the comprehension of the operative differences between PW and CW radars, as well as their different applications and limitations. Radar simulators will be used instead real radar systems, because, on the one hand, it is neither operative nor safe to activate several of such systems within a short range, and in the second hand, simulators allow to create different tactical scenarios which could not be possible in a real environment. An overview of radar cross section concepts explained in theory will also be analysed. The dependence on the geometry of the radar cross section and radar response will be studied.
Lab session 3: Movement detector radar	This practice describes a simple CW radar system works, by means of a movement sensor. The student will set up a basic CW radar system within the laboratory, where the ability of the student to handle instrumentation equipment will also be evaluated.
Lab session 4: Digital signal processing	The goal of this practice is to help the comprehension of the digital signal processing techniques used in radar systems nowadays. It will include: MTI systems, filter banks and pulse compression techniques.

Lab session 5: Optoelectronic devices	The goal of this practice is to get the student to know about optoelectronic sensors operating either in visible or in non-visible spectrum. They will learn to operate different optoelectronic equipment, such as thermal cameras, night-vision cameras, telemeters, ⬜ They will also learn about the primary light-emitting devices, such as LEDs or LASER.
Lab session 6: Acoustic propagation	The goal of this session is to help the student visualise the mechanisms that play a role in underwater acoustic propagation. With the aid of a computer program, the student will simulate and observe how acoustic waves propagate in multilayered media. This will enable him to analyze the performance of SONAR systems under different conditions (e.g. warm waters vs. cold waters) and identify the opportunities where submarines can go undetected. Several types of SONAR systems will be analyzed, with their strengths and weaknesses.
Lab session 7: Echo sounder	The goal of this session is to help the student understand the operation of an ultrasonic echo sounder, and the underlying physical phenomena. The student will use a scale model comprising: a computer, a pulse-echo ultrasound system, a water tank, sand and rocks to simulate the seabed, and different objects as targets. With this low-scale sonar system, the student will learn the operation of this type of equipment, as well as the interpretation of the results. The student will analyze the limitations of the system, as well as various artifacts due to the mechanisms of acoustic propagation. The student will generalize the observed results to a real system, analyzing the potential problems (or advantages) that could arise.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Laboratory practical	14	7	21
Seminars	21	5	26
Problem and/or exercise solving	9	12	21
Problem and/or exercise solving	2	4	6
Objective questions exam	1	1	2
Essay	1	3	4

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

Methodologies

	Description
Lecturing	These sessions will be used to explain in detail the theoretical contents of the syllabus. Whiteboard and slides will be used as the basic methodology. Whenever slides are used, a copy in paper will be provided beforehand. However, slides should not be considered as a replacement for lectures, since they are only complementary material.
Laboratory practical	Lectures If necessary, a prior explanation of some particular concepts will be performed beforehand, in order to optimize the practical sessions. Laboratory practices: Students will be working in groups and the lecturer will take care of their work. The goal of these sessions is to strengthen the theoretical concepts studied in theoretical lectures. Practical sessions have a series of rules that the student must abide: - Practical sessions are compulsory and in-person classes. - Lost sessions cannot be recovered, unless justified absences.
Seminars	Some weekly hours will be dedicated to solve problems, where small groups will be encouraged. This section includes the intensive course designed for preparing the extraordinary exam.

Personalized assistance

Methodologies	Description

Seminars	Two types of tutorial actions might be distinguished: the academic tutoring and the personalized tutoring. In the academic tutoring, office hours will be at the student disposition where they can consult any doubt related with the contents, organisation and/or schedule of the subject. Tutorials can be individualized, encouraging group sessions for problem-solving hours. In the personalized tutoring, each student, individually, will be able to comment with the lecturer any problem with the subject, with the goal of finding a proper solution. Combining both types of tutorial actions, the different paces of learning will be attended through attention to diversity. Lecturers will properly assist the students through the learning process, both in-person and/or online formats (email, VTC, Moovi forums,...), and always under prior appointment.

Assessment

	Description	Qualification	Training and Learning Results		
Problem and/or exercise solving	Midterm exam: It will evaluate 30% of the theoretical knowledge of the subject. Individual, of about approximately 1 hour. Over 10 points. Can have the form of test, short questions, problems or a combination of all of them. No minimum required.	30	B3	C30	D1 D2 D5 D8 D9 D10 D16
Problem and/or exercise solving	Final term exam: It will evaluate the 40% of the theoretical knowledge of the subject. Individual, about 2-3 hours. Over 10 points. Can have the form of test, short questions, problems or a combination of all of them. A minimum of 4.0 points over 10 is required in each of the parts to be able to pass the subject.	40	B3	C30	D1 D2 D5 D8 D9 D10 D16
Objective questions exam	Laboratory exams: It will evaluate 20% of the practical knowledge of the subject, divided in 2 test of a 10%. Individual, of about 10-20 min. Over 10 points. Can have the form of test, short questions, problems or a combination of all of them. A minimum of 4.0 over 10 is required in the 20% assigned to laboratory training.	20		C30	D1 D2 D5 D8 D9 D16
Essay	Multimedia video: It will evaluate 10% of the full knowledge of the subject (theoretical and practical). Video recorded by the students, performing an easy subject-related experiment. Maximum length: 3 min. Individual, or in groups of two students. Over 10 points.	10	B3	C30	D1 D2 D9 D10

Other comments on the Evaluation

Ordinary exam:

The weight of the distinct parts in the final note of the ordinary exam (*NEO*) gets distributed as follows:

- Theory (*T*): 80%
- Practices (*L*): 20%

Theory:

Consists of:

- A single exam, of approximately 2-3 hours, to be performed within the course calendar.
- Ranked over 10 points (*T*).
- Individual.
- It can include tests, short questions and/or problems or a combination of them.

Laboratory:

Consists of:

- A single exam, of approximately 20-30 min., regarding the contents of the practical sessions.
- Ranked over 10 points (*L*).
- Individual.
- It can include tests, short questions and/or problems or a combination of them.

Final mark and minimum requirements to pass the subject:

The final mark (*NEO*) will be computed following the next equation:

NEO = 0.8 * T + 0.2 * L

A minimum of 4.0 points over 10 is required for both the L exam and the T exam. Once obtained these minimums, a minimum of 5.0 points over 10 in the total computation of *NEO* is mandatory to pass the subject.

Extraordinary exam:

The students that did not pass the subject on first convocatory must attend the second convocatory (or extraordinary exam), that will have the same structure, exam duration, percentages and minimum points required thant in the ordinary exam.

Code of Honor:

During exams, the use of non-allowed electronic devices, notes or books is forbidden.

Exams lacking some of the sheets will not be graded.

Results obtained must be properly justified in all cases, in any of the exams or activities. None of the numerical results will be considered if no explanation is given about the methodoly used to obtain them.

It is expected that all the students abide to these considerations. If a non-ethical behaviour is detected, the student will automatically be graded with a 0.0 at the current examination.

