Teaching Guide				
Identifying Data				2023/24
Subject (*)	Mechanical Technology		Code	631G03029
Study programme	Grao en Máquinas Navais			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	Yearly	Third	Optional	9
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Ciencias da Navegación e Enxeñaría Mariña			
Coordinador	Fraguela Díaz, Feliciano		E-mail	feliciano.fraguela@udc.es
Lecturers	Fraguela Díaz, Feliciano Garcia-Bustelo Garcia, Enrique Juan Romero Gomez, Javier		E-mail	feliciano.fraguela@udc.es enrique.garcia-bustelo@udc.es j.romero.gomez@udc.es
Web				
General description	It is intended that the student acquires the necessary and sufficient theoretical and practical knowledge, leading to obtaining the academic title he seeks; and in the exercise of his profession, he can resolve any issues that arise in the field of mechanical technology and metrotechnics.			

Study programme competences	
Code	Study programme competences
A1	CE01 - Realizar unha garda de máquinas segura
A2	CE02 - Facer funcionar a maquinaria principal e auxiliar e os sistemas de control correspondentes.
A5	CE05 - Utilizar debidamente as ferramentas de man, máquinas ferramenta e instrumentos de medición para as operacións de fabricación, detección de avarías e reparación a bordo do buque.
A6	CE06 - Mantemento e reparación das máquinas e o equipo de a bordo.
A8	CE08 - Vixiar o cumprimento das prescricións lexislativas.
A17	CE17 - Contribuír á seguridade do persoal e do buque
A75	CE75 - Interpretar e representar correctamente o espazo tridimensional, coñecendo os obxectivos e o emprego dos sistemas de representación gráfica.
A76	CE76 - Ensamblar e realizar tarefas básicas de mantemento e reparación de equipos informáticos. Instalar, manexar e restaurar un sistema operativo, xestionando unha xerarquía de usuarios e realizando auditorías do mesmo. Instalar e configurar unha rede de equipos informáticos, establecendo distintos mecanismos de seguridade.
A80	CE80 - Coñecer as características e limitacións dos materiais utilizados para a reparación de buques e equipos.
A88	CE88 - Manter e reformar instalacións e equipos de cuberta, instalacións contra incendios, dispositivos e medios de salvamento e todos aqueles elementos relacionados coa seguridade da navegación, dentro do ámbito da súa especialidade, é dicir, operación e explotación.
A90	CE90 - Operar, reparar, manter e optimizar a nivel operacional as instalacións industriais relacionadas coa enxeñería mariña, como motores alternativos de combustión interna e subsistemas; turbinas de vapor e de gas, caldeiras e subsistemas asociados; ciclos combinados; equipos eléctricos, electrónicos, e de regulación e control; as instalacións auxiliares, tales como instalacións frigoríficas, instalacións de aire acondicionado, plantas potabilizadoras, grupos electrógenos, etc.
A91	CE91 - Redactar e interpretar documentación técnica.
A93	CE93 - Interpretar especificacións, regulamentos e normas de obrigado cumprimento.
A94	CE94 - Realizar inspeccións, medicións, valoracións, taxacións, peritacións, estudos, informes, planos de labores e certificacións nas instalacións do ámbito da súa especialidade.
A99	CE99 - Ter a capacidade para exercer como Oficial de Máquinas da Mariña Mercante, unha vez superados os requisitos esixidos pola Administración Marítima.
B2	CB2 - Aplicar os coñecementos no seu traballo ou vocación dunha forma profesional e posuír competencias demostrables por medio da elaboración e defensa de argumentos e resolución de problemas dentro da área dos seus estudos