Sources of information
Basic Bibliography
Curry, G. Richard, **Radar Essentials. A concise handbook for radar design and performance analysis**, 1ª ed., Scitech Publishing Inc., 2012
Complementary Bibliography
Denny M., **Blip, Ping & Buzz. Making sense of radar and sonar**, 1ª ed., The Johns Hopkins University Press, 2007
Skolnik, Merril I., **Introduction to Radar Systems**, 3ª ed., McGraw Hill, 2003
Eaves J., Reedy E., **Principles of Modern Radar**, 2ª ed., Springer, 2011
Marage J., Mori Y.,, **Sonars and Underwater acoustics**, 1ª ed., Wiley, 2010
Mahafza B. R., **Radar systems analysis and design using Matlab**, 3ª ed., CRC Press, 2010

Recommendations

Subjects that it is recommended to have taken before

Fundamentals of electrical engineering/P52G381V01205
Electronic technology/P52G381V01301
Radio-communication systems/P52G381V01408

Basics of computer networks

Subject	Basics of computer networks				
Code	P52G381V01503				
Study programme	Grado en Ingeniería Mecánica				
Descriptors	ECTS Credits		Choose	Year	Quadmester
	6		Mandatory	5th	1st
Teaching language	Spanish				
Department					
Coordinator	Fernández Gavilanes, Milagros				
Lecturers	Fernández García, Norberto Fernández Gavilanes, Milagros				
E-mail	mfgavilanes@cud.uvigo.es				
Web	http://moovi.uvigo.gal				
General description	This subject is part of the Intensification in Naval Technologies, and it is sought to provide the students with training, both theoretical and practical, on the fundamental concepts of communication networks and telematic services: basis on data transmission technologies, architecture of networks and communication services, the main components of ICT infrastructures and information systems, network management and planning methods, and basic aspects of computer network security. In the final part of the subject, basic questions related to cyber defense and cybersecurity are also introduced. The classroom sessions will be used to introduce theoretical concepts, which will be complemented with different laboratory practices and problem solving during the tutoring sessions and the seminars.				

Skills

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.
C31	CITN6/OPT2 To acquire the ability to understand the concepts of network architecture, protocols and communication interfaces.
C32	CITN7/OPT3 To acquire the ability to differentiate the concepts of access and transport networks, circuit switching and packet switching networks, as well as knowledge of methods of interconnecting networks and routing.
C33	CITN8/OPT4 To know and use correctly the information systems.
D1	Analysis and synthesis
D2	Problems resolution.
D3	Oral and written proficiency
D6	Application of computer science in the field of study.
D8	Decision making.
D9	Apply knowledge.
D10	Self learning and work.

Learning outcomes

Expected results from this subject	Training and Learning Results		
Recognise the meaning and content of the financial activity as an object of knowledge of the Finance and Tax Law			
Know the technological basis of telematics and data transmission.	B3	C31 C32 C33	D1 D3 D6 D9 D10
Understand the basic principles and architectures of communication networks and services.	B3	C31 C32 C33	D3 D6 D9 D10
Know the main components of ICT infrastructures.	B3	C31 C32 C33	D1 D2 D3 D6 D8 D9 D10

Know the basic security aspects of computer networks.	B3	C31 C32 C33	D1 D3 D6 D9 D10
ENAEE learning outcome: 1.- Knowledge and understanding. LO 1.3.- Be aware of the multidisciplinary context of engineering. Level of development: Adequate (2)		C31 C32 C33	
ENAEE learning outcome: 5.- Practical application of engineering. LO 5.1.- Understanding of the applicable techniques and analysis, project and research methods and their limitations in the field of their specialty. Level of development: Adequate (2)			D9
ENAEE learning outcome: 5.- Practical application of engineering. LO 5.3.- Knowledge of the application of materials, equipment and tools, technology and engineering processes and their limitations in the field of their specialty. Level of development: Adequate (2)		C31 C32 C33	D6 D9
ENAEE learning outcome: 6.- Elaboration of judgements LO 6.1- Ability to collect and interpret data and handle complex concepts within their speciality, in order to make judgements involving reflection on ethical and social issues.		C31 C32 C33	

Contents

Topic	
Introduction, protocols and layers.	Introduction and motivation. Basic network concepts. Reference models. Standardisation bodies. History of the Internet.
Physical and link layers.	Introduction to the physical layer. Transmission media. Signals and modulations. Limit capacity of communication channels. Introduction to the link layer. Frame delimitation. Introduction to transmission errors. Detection and correction of errors.
Retransmission, multiple access and switching.	Retransmission. Random multiple access. Multiple access without contention. Switched Local Area Networks (LAN). Virtual LAN.
Packet forwarding and network connection.	Introduction to the network layer. IP protocol (v4 and v6). ARP protocol Packet fragmentation ICMP protocol Network Address Translation (NAT). Virtual circuits (MPLS).
Routing.	Introduction to routing. Dijkstra's algorithm. Routing algorithms in networks. Hierarchical routing. Border Gateway Protocol (BGP).
Transport layer. Reliable transport.	Introduction to the transport layer. Connectionless protocols: User Datagram Protocol (UDP). Connection-oriented protocols: Transmission Control Protocol (TCP) Connection establishment and release. Reliability mechanisms. Flow control. Congestion control.
Quality of service.	Introduction to quality of service. Multimedia data transmission over best effort networks. Content distribution networks. Differentiated services.
Application layer.	Introduction to the application layer. Domain Name System (DNS). Hypertext Transfer Protocol (HTTP). Dynamic Host Configuration Protocol (DHCP).

Cyberdefense and cybersecurity.	Introduction to security in computer networks.
	Ethical-social aspects of network security.
	Cybersecurity risk management.
	Confidentiality of messages.
	Authenticity and integrity of messages.
	Security protocols: WPA, IPsec, TLS.
	Security software tools.
Networked information systems.	Architecture and components of an information system.
	Big data and cloud computing.
	Intelligent Systems.
Information and command and control systems in the Navy.	Intranet overview.
	Command and control systems.
	NATO Secret WAN.
	Naval command system.
	SIJE.
	Future of information systems.
	SIM.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	47	75
Laboratory practical	12	12	24
Problem solving	7	0	7
Mentored work	15	14	29
Presentation	2	2	4
Laboratory practice	3	0	3
Essay questions exam	2	0	2
Essay questions exam	6	0	6

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

Methodologies

	Description
Lecturing	Presentation by the lecturer of the contents on the subject under study, theoretical basis and guidelines of a work, exercise or project to be developed by the student.
Laboratory practical	Activities with the goal of applying knowledge to specific situations and for the acquisition of basic and procedural skills related to the subject matter of the study. They take place in special spaces with specialized equipment (laboratories, computer rooms, etc.).
Problem solving	Activity in which problems and exercises related to the course are formulated. The student must develop the appropriate or correct solutions through the exercise of routines, the application of formulas or algorithms, the application of transformation procedures of the available information and the interpretation of the results.
Mentored work	An intensive course will be developed in which the students who have not passed the course in ordinary call will work, under the supervision of the lecturer, reviewing the theoretical and practical concepts and carrying out activities, problems and exercises in preparation for the examination of the extraordinary call.

Personalized assistance

Methodologies	Description
Lecturing	The lecturers of the course will personally answer the doubts and queries of the students, both in person, according to the schedule that will be published on the center's website, and through telematic means (email, videoconference, Moovi forums, etc.) by previous appointment.
Laboratory practical	The lecturers of the course will personally answer the doubts and queries of the students, both in person, according to the schedule that will be published on the center's website, and through telematic means (email, videoconference, Moovi forums, etc.) by previous appointment.
Mentored work	The lecturers of the course will personally answer the doubts and queries of the students, both in person, according to the schedule that will be published on the center's website, and through telematic means (email, videoconference, Moovi forums, etc.) by previous appointment.
Problem solving	The lecturers of the course will personally answer the doubts and queries of the students, both in person, according to the schedule that will be published on the center's website, and through telematic means (email, videoconference, Moovi forums, etc.) by previous appointment.

Assessment

	Description	Qualification	Training and Learning Results		
Presentation	Submission and presentation of a work related to the subject matter (TL): Evaluation of the work related to the subject and their presentations (approximate date: week 13 of the semester)	15	B3	C31 C32 C33	D1 D3 D6 D8 D10
Laboratory practice	Practical examination (PL): Individual test to evaluate the knowledge acquired in the practical sessions (approximate date: week 14 of the semester). It consists of solving problems similar to those analyzed in the practical sessions.	15	B3	C31 C32 C33	D1 D2 D3 D6 D9 D10
Essay questions exam	Partial examination (PT, 30% of the grade): Written exam to evaluate the knowledge acquired in the theory sessions T1 to T6 (approximate date: week 8 of the semester). Final Exam (ET, 40% of the grade): Final written exam to evaluate the knowledge acquired in the theory sessions T1 to T11 (approximate date: week 14 of the semester). These examinations can be in the form of a multiple choice questionnaire, short answer questionnaire, problem solving, or some combination of the above.	70	B3	C31 C32 C33	D1 D2 D3 D6 D8 D9

Other comments on the Evaluation

Final mark and minimum requirements to pass the course through continuous assessment:

To ensure that the student has acquired the minimum skills in each of the aspects of the course, students will be required to achieve a minimum score of 4.0 out of 10 in the final theory exam. If we name MED_CON to the average grade for continuous assessment, which is calculated as:

$$MED\_CON = 0.3 * PT + 0.4 * ET + 0.15 * PL + 0.15 * TL$$

The final continuous assessment mark (NEC) will coincide with MED_CON in the event that ET is greater than or equal to 4.0 and, otherwise, it will be calculated as:

$$NEC = min (4, MED\_CON)$$

This grade (NEC) should be equal to or greater than 5 (on a scale of 10) to pass the course. The student who does not pass the course in this call must take the ordinary exam.

Final mark and minimum requirements to pass the course in the ordinary exam:

The final grade in the ordinary exam (NEO) is calculated with the following formula:

$$NEO = 0.7 * T + 0.3 * L$$

Where:

- T represents the theoretical part of the ordinary exam of the course. Individual written exam to evaluate the knowledge acquired in the theory sessions T1 to T11. It can be in the form of a multiple choice questionnaire, short answer questionnaire, problem solving, or some combination of the above.
- L represents the practical part of the ordinary exam of the course. Individual written exam to evaluate the knowledge acquired in the practical sessions of the subject. It consists of solving problems similar to those analyzed in the practical sessions and / or questions about the work presented and / or presentations.

This grade (NEO) should be equal to or greater than 5 (on a scale of 10) to pass the course. The student who does not pass the course in this call or in continuous assessment must attend the extraordinary call.

Final mark and minimum requirements to pass the course in the extraordinary exam:

The final grade in the extraordinary exam (NEE) is calculated with the following formula:

$$NEE = 0.7 * T + 0.3 * L$$

Where:

- T represents the theoretical part of the extraordinary exam of the course. Individual written exam to evaluate the knowledge acquired in the theory sessions T1 to T11. It can be in the form of a multiple choice questionnaire, short answer questionnaire, problem solving, or some combination of the above.

- L represents the practical part of the extraordinary exam of the course. Individual written exam to evaluate the knowledge acquired in the practical sessions of the subject. It consists of solving problems similar to those analyzed in the practical sessions and / or questions about the work presented and / or presentations.

This grade (NEE) should be equal to or greater than 5 (on a scale of 10) to pass the course.

STUDENT ETHICAL CODE

Any attempt at evaluation fraud will be prosecuted and punished. Fraud carried out by a student or its facilitation to third parties will be penalized as follows:

- **Continuous assessment**: The student will receive a 0 as grade in the part of the course (theory or practical) where fraud occurs.

- **Ordinary exam**: The student will receive a 0 as grade for all parts of the exam.

- **Extraordinary exam**: The student will receive a 0 as grade in all parts of the exam.

Sources of information

Basic Bibliography

A. S. Tanenbaum, N. Feamster, D. Wetherall, **Computer Networks: Global Editionnal Version**, 6a edición, Prentice-Hall, 2021

J. F. Kurose , K. W. Ross, **Redes de computadoras: Un enfoque descendente**, 7a edición, Pearson Education, 2017

Complementary Bibliography

R. K. Jain, **The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling**, 1a edición, Wiley, 1991

K. R. Fall, W. R. Stevens, **TCP/IP Illustrated, Volume 1: The Protocols**, 2a edición, Addison-Wesley, 2011

K. R. Fall, W. R. Stevens, **TCP/IP Illustrated, Volume 2: The Implementation**, 2a edición, Addison-Wesley, 2011

Recommendations

Other comments

In order for the student to successfully pass this subject, it is advisable to have:

- Well-developed written and oral comprehension skills.
- Ability to abstract and synthesize information.
- Skills for group work and group communication.

Theory of the ship and shipbuilding				
Subject	Theory of the ship and shipbuilding			
Code	P52G381V01504			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	5th	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Carrasco Pena, Pedro Jesús			
Lecturers	Carrasco Pena, Pedro Jesús González-Cela Echevarría, Gerardo			
E-mail	pedrocarrasco@cud.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	This subject is framed among the specific ones of the intensification in naval technology (General Corps). Its objective is to provide specific skills or abilities to carry out the position of Damage Control Officer (S.I.). The S.I. is the set of processes, standards, techniques and material and human means used to prevent, reduce, and correct the effects that, on a ship or its crew, derive from accidents or enemy actions.			