B3	CB3 - Ter a capacidade de reunir e interpretar datos relevantes para emitir xuicios que inclúan unha reflexión sobre temas relevantes de índole social, científica ou ética
B4	CB4 - Poder transmitir información, ideas, problemas e solucións a un público tanto especializado como non especializado.
B5	CB5 - Ter desenvolvido aquelas habilidades de aprendizaxe necesarias para emprender estudos posteriores con un alto grao de autonomía.
B6	CG01 - Capacidade para xestionar os propios coñecementos e utilizar de forma eficiente técnicas de traballo intelectual.
B7	CG02 - Resolver problemas de forma efectiva.
B8	CG03 - Comunicarse de maneira efectiva nunha contorna de traballo.
B9	CG04 - Traballar de forma autónoma con iniciativa.
B10	CG05 - Traballar de forma colaborativa.
B11	CG06 - Comportarse con ética e responsabilidade social como cidadán e como profesional.
B12	CG07 - Capacidade para interpretar, seleccionar e valorar conceptos adquiridos noutras disciplinas do ámbito mariño, mediante fundamentos físico-matemáticos.
B13	CG08 - Capacidade para a aprendizaxe de novos métodos e teorías, que lle doten dunha gran versatilidade para adaptarse a novas situacións.
B14	CG09 - Comunicar por escrito e oralmente os coñecementos procedentes da linguaxe científica.
B15	CG10 - Capacidade para resolver problemas con iniciativa, toma de decisións, creatividade, razoamento crítico e de comunicar e transmitir coñecementos habilidades e destrezas.
B16	CG11 - Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
B17	CG12 - Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.
B18	CG13 - Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.
C1	CT01 - Expresarse correctamente, tanto de forma oral como escrita, nas linguas oficiais da comunidade autónoma.
C3	CT03 - Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
C4	CT04 - Desenvolverse para o exercicio dunha cidadanía respectuosa coa cultura democrática, os dereitos humanos e a perspectiva de xénero.
C5	CT05 - Entender a importancia da cultura emprendedora e coñecer os medios ao alcance das persoas emprendedoras.
C6	CT06 - Adquirir habilidades para a vida e hábitos, rutinas e estilos de vida saudables.
C7	CT07 - Desenvolver a capacidade de traballar en equipos interdisciplinares ou transdisciplinares, para ofrecer propostas que contribúan a un desenvolvemento sostible ambiental, económico, político e social.
C8	CT08 - Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.
C9	CT09 - Ter a capacidade de xestionar tempos e recursos: desenvolver plans, priorizar actividades, identificar as críticas, establecer prazos e cumprilos.

Learning outcomes	
Learning outcomes	Study programme competences

Knowledge and use of the different manual tools, machine tools and different joining technologies for the conformation and manufacture of parts whose dimensions, geometry and finish meet the established tolerance criteria.	A1 A2 A5 A6 A17 A75 A80 A88 A90 A91 A99	B2 B4 B6 B7 B8 B9 B10 B11 B12 B13 B15 B16 B17	C4 C5 C7 C8 C9
Knowledge and use of metrology equipment for dimensional, geometric and finishing verification and control of mechanized and welded parts and assemblies.	A1 A5 A6 A17 A75 A90 A91 A93 A94	B2 B3 B4 B6 B7 B8 B9 B10 B11 B12 B13 B15 B16 B17	C1 C3 C4 C5 C7 C8 C9
Knowledge and performance of destructive and non-destructive tests and understanding of the results obtained.	A5 A6 A8 A17 A76 A80 A90 A91 A93 A94 A99	B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18	C3 C4 C5 C7 C8 C9

Knowledge and calculation of the different joining techniques.	A1 A2 A5 A6 A8 A17 A75 A80 A88 A90 A91 A93 A94 A99	B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18	C3 C4 C5 C6 C7 C8 C9
Knowledge and calculation of elements of machines and mechanisms	A1 A2 A5 A6 A8 A17 A75 A80 A88 A90 A91 A93 A94 A99	B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18	C3 C4 C5 C6 C7 C8 C9
Knowledge and use of different manual tools, tools and different equipment and machines for the disassembly and assembly of mechanical components.	A1 A2 A5 A6 A17 A75 A80 A88 A90 A91 A99	B2 B4 B6 B7 B8 B9 B10 B11 B12 B13 B15 B16 B17	C4 C5 C7 C8 C9

Inspection and identification of defect detection in mechanical components.	A5 A6 A8 A17 A76 A80 A90 A91 A93 A94 A99	B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18	C3 C4 C5 C7 C8 C9

Contents	
Topic	**Sub-topic**
1. INTRODUCTION TO MECHANICAL TECHNOLOGY	? Concept of Mechanical Technology. ? Classification of conformation processes. ? Relationship of Mechanical Technology with other disciplines. ? Current status and future trends.
2. ORGANIZATION OF THE MECHANICAL WORKSHOP	? Generalities ? Lighting and electrical, water and compressed air distribution. ? Technical section, production section and warehouses. ? Safety and risk prevention in mechanical work. ? Safety measures that should be adopted to guarantee a safe work environment and for the use of hand tools, machine tools and measuring instruments.
3. INTRODUCTION TO THE TOOLS AND TOOLS OF THE MECHANICAL WORKSHOP	? The bench and vices. ? Verification tools. Nomenclature and employment. ? Tracing tools. Nomenclature and employment. ? Tools for manual use. Nomenclature and application. ? Machine tools. Nomenclature and application. ? Characteristics and limitations of the process used for manufacturing and repair. ? Properties and parameters related to the manufacture and repair of systems and components.
4. INTRODUCTION TO THE MATERIALS	Metallurgical products and classification of ferrous alloys. ? Steels: chemical composition, classification and commercial forms. ? Foundries: classification Metallurgical products and classification of ferrous alloys. ? Steels: chemical composition, classification and commercial forms. ? Foundries: classification ? Sintered materials: classification ? Non-ferrous materials: classification, properties and applications. ? Non-metallic materials: classification, properties and applications.