The first objective of the course is to ensure that students know and understand everything related to ship stability (hydrostatic and intact and damage stability). As well as the basic concepts related to naval hydrodynamics and seakeeping due to the interaction with external factors such as waves, wind, or currents.

Secondly, the course will enable students to acquire sufficient knowledge of shipbuilding. Thus, they will know the structural elements of the ship, its purpose, behavior, forms of failure and their implications when they occur.

This knowledge will enable future officers to take on roles related to the survivability of surface ships and submarines. In this way, graduates will be able to have naval units ready for combat, to sustain them in combat and to carry out the temporary post-combat repairs necessary to maintain the ship at the highest operational level.

Skills

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.
B6	Capacity for handling specifications, regulations and mandatory standards.
C38	CITN12/OPT8 To know the nomenclature, the basic principles of the procedures of construction and operation of ships, the basics of buoyancy and stability, the materials for its construction and structure.
C39	CITN13/OPT9 To acquire the ability to perform calculations of buoyancy and stability.
C40	CITN14/OPT10 To apply the principles of control breakdowns in order to reduce the risk of personal and material, and for decision-making in case of onboard emergencies.
D2	Problems resolution.
D8	Decision making.
D9	Apply knowledge.
D16	Critical thinking.

Learning outcomes

Expected results from this subject	Training and Learning Results

Students will be able to:
1. Identify the basic concepts of statistical analysis: unit, observation, case, variable, value, category, data, population and sample.
2. Describe the structure, organization, operation and relation with the citizenship of the public statistical systems at regional, national and European levels.
3. Find and analyze public statistics from regional, national and European administration databases.
4. Recognize and describe the relationship between variables.
5. Illustrate the behaviour of variables through suitable charts.
6. Calculate and interpret the most relevant position, dispersion and form measures.
7. Classify the variables according to the type of values and operations that can do with them.
8. Classify, organize and summarize data using computing tools.
9. Support their arguments using tables, charts and measures of position, dispersion, form and relation.
10. Judge, question and value others in a constructive manner and work with other people.

Know the ship building technology and operation and the basics of buoyancy and stability	B3 B6	C38	
Know ship buoyancy and stabiliby calculations	B4	C39	D2 D8 D9 D16
Know the basics of damage control on board	B3 B6	C40	
ENAEE LEARNING OUTCOME: KNOWLEDGE AND UNDERSTANDING: LO1.3.- Awareness of the wider multidisciplinary context of engineering (Level of achievement: Intermediate (2)).		C38 C39	
ENAEE LEARNING OUTCOME: ENGINEERING ANALYSIS: LO2.2.- Ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical ▯societal, health and safety, environmental, economic and industrial ▯ constraints (level of achievement: Intermediate (2)).	B4	C39	D2 D8 D9 D16
ENAEE LEARNING OUTCOME: INVESTIGATIONS: LO4.2.- Ability to consult and apply codes of practice and safety regulations in their field of study (level of achievement: Intermediate (2)).	B6		
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICE: LO5.3.- Understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study (level of achievement: Intermediate (2)).		C38 C39 C40	D8 D9
ENAEE LEARNING OUTCOME: ENGINEERING PRACTICE: LO5.4.- Ability to apply norms of engineering practice in their field of study (level of achievement: Intermediate (2)).	B6	C40	D9

Contents

Topic	
1. General considerations on ship theory:	1.1. Buoyancy. 1.2. Stability.
2. Geometry of the hull:	2.1. Lines plan 2.2. Offset tables. 2.3. Main coefficients. 2.4. Hydrostatic curves.
3. Transverse Stabiliy:	3.1. Initial stability 3.2. Stability experiment. 3.3. Grounding.
4. Longitudinal stability:	4.1. Effect of grounding. 4.2. Docking. 4.3. Launching.
5. Damage stability:	5.1. Floodings. 5.2. Effects.
6. Watertight subdivision:	6.1. Compartmentalization. 6.2. Tightness control.
7. Regulations:	7.1. Classification. 7.2. IMO rules. 7.3. Freeboard. 7.4 GT rules.
8. CAD apps:	8.1. Naval Design. 8.2. Shipbuilding.
9. Shipbuilding:	9.1. Definition. 9.2. The ship and its types. 9.3. Shipbuilding materials.

10. General description of the hull:	10.1. Structural topology.
	10.2. Hull elements.
	10.3. Joint processes.
11. Structural Stresses:	11.1. Calm Waters.
12.Structural Stresses:	12.1. Rough seas.
13. Basics of naval structures calculations.	13.1. Flowchart for calculations.
14. Warship⯑s structure particulars.	14.1. Special loads.
Practices:	P1: Buoyancy.
	P2: Transversal Stability.
	P3: Longitudinal Stability.
	P4: Damage conditions.
	P5: Transversal Stability Spredsheet.
	P6: Longitudinal Stability Spredsheet
	P7: Technical Documentation use.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	42	70
Laboratory practical	14	28	42
Seminars	14	17	31
Problem solving	7	0	7

*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 basic theoretical contents of the program will be explained in detail in these lectures. Explanatory examples will be presented for deeper understanding of the subject. Slide presentations and blackboard will be used in combination. As far as possible, presentations will be provided to the students prior to the sessions. In any case, the hardcopy reproductions of the slide presentations should never be considered as substitutes of texts or notes. Thus, this material must be considered a complementary material.
Laboratory practical	Practical Tips in Master Classes. Sometimes, it will be necessary to explain certain practical concepts by providing useful tips for making the best use of the practical classes. Problem Solving. Activity in which problems and / or exercises related to the subject are formulated by the lecturers. The student must develop the appropriate or correct solutions through the repetition of routines, the application of formulas or of procedures. It is usually used as a complement to evaluate the students. Laboratory Practical. Activities for applying the knowledge to situations and for the acquisition of basic and procedural skills related to the subject. They are developed in dedicated rooms like laboratories, computer rooms, etc.
Seminars	The tutorial action is faced as a group support of the student's learning process. Tutorials are preferably done in small group seminars. In the seminars, the student's attitude towards the lecturer and the rest of their classmates is evaluated through annotations made by the lecturer.
Problem solving	Activity in which problems and / or exercises related to the subject are formulated by lecturers. The student must develop the appropriate or correct solutions through the repetition of routines, the application of formulas or of procedures. It is usually used as a complement to the lecture sessions.

Personalized assistance

Methodologies	Description
Problem solving	The teaching action will distinguish academic tutoring actions and personalized tutoring actions. For academic tutoring, students will have scheduled hours of tutoring. In these hours of tutoring, students will be able to consult any questions related to the contents, organization of the subject, development of the project, etc. For these tutorials, group tutorials will be encouraged to solve problems related to group activities, or simply to inform the lecturer about the evolution of group work. In the personalized tutorials, each student, individually, will be able to comment with the lecturer about any problem that prevents him from adequately monitoring the subject or any of its parts. these tutorials seek to find a solution to these problems between student and lecturer. It seeks, combining the two types of tutoring, it is intended to compensate the different learning rhythms through attention to diversity. The lecturers of the subject will answer the questions and queries of the students in person, following the schedule that will be published on the Centre⯑s website. They will also answer these questions through telematic means (email, videoconference, Moovi forums, etc.) under the modality of prior appointment.