5. STANDARDIZATION AND QUALITY CONTROL	? Concept of Normalization and need for its use. ? Development of standards and world bodies that create them. ? Interchangeability. ISO Dimensional Tolerance System ? Importance of quality in the project and productivity: quality control methods
6. INTRODUCTION TO METROLOGY	? Concept of Metrology and Metrotechnics. ? Systems of units: historical review, patterns, multiples, submultiples and equivalences between systems. ? Measurement errors. Guys. Mathematical treatment of measurement errors. ? Measurement methods: direct and indirect measurement
7. MEASUREMENT AND CALIBRATION OF DIMENSIONS, SURFACES and SHAPES	? Instruments and methods for direct measurement of lengths ? Instruments and methods to measure lengths by comparison. ? Instruments and methods for direct measurement of angles. Angle patterns. ? Geometric instruments and methods for measuring angles, radii and cones. ? Concept and importance of surface finish. ? Measurement parameters of surface quality. symbology. ? Instruments and methods for measuring roughness ? Verification of forms in general ? Verification of particular forms. ? Verification of alignment of machine axes
8. JOINING TECHNIQUES BY ADJUSTMENT	? Interchangeability ? Dimensional tolerance ? ISO Tolerance System ? Mechanical adjustment ? ISO system settings ? Applications
9. MECHANICAL ELEMENTS: ROLLING BEARINGS	? Definition and uses of bearings. ? Components, materials and characteristics. Manufacturing. ? Types of bearings and the forces they transmit. Designation and applications. ? Choice of bearings, assembly, disassembly, lubrication and diagnosis. ? Assembly and disassembly techniques, verification and inspection
10. MECHANICAL ELEMENTS: GEARS	? Mechanics of the friction cylinder and the gear. ? Properties of the involute. Stresses on the tooth. ? Methodology for obtaining a given gear ratio. ? Straight toothed wheels. Metric modular system and Anglo-Saxon system. ? Helical toothed wheels. ? Calculation of gear trains for a given gear ratio. ? Assembly and disassembly techniques, verification and inspection
11. TRANSMISSION SYSTEMS	? Mechanics of the friction cylinder and the gear. ? Properties of the involute. Stresses on the tooth. ? Methodology for obtaining a given gear ratio. ? Straight toothed wheels. Metric modular system and Anglo-Saxon system. ? Helical toothed wheels. ? Calculation of gear trains for a given gear ratio. ? Assembly and disassembly techniques, verification and inspection

12. JOINING TECHNIQUES BY THREADED ELEMENTS	? Definition and generation of a thread. ? Classification of threads and applications. Direction of the thread. Thread of several entrances. ? Fundamental elements and dimensions of a thread. ? Types of threaded elements for union. Classification of bolts and nuts. ? Thread systems: fastening, drive and special threads. ? Thread dimensioning. Calculation, measurement and verification of threads. ? Washers and nut retention methods. ? Study of the tightening torque to cause a determined tensile load on a screw.
13. JOINING TECHNIQUES BY WELDING	? Welding metallurgy. weldability. Effects of heat input. ? Design and types of welded joints. Check. symbology. ? Soft soldering. ? Oxyacetylene welding ? Submerged electric arc welding. ? Welding by electric arc with coated electrode. ? Electric arc welding in an inert atmosphere. ? Electric resistance welding: spot, bump, seam and butt ? Welding by mechanical action: forging, pressure, percussion, friction and ultrasound. ? Welding by chemical action: explosion and aluminothermic ? Electromagnetic induction welding: impulses and high frequency. ? High thermal density welding: laser, plasma, and electron beam. ? Special welding processes.
14. DESTRUCTIVE TESTING TECHNIQUES	? Definition and purpose of Destructive Testing. ? Mechanical properties of materials ? Tensile test ? Hardness test: Brinell and Rockwell methods. ? Shock test
15. NON-DESTRUCTIVE TESTING TECHNIQUES	? Definition and purpose of Non-Destructive Testing. ? VISUAL INSPECTION. Human vision assistance techniques. ? PENETRATING LIQUIDS. Types of liquids and methodology. ? ELECTROMAGNETIC RADIATION. Fluoroscopy and Tomography. ? INDUCED CURRENTS. Methodology and applications. ? MAGNETIC PARTICLES. Methodology and magnetic effects on the pieces. ? ULTRASOUND. Methodology depending on the material and the medium. ? INFRARED THERMOGRAPHY. Instrumentation and applications.
16. CUTTING TECHNIQUES	? CUTTING TOOLS: Saws, band saws, grinders, ... ? OXYCUT: Shaping by oxyacetylene flame ? WATER CUT ? ARC-AIR: Cutting and patching by arc-air:. ? PLASMA CUTTING: Shaping by electron beam
17. INTRODUCTION TO THE FORMATION BY MATERIAL REMOVAL.	? Shaping processes by chip removal ? Elementary monofilament tool: geometry and characteristic angles ? Mechanics of cutting. Chip formation and efforts on the tool. ? Thermodynamics of the cut. Materials and fluids used. ? Duration of the tool: speed, wear and cutting economy. ? Multi-edged tools: concept, types and use

18. FORMING TECHNIQUES BY MATERIAL REMOVAL	? TURNING: components and types of lathes, tools and operations ? PLANING: components and types of planing, tools and tools ? KNURLING: components and operations. ? CHISELING: tools and operations for cutting and grooving. ? SCRAPPING: tools and finishing operations by hand. ? FILING: types of files and filing operations. ? SAWING: types of saws and sawing operations. ? MILLING: components and types of milling machines, tools and operations ? DRILLING: tool geometry, operations, times and pulling power ? SPOTTING: components and types of spotting, tools and tools. ? BORING: types of chucks, manual and machine boring operations ? REAMING: types of reamers, manual and machine reaming operations. ? BROACHING: types of broaches, internal, external and helical broaching operations. ? THREADING: Taps and dies, practice of threading by hand.
19. AUTOMATION OF MACHINING PROCESSES	? Introduction to numerical control and production automation. ? Applications, advantages and disadvantages of numerical control. ? Characteristics of machine tools governed by numerical control. ? Reference points, axis nomenclature and movement. ? Control notions of a numerical control industrial machine.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Supervised projects	A1 A2 A5 A6 A8 A17 A75 A80 A88 A90 A91 A93 A94 A99 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 C1 C3 C4 C5 C6 C7 C8 C9	0	20	20
Problem solving	A1 A2 A5 A6 A8 A17 A75 A76 A80 A88 A90 A91 A93 A94 A99 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 C1 C3 C4 C5 C6 C7 C8 C9	0	20	20
Workshop	A1 A2 A5 A6 A8 A17 A75 A80 A88 A90 A91 A93 A94 A99 B2 B3 B4 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 C3 C4 C5 C6 C7 C8 C9	30	30	60

Case study	A1 A2 A6 A8 A17 A75 A76 A80 A88 A90 A91 A93 A94 A99 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 C1 C3 C4 C5 C6 C7 C8 C9	15	15	30
Objective test	A1 A2 A5 A6 A8 A17 A75 A76 A80 A88 A90 A91 A93 A94 A99 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 C1 C3 C4 C5 C6 C7 C8 C9	3	0	3
Guest lecture / keynote speech	A1 A2 A6 A8 A17 A75 A76 A80 A88 A90 A91 A93 A94 A99 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 C1 C3 C4 C5 C6 C7 C8 C9	45	45	90
Personalized attention		2	0	2
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	**Description**
Supervised projects	They are proposed as a continuation of the workshop practices but with greater student autonomy in carrying out two works.
Problem solving	The exercises proposed for each topic will be resolved, allowing the application of the most appropriate mathematical models in each case in relation to the theoretical contents developed in the master sessions and also in relation to professional practice.
Workshop	In order for the student to consolidate the theory, the application works will be carried out in the workshop and laboratories in the specialties of conformation of surfaces with machining systems, welded joints and application of non-destructive tests in the verification of elements and systems.
Case study	In order for the student to consolidate the theory, case studies will be carried out in the workshop and in the classroom in the specialties of conformation of surfaces with machining systems, welded joints and application of non-destructive tests in the verification of elements and systems.
Objective test	Partial tests will be carried out in order for the student to become familiar with the type of questions that are raised in the written tests. It will consist of a theoretical part and a practical one, in such a way that both compute. Ordinary and extraordinary exams will be governed by the same format
Guest lecture / keynote speech	There will be a detailed explanation of the contents of the subject and that are distributed in topics. The student will have at all times the bibliographical material, of the subject to be dealt with in each master session. Participation in the classroom will be encouraged through comments that relate theoretical content to real life experiences.

Personalized attention	
Methodologies	**Description**

Supervised projects	It is about guiding the student in those questions related to the subject taught and that are of special difficulty for their understanding. Also included are the corresponding revisions of the reports and continuous evaluation works. The information and contact channels will be the Virtual Campus and the individualized tutorials.