Assessment

	Description	Qualification	Training and Learning Results
Lecturing	The theory contents taught in the master sessions are evaluated by 2 intermediate exams along the semester. These intermediate exams are short written tests (1 hour), whose purpose is to evaluate the assimilation of the contents by the students, are to motivate the autonomous study and identify those students requiring individual tutorial attention. During the course two intermediate tests are carried out consisting of conceptual questions and short problems with a weigth of 15% each one in the final note. Regarding the final exam is a long-term test (4 hours) that aims to evaluate the learning of all the contents of the subject by means of theory questions and problems. The weigth assigned to this part is 40%.	70	B3 C38 D2 B4 C39 D8 B6 C40 D9 D16
Laboratory practical	The evaluation of the practices (NP) carries out making the average of the punctuations obtained in each one of the practices, all of them has the same weight.	20	C39 D2 D9 D16
Problem solving	Participation (date: it evaluates in the seminars and in the debates in class of theory)	10	D16

Other comments on the Evaluation

Student final mark is obtained by a weighted sum over the scores achieved in each of the above mentioned parts. A continuous evaluation mark (NEC) is defined according to:

$$NEC = 0,15 * PI1 + 0,15 * PI2 + 0,2 * NP + 0,4 * PF + 0,1 * CP$$

Passing the course by continuous evaluation requires a NEC mark equal to or greater than 5 points. However, minimum requirements will be required in some sections in order to ensure a satisfactory balance between all types of skills. These requirements are:

1. Carry out of both intermediate exams and conduct at least 6 of the 7 practical sessions.2. Obtain a grade of 4 or more points out of 10 in the Final Exam.

Students with NEC less than 5 or who do not fulfill one of the two previous requirements must attend to the regular exam in order to pass the subject. For those students who do not meet the two requirements the final mark of continuous evaluation is obtained as: NEC FINAL = min (4, NEC). In addition, the option to attend the regular exam is offered to all those students who wish to improve their continuous evaluation mark.

Both the regular and the extraordinary exam will evaluate all the subject skills. Therefore, these exams will include a question regarding the tasks performed during the practices.

ETHICAL COMMITMENT: Students are expected to have appropriate ethical behavior. If unethical behavior (cheating, plagiarism, use of unauthorized electronic devices or others) is detected, the student will be penalized with the impossibility of passing the subject by the continuous evaluation modality (in which he will obtain a grade of 0). If this type of behavior is detected in regular or extraordinary exams, a 0 mark qualification is passed to his academic record.

Sources of information

Basic Bibliography

Armada Española, **I-CP-03 Estabilidad**, Armada,

Armada Española, **I-CP-02 Control de averías**, Armada,

Complementary Bibliography

A. Biran, **Ship hydrostatics and stability**, New Riders Publishing,

J. Olivella Puig, **Teoría del buque. Flotabilidad y estabilidad**, UPC,

J. Olivella Puig, **Teoría del buque. Flotabilidad y estabilidad (Problemas).**, UPC,

Lewis, E. V., **Principles of naval architecture second revision: stability and strength. Volume I.**, SNAME,

Lewis, E. V., **Principles of naval architecture second revision: stability and strength. Volume II.**, SNAME,

Bonilla de la Corte, A., **Teoría del buque.**, Librería San José,

Bonilla de la Corte, A., **Construcción naval y servicios.**, Librería San José,

de Juan García Aguado, J. M., **Estática del buque.**, UDC,

de Juan García Aguado, J. M., **Principios de teoría del buque: Dinámica.**, UDC,

Bureau of Naval Personel USN, **Principles of naval engineering**, NAVPERS,

Recommendations

Subjects that it is recommended to have taken before

Mathematics: Calculus II and differential equations/P52G381V01201
Fluid mechanics/P52G381V01208

Other comments

It is recommended a review of basic elements studied in other subjects such as:

- Gravitation, Center of gravity, composition of centers of masses, Pappus-Guldin and Steiner theorems.

- Density, Archimedes' theorem, fundamental principle of hydrostatics, viscosity, Bernoulli's equations, continuity and Venturi effect.

- Descriptive geometry, systems of orthografic views and cutting planes.

- Methods of approximate integration of areas and volumes, linear regressions, trapezoidal and Simpson's rules.

IDENTIFYING DATA

Automobiles

Subject	Automobiles
Code	P52G381V01505
Study programme	Grado en Ingeniería Mecánica

Descriptors	ECTS Credits		Choose	Year	Quadmester
	6		Mandatory	5th	1st

Teaching language	Spanish
Department	
Coordinator	Casqueiro Placer, Carlos
Lecturers	Casqueiro Placer, Carlos
E-mail	ccasqueiro@cud.uvigo.es
Web	http://moovi.uvigo.gal
General description	This guide presents relative information to the subject of Automobiles of fifth course of the Bachelor Degree in Mechanical Engineering taught in the Defense University Center at the Spanish Naval Academy, which lists the competencies that the students have to achieve, the schedule of educational activities, the contents and its temporary programming, an estimate of the work load of the student, the specific criteria for his evaluation and the bibliography recommended for a correct follow-up of the matter. The main objetive of the subject will be to develop the knowledge of the vehicular dynamics. This is an exclusive competency of this subject.

Skills

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.
C41	CITN15/OPT11 Develop knowledge of vehicle dynamics
D1	Analysis and synthesis
D2	Problems resolution.
D3	Oral and written proficiency
D5	Information Management.
D8	Decision making.
D9	Apply knowledge.
D10	Self learning and work.
D12	Research skills.
D16	Critical thinking.
D17	Working as a team.
D20	Ability to communicate with people not expert in the field.

Learning outcomes

Expected results from this subject	Training and Learning Results		
New			
To know the technological basis of the automobile vehicles	B3 B4	C41	D1 D2 D3 D5 D8 D9 D10 D12 D16 D17
ENAEE learning outcome: KNOWLEDGE and UNDERSTANDING: LO1.2.- knowledge and understanding of the mathematics and other basic sciences underlying their engineering specialisation, at a level necessary to achieve the other programme outcomes [Intermediate (2)].	B3		
ENAEE learning outcome: ENGINEERING ANALYSIS: LO2.2.- ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical societal, health and safety, environmental, economic and industrial constraints [Intermediate (2)].	B4		D1 D2 D8 D9 D16

ENAEE learning outcome: ENGINEERING PRACTICE: LO4.1.- ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, to carry out simulation and analysis in order to pursue detailed investigations and research of technical issues in their field of study; [Intermediate (2)].		D5
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.2.- practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study [Intermediate (2)].	B4	D2 D9 D12 D16
ENAEE learning outcome: ENGINEERING PRACTICE: LO5.3.- understanding of applicable materials, equipment and tools, engineering technologies and processes, and of their limitations in their field of study [Intermediate (2)].	C41	D8 D9
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large [Intermediate (2)].		D1 D3 D20
ENAEE learning outcome: COMMUNICATION AND TEAM-WORKING: LO7.2.- ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers [Intermediate (2)].		D17

Contents

Topic	
Topic 1: Introduction to the theory of the automotive vehicles. (T1)	The automotive vehicle: concept. Main requests of the automotive vehicle. The system man-machine-enviroment. Objectives and scope of the theory of the automotive vehicles.
Topic 2: Introduction to tactical vehicles. (T2)	Basic characteristics of tactical vehicles. Spanish marines' vehicles. Most common faults: diagnosis. Specific legislation of circulation.
Topic 3: Interaction between vehicle and road surface. (T3)	General characteristics of tyres. Mechanical characteristics of tyres. Longitudinal stress (traction, braking). Lateral stress (slip angle). Mathematical models. Rolling characteristics of chain vehicles.
Topic 4: Longitudinal dynamics: perfomances. (T4)	Resistance to movement. Basic equation of longitudinal motion. Maximum tractive effort limited by adhesion. Motor and transmission characteristics. Prediction of the performance of a vehicle.
Topic 5: The powertrain. (T5)	The internal combustion engine. Types of transmissions. Transmission components. The manual gearbox. Automatic gearboxes. Homokinetic joints. The differential, function and types. Differential lock. Reducer gearbox.
Topic 6: Braking of automotive vehicles. (T6)	Moment and forces of the braking process. Adhesion condition: optimal braking. Braking process. Braking system.
Topic 7: Vehicle lateral dynamics. (T7)	Steering geometry. Low speed manoeuvrability.Tipping and skid speed limit. Directional steady-state vehicle behavior. Load influence.
Topic 8: Suspension system. (T8)	Vibrations, vehicle and human effects. Suspension system: mathematical model. Kinematics of suspension. Suspension systems: elastic elements (spring, torsion bars, leaf springs) and dampers. Pneumatic suspension. Influence of suspension on the vehicle dynamic behaviour. Kinematics of suspension and tyre behaviour. Suspension set up.
Topic 9: Driving techniques. (T9)	Driver position. Use of hands. The vision. Specific off road driving techniques. Sand, mud and snow driving.
Topic 10: Vehicle recovery. (T10)	Theory of levers and pulleys: levers of first, second and third genus. Practical examples. Pulleys, forces and tensions. Pulley friction and resistance. Vehicle recovery: definition. Recovery steps. Traction recovery. Forces to consider. Recovery machines: mechanical advantage. Resistance according to the terrain and according to the slope. Recovery of overturned vehicles: forces to consider. Anchors. Exceptional traction and anchoring methods. Expedited methods of hoisting. Traction recovery practices: with return and without return. Practices of anchors: from bar to sand. IM recovery means. Capabilities of the vehicle winches in service of the IM: Hummer, Pegaso 7323 and Iveco 257M trucks. Anchors for towing, recovery and hoisting of the main IM vehicles: Hummer, Pegaso 7323 and Iveco 257M trucks, AAV, CCM M-60, Piranha III. Car M-88 and AAVR: crane and winch capabilities. General description of the M-88 car crane: limitations. Overview of the AAVR Truck Crane: Limitations.

Topic 11: Safety systems. (T11)	Active and passive safety. Driving assistance systems: traction and stability control, ABS. Influence of driving technique. Passive safety: deformable structures, safety cell, seat belts, airbag.
Topic 12: Alternative powertrains. (T12)	The fuel cell. Hybrid vehicles. Electric vehicles. Hydrogen propulsion systems.
Practical sessions 1 and 2 (2 sessions, 4 hours). Vehicle monitoring. (PL1 y PL2)	Use of Data Acquisition Systems (DAS) in the automobile: installation of hardware, configuration, reading and interpretation of data. The student will give a report about the work done and / or will answer a questionnaire.
Practical sessions 3 and 4 (2 sessions, 4 hours). Calculation of perfomances and braking characteristics (PL4)	Analysis and prediction of vehicle performance using software. Analysis and prediction of the braking performance of the vehicle using software. The student will give a report with the results and / or will answer a questionnaire.
Practical sessions 5, 6 and 7 (3 sessions, 6 hours). Lateral dynamics. (PL5, PL6 and PL7)	Analysis and prediction of lateral dynamic behavior of the vehicle using software. The student will give a report with the results and / or will answer a questionnaire.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	25	22	47
Problem solving	7	14	21
Mentored work	3	6	9
Practices through ICT	12	10.6	22.6
Laboratory practical	2	1.4	3.4
Seminars	15	10	25
Autonomous problem solving	11	11	22

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

Methodologies

	Description
	Description
Lecturing	In these sessions, the basic theoretical contents of the program will be explained in detail, explaining examples with which to deepen the understanding of the subject. Computer presentations and blackboard will be used, especially to convey information such as definitions, graphs, etc. The content of these classes will be complemented with notes and the slides will also be available for the student.
Problem solving	Since the tutorial action is treated as a group support action to the student's learning process, the tutorials will preferably be conducted in seminars and in the form of small group meetings, with problem solving, exercises or case studies.
Mentored work	It is intended to motivate the student in the research activity, and to foster personal relationships by sharing problems and solutions. In order to acquire certain competences it is necessary to propose activities based on the use of active methodologies. Part of the theoretical content should be developed and / or applied to practical cases treated in group and presented in class, for which part of the time devoted to theoretical classes will be allocated.
Practices through ICT	Analysis and prediction of lateral and longitudinal dynamic behavior of the vehicle using software. The student will deliver reports with the results and / or answer questionnaires. The didactic method to follow in the delivery of practical classes is that the lecturer supervises the work done by the students. The laboratory practices are aimed at strengthening the theoretical concepts addressed in the sessions in the classroom.
Laboratory practical	The didactic method to follow in the delivery of practical classes is that the lecturer supervises the work done by the students. The laboratory practices are aimed at strengthening the theoretical concepts addressed in the sessions in the classroom.
Seminars	Intensive course of 15 hours stop those students that suspended the subject in first call, previous to the examination in second call. Group tutoring with lecturer.
Autonomous problem solving	Employed in the assessment tests in order to verify the abilities acquired by the student.

Personalized assistance

Methodologies	Description
Problem solving	Student solves exercises or practical cases with lecturer help. In the personalized tutoring, each student, individually, can discuss with the lecturer any problem related to their learning achievements in the subject. The lecturer will personally solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD-ENM, as well as through telematic means (email, videoconference, Moovi forums, etc.) with previous appointment.