Assessment			
Methodologies	Competencies	Description	Qualification
Workshop	A1 A2 A5 A6 A8 A17 A75 A80 A88 A90 A91 A93 A94 A99 B2 B3 B4 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 C3 C4 C5 C6 C7 C8 C9	Continuous evaluation, taking into account the attitude and participation of the student and the degree of compliance reflected in the work requested in the practices in the workshop. It is about guiding the student in those questions related to the subject taught and that are of special difficulty for his understanding. Also included are the corresponding revisions of the reports and continuous evaluation works. The information and contact channels will be the Virtual Campus and the individualized tutorials.	30
Objective test	A1 A2 A5 A6 A8 A17 A75 A76 A80 A88 A90 A91 A93 A94 A99 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 C1 C3 C4 C5 C6 C7 C8 C9	Evaluation of knowledge and understanding of the basic contents of the subject, considering the abilities and skills of the student, their strategies and approaches in solving problems. The degree of evolution of the student and their ability to analyze, prosecute and solve specific problems will be expressly valued, requiring a balanced theoretical-practical training.	70

Assessment comments
The evaluation criteria contemplated in the charts A-III/1 and A-III/3 of the STCW Code, and recoleitos in the Quality Guarantee System, bear in mind when designing and carrying out the evaluation. Or students with recognition of dedication to part-time and academic exemption from assistance, second establishes "RULE THAT REGULATES OR REGIMES OF DEDICATION TO THE STUDY OF GRAO NA UDC STUDENTS (Arts. 2.3; 3.b; 4.3 and 7.5) The evaluation procedure is the same in all the calls, second chance, early and extraordinary call

Sources of information	
Basic	NESS & SHERLOCK (1996). Non Destructive Testing Handbook. ASNDTMILLAN GÓMEZ (2003). Procedimientos de Mecanizado. Ed Thomson-ParaninfoPIOTROWSKI (1986). Shaft Alignment Handbook . Marcel Dekker, IncCARBAJALES PEREIRA (1999). Tecnología Mecánica Naval. Tomos I y II. CometaRODRÍGUEZ SALGADO (2006). Soldadura.. BelliscoCOCA REBOLLERO (1996). Tecnología Mecánica y Metrotecnia. PirámideLASHERAS (1987). Tecnología Mecánica y Metrotecnia. DonostiarraRAYMOND A. GUYER (1993). Rolling Bearing Handbook and Troubleshooting Guide. . Chilton Book CompanyPÉREZ (1988). Complementos de Tecnología Mecánica y Metrología Dimensional. ETSIISOLAR (1990). Tecnología de Matricería y Moldes. EVERESTLARBURU (2007). Máquinas. Prontuario. Thomson-ParaninfoCASILLAS (1992). Máquinas. Cálculos de Taller. MELSAAENOR (1996). Soldadura. Ingeniería Mecánica Tomo 13. . AENORGALVERY & MARLOW (2006). Guía de Soldadura para el Técnico Profesional. Ed. Limusa-NoriegaGERLING (2002). Medición de longitudes. REVERTÉCARRO (1978). Curso de Metrología Dimensional. ETSII
Complementary	

Recommendations

Subjects that it is recommended to have taken before
Mechanics and Strength of Materials/631G03013 Science and Engineering of Materials/631G03009 Technical Draw/631G03007
Subjects that are recommended to be taken simultaneously
Maintenance Management for Ships/631G03026
Subjects that continue the syllabus
Other comments
To help achieve a sustainable immediate environment and meet the objective of action number 5: "Healthy and environmentally and socially sustainable teaching and research" of the "Green Campus Action Plan":a) The delivery of the documentary works carried out in this matter will preferably be requested in virtual format or computer support, and may be done through Moodle, in digital format, without the need to print them. In the case of being done on paper, plastics will not be used, the prints will be double-sided on recycled paper, and the printing of drafts will be avoided.b) The full integration of students who, for physical, sensory, mental, socio-cultural or gender reasons, experience difficulties in gaining suitable, equal and beneficial access to university life will be facilitated.c) The importance of ethical principles related to the values of sustainability in personal and professional behavior must be taken into account.d) As stated in the different regulations applicable to university teaching, the gender perspective must be incorporated in this area (non-sexist language will be used, bibliography of authors of both sexes will be used, intervention in class of students will be encouraged ...)e) Work will be done to identify and modify prejudices and sexist attitudes and influence the environment to modify them and promote values of respect and equality.f) Situations of gender discrimination should be identified, and actions and measures proposed to correct them.