	Description	Qualification	Training and Learning Results	

| Seminars | Group tutorials with the subject lecturer. In the personalized tutoring, each student, individually, can discuss with the lecturer any problem related to their learning achievements in the subject. The lecturer will personally solve the questions of the students both in person, according to the tutoring schedule published on the web page of the CUD-ENM, as well as through telematic means (email, videoconference, Moovi forums, etc.) with previous appointment. |

Assessment

	Description	Qualification	Training and Learning Results	
Mentored work	The student will carry out a research work (TI) about a case proposed by the lecturer and will deal with issues related to topics 11 and 12. The work will be scored from 0 to 10 according to their content and defense, following the rubric provided at the time of assigning the topics to the students	15	B3 B4	D1 D2 D3 D5 D8 D9 D10 D16 D17
Practices through ICT	The evaluation of the practical part (NP) will be made from the reports or questionnaires corresponding to each one (a total of 4-5), with a total value of 10 points.	15	B3 B4	D1 D2 D3 D5 D8 D9 D10 D16 D17 D20
Autonomous problem solving	Two theoretical and practical tests of continuous evaluation (15% each) will be carried out at the end of blocks or parts 2 and 3. Their evaluation will be carried out on 10 points each. The Continuous Assessment Final Test (with a 40% weight) will be carried out in the evaluation week and will be valued at 10 points. It will be necessary to obtain a grade higher or equal to 4 points out of 10 in the final exam of continuous evaluation in order to qualify for the one approved by continuous assessment.	70	B3 B4	D1 D2 D3 D5 D8 D9 D16

Other comments on the Evaluation

The final mark of continuous assessment (NEC) shall be calculated as follows:

$$NEC = 0.15 \cdot P1 + 0.15 \cdot P2 + 0.15 \cdot TI + 0.15 \cdot NP + 0.4 \cdot PF$$

The student must submit to the regular examination of all the contents of the subject, which will represent 100% of the grade, in the following cases:

- The final grade of continuous assessment (NEC) is less than 5.
- The non-delivery of research work.
- The non-execution or delivery of the memory of practices, unless it is exempted for good cause.
- Obtain a grade below 4 points out of 10 on the final continuous assessment exam.

The continuous evaluation note in case of not fulfilling some of the last four previous requirements will be obtained by the expression: NECS = min (4, NEC)

In any case, the student who has passed the continuous assessment, will have the possibility to submit to the regular exam to improve his/her grade.

In case the student is discovered performing any action that makes possible the copy in some of his/her exams, or in possession of material not allowed during the performance of any of the tests, or whose research work has incurred plagiarism, will be qualified with a zero in the current call.

Sources of information
Basic Bibliography

Luque, P, **Ingeniería del Automóvil. Sistemas y comportamiento dinámico**, Ed. Paraninfo, 2004

Complementary Bibliography

Arias-Paz, M., **Motocicletas**, Ed. Dossat,

Bosch, **Manual de la Técnica del Automóvil**, Ed. Reverté,

Cascajosa, Manuel, **Ingeniería de vehículos : sistemas y cálculos**, Ed. Tebar,

Técnica de recuperación de vehículos de ruedas, Escuela de Aplicación de Infantería de Marina,

Conducción Todo-Terreno y Recuperación de vehículos, Escuela de Infantería de Marina.,

Manual de Características de los Vehículos de Infantería de Marina, Junta Táctica de Infantería de Marina.,

Guía del conductor militar (OR6-002), Estado Mayor del Ejército de Tierra.,

Recommendations

Other comments

Proper development of the subject requires that the student has competencies in the field of differential calculus, vector and kinematic computation and dynamics of the point and the solid.

Complementary training				
Subject	Complementary training			
Code	P52G381V01506			
Study programme	Grado en Ingeniería Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	5th	2nd
Teaching language				
Department				
Coordinator	Barragáns Martínez, Ana Belén			
Lecturers	Barragáns Martínez, Ana Belén			
E-mail	belen@cud.uvigo.es			

----- UNPUBLISHED TEACHING GUIDE -----

IDENTIFYING DATA

Final Year Dissertation

Subject	Final Year Dissertation
Code	P52G381V01991
Study programme	Grado en Ingeniería Mecánica

Descriptors	ECTS Credits		Choose	Year	Quadmester
	12		Mandatory	5th	2nd

Teaching language	Spanish English
Department	
Coordinator	Maceiras Castro, María del Rocío
Lecturers	Maceiras Castro, María del Rocío
E-mail	rmaceiras@cud.uvigo.es
Web	http://cud.uvigo.es/trabajos-fin-de-grado/
General description	The Final Year Project (TFG) forms part, like module, of the curriculum of the Mechanical Engineering Bachelor Degree. It is an original and personal work that each student will make under lecturer supervision, allowing him/her to show in an integrated way the acquisition of the formative contents and the competences associated to the degree. With this work the student applies the knowledges adquired during his/her training, so much of the module of specific mechanical technology as of other fields of knowledge related with the mechanical engineering necessary to carry out the TFG, which reflects its multidisciplinary character. Moreover, it is pretended that the student adquire or reinforce some capacities that allow him/her to project, design and develop complex products, processes and systems of the speciality; have consciousness of the social appearances, of health and security, environmental, economic and industrial; select and apply methods of appropriate project; and look for solutions from a technical point of view as well as its implementation and adequation to the environment. Its definition and contents are explained more extensively in the regulations for the completion of the Final Year Project approved by Centre Board, in its first version, in session celebrated on 2/9/2014, and whose updated content is shown in the website of CUD-ENM, in the section dedicated to the TFG (Studies Section -> Mechanical Engineering Degree ->Student -> Final Year Project).

Skills

Code	
B1	Skills for writing, signing and developing projects in the field of industrial engineering, whose purpose is, specializing in Mechanics, according to the knowledge acquired pursuant to paragraph 5 of this order, construction, alteration, repair, maintenance, demolition, manufacturing, installation, assembly or operation of: structures, mechanical equipments, energy facilities, electrical systems and electronic installations and industrial plants, and manufacturing processes and automation.
B2	Ability to manage the activities object of the engineering projects described in CG1.
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.
B10	Ability to work in a multidisciplinary and multilingual environment.
B12	Original exercise to realise individually and present and defend in front of a university committee, consistent in a project in the field of the specific technologies of the Industrial Engineering in the Mechanical speciality of professional nature in which the skills and competences acquired in the educations are summarised and integrated.
D4	Oral and written proficiency in a foreign language.
D12	Research skills.

Learning outcomes

Expected results from this subject	Training and Learning Results	
Research and structuring of information on any subject	B1 B2 B3 B4 B10 B12	D12

Preparation of a project reportwhich collects : introdcution, problematic or state of the art, aims, phases of the project, development of the project, conclusions and future lines.	B1 B2 B3 B4 B10 B12	D4 D12
Design of equipments, prototypes, programs of simulation, etc, according to specifications.	B1 B2 B3 B4 B10 B12	D12
New		
ENAEE LEARNING OUTCOME. KNOWLEDGE AND UNDERSTANDING LO1.3.- awareness of the wider multidisciplinary context of engineering (level of development of this learning outcome - Intermediate (2)).	B10 B12	
ENAEE LEARNING OUTCOME. ENGINEERING ANALYSIS LO2.1.- The capacity to analyse products, processes and complex systems in his field of study; choose and apply of pertinent form analytical methods, of calculation and experimental already established and interpret properly resulted of said analysis (Intermediate (2))	B1 B2 B4	
ENAEE LEARNING OUTCOME. ENGINEERING ANALYSIS LO2.2.- ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical societal, health and safety, environmental, economic and industrial constraints (Intermediate (2))	B4	
ENAEE LEARNING OUTCOME. ENGINEERING DESIGN LO3.1.- ability to develop and design complex products (devices, artefacts, etc.), processes and systems in their field of study to meet established requirements, that can include an awareness of non-technical societal, health and safety, environmental, economic and industrial considerations; to select and apply relevant design methodologies (Intermediate (2))	B4 B12	
ENAEE LEARNING OUTCOME. ENGINEERING DESIGN LO3.2.- ability to design using some awareness of the forefront of their engineering specialisation (Intermediate (2))	B1 B4 B12	
ENAEE LEARNING OUTCOME. INVESTIGATIONS LO4.1.- ability to conduct searches of literature, to consult and to critically use scientific databases and other appropriate sources of information, to carry out simulation and analysis in order to pursue detailed investigations and research of technical issues in their field of study (Intermediate (2))		D12
ENAEE LEARNING OUTCOME. INVESTIGATIONS LO4.3.- laboratory/workshop skills and ability to design and conduct experimental investigations, interpret data and draw conclusions in their field of study (Intermediate (2))	B12	D12
ENAEE LEARNING OUTCOME. ENGINEERING PRACTICE LO5.2.- practical skills for solving complex problems, realising complex engineering designs and conducting investigations in their field of study (Intermediate (2))	B4	D12
ENAEE LEARNING OUTCOME. MAKING JUDGEMENTS LO6.2.- ability to manage complex technical or professional activities or projects in their field of study, taking responsibility for decision making (Advanced (3))	B1 B2	
ENAEE LEARNING OUTCOME. COMMUNICATION AND TEAM WORKING LO7.1.- ability to communicate effectively information, ideas, problems and solutions with engineering community and society at large (Advanced (3))	B1 B4 B12	D4
ENAEE LEARNING OUTCOME. COMMUNICATION AND TEAM WORKING LO7.2.- ability to function effectively in a national and international context, as an individual and as a member of a team and to cooperate effectively with engineers and non-engineers (Intermediate (2))	B1	D4

Contents

Topic	
Final Year Project	It tries to tackle the resolution of an original and individual exercise in which the student confronts to a real problem of the field of the engineering, uses the methodology acquired during his/her training and proposes a technically valid and viable solution. The contents of each TFG will be defined in the individual proposals offered by the lecturers and approved in the Centre Board, according to the regulations for the realisation of the Final Year Project. Each TFG will have a different content.

Planning

	Class hours	Hours outside the classroom	Total hours

Mentored work	20	0	20
Seminars	10	40	50
Autonomous problem solving	0	210	210
Presentation	5	15	20

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

Methodologies

	Description
Mentored work	The student, in an individual way, guided and supervised by his/her advisor, elaborates, as a result of the developed work, a project according to the indications of the Regulations for the realisation of the Final Year Project of the CUD-ENM. In said memory, the student presents the results of his/her work in which he/she has had to project, design or develop products, processes or systems of the field, as well as propose solutions to the problem posed in the field of the engineering, taking into account in the measure of the possible social factors, of health and security, environmental, economic and industrial.
Seminars	The students that fails the Final Year Project will have to improve, in an individual way, guided and supervised by his/her advisor, the project according to the indications of committee.
Autonomous problem solving	Studies/previous activities Before carrying out the work (also during the same), the student will have to make bibliographic researches and consult specific databases, what will allow him/her a better processing and preparation so much of documentation, as of proposals of resolution to the problem proposed in the TFG. These activities will be carried out in the classroom and/or laboratory, independently by the students. Personalised and individualized attention by the advisor The advisor will supervise the progress of the TFG through periodic meetings where he/she will provide feedback to the student. Integrated methodologies The student presents the result obtained in the preparation of a document on the thematic of the matter. It will be carried out individually, both in writing (memory) and orally (presentation). Presentation and public defense The students must prepare and defend the work done in front of a committee. The defense may be carried out in a face-to-face or online session (by using a web conference platform).

Personalized assistance

Methodologies	Description
Mentored work	The advisor will supervise the progress of the TFG through periodic meetings where he/she will provide feedback to the student. The advisor will take time to help personally to each of the TFG students, to guide their work and guide their learning process, as well as to review and correct the report.
Seminars	The advisor will supervise the improvement of the TFG through periodic meetings where he/she will provide feedback to the student. The advisor will take time to help personally to the TFG students, to guide their work and guide their learning process, as well as to review and correct the report.

Tests	Description
Presentation	The students must prepare and defend the work done in front of a committee. It will be able to be presentially or telematically, through the platform of videoconference web.

Assessment

	Description	Qualification	Training and Learning Results	
Mentored work	Report of the TFG advisor	25	B1 B2 B4 B12	D12
Presentation	Report of the committee of the TFG Evaluation of the presentation and defense	75	B1 B2 B3 B4 B10 B12	D4 D12

Other comments on the Evaluation

At least one committee will be appointed, consisting of three lecturers for each of the following areas: **MAT** (Mathematics),

MEC (Mechanics), **ELE** (Electricity, Electrotechnics and Automatic), **QUI** (Chemical and Environmental Technology), **TEL** (Telecommunications), **OI** (Industrial Organization).

The evaluation will be carried out according to the regulations for the completion of the Final Year Project as well as the evaluation rubric, both approved by the Center Board, whose updated contents are shown on the CUD-ENM website, in the section dedicated to the TFG (Studies Section -> Mechanical Engineering Degree ->Student -> Final Year Project).

ETHICAL COMMITMENT: Students are expected to have adequate ethical behavior. If a type of unethical behavior is detected (cheating, plagiarism or others), the student will be penalized so that in that call he / she will obtain a qualification of 0.0.

If the student fails, the evaluation committee will make a report with the appropriate recommendations to the student or advisors for improving the work in afuture evaluation.

Sources of information
Basic Bibliography
Complementary Bibliography

Recommendations

Other comments

Important information: In the moment of the defense of the TFG, the student must have all the remaining subjects of the degree passed, as established in the article 7.7 of the Regulation for the realisation of the Final Year Project of the University of Vigo.