Teaching Guide				
Identifying Data				2020/21
Subject (*)	Engineering Metrology and Quality Control		Code	730G03032
Study programme	Grao en Enxeñaría Mecánica			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Third	Obligatory	6
Language	SpanishGalician			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Naval e Industrial			
Coordinador	Yañez Casal, Armando Jose	E-mail	armando.yanez@udc.es	
Lecturers	Lopez Diaz, Ana Jesus Yañez Casal, Armando Jose	E-mail	ana.xesus.lopez@udc.es armando.yanez@udc.es	
Web				
General description	The subject of Metrology and Quality Control deals with the techniques necessary for the planning and implementation of quality control in manufacturing processes. First introduced on the concepts fundamental measurement to characterize the variables that will later be used in quality control. Later, it focuses on the close relationship between the variability of the manufacturing parameters and quality end product, for day after studying such variability from a statistical viewpoint. Finally, describes the technical quality control based on statistics, which is known as statistical process control. Such techniques are aimed at finding a balance between the costs of quality control, cope with the costs of making a potential insufficient control.			
Contingency plan	1. There are no modifications to the contents 2. Methodologies *Teaching methodologies will be adapted to the online applications available at UDC. 3. Personalized attention to students through TEAMS 4. There are no modifications in the evaluation 5. There are no modifications to the bibliography or webgraphy			

Study programme competences	
Code	Study programme competences
A26	TEM8 - Coñecemento aplicado de sistemas e procesos de fabricación, metroloxía e control de calidade.
B1	CB01 - Que os estudantes demostren posuír e comprender coñecementos nunha área de estudo que parte da base da educación secundaria xeral e adoita encontrarse a un nivel que, aínda que se apoia en libros de texto avanzados, inclúe tamén algúns aspectos que implican coñecementos procedentes da vangarda do seu campo de estudo
B2	CB02 - Que os estudantes saiban aplicar os seus coñecementos ao seu traballo ou vocación dunha forma profesional e posúan as competencias que adoitan demostrarse por medio da elaboración e defensa de argumentos e a resolución de problemas dentro da súa área de estudo
B4	CB04 - Que os estudantes poidan transmitir información, ideas, problemas e solucións a un público tanto especializado como leigo
B5	CB05 - Que os estudantes desenvolvan aquelas habilidades de aprendizaxe necesarias para emprenderen estudos posteriores cun alto grao de autonomía
B7	B5 - Ser capaz de realizar unha análise crítica, avaliación e síntese de ideas novas e complexas

B9	B8 - Adquirir unha formación metodolóxica que garanta o desenvolvemento de proxectos de investigación (de carácter cuantitativo e/ou cualitativo) cunha finalidade estratéxica e que contribúan a situarnos na vangarda do coñecemento
C1	C3 - Utilizar as ferramentas básicas das tecnoloxías da información e as comunicacións (TIC) necesarias para o exercicio da súa profesión e para a aprendizaxe ao longo da súa vida.
C4	C6 - Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C5	C7 - Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.

Learning outcomes			
Learning outcomes	Study programme competences		
Knowing the tools currently available to characterize dimensionally industrial product. Select the most appropriate to take a measurement.	A26	B1 B2 B4 B5 B7 B9	C1 C4 C5
Knowing the measurement principles that should be taken into account to make a measurement	A26	B1 B2 B4 B5 B7 B9	C1 C4 C5
Understanding the importance of quality control in modern manufacturing processes. Studying different types of variability, its causes and effects. Understanding variability as a measure of the quality of a manufacturing process.	A26	B1 B2 B4 B5 B7 B9	C1 C4 C5

Contents	
Topic	Sub-topic
1. Introduction to metrology.	1.1. Introduction and history of metrology. 1.2. Systems units. The International System. 1.3. The measurement procedure. 1.4. Uncertainty quantification 1.5. Traceability and calibration
2. Applications of metrology industry	2.1. Dimensional metrology. 2.2. Length measurement. Instrumentation. 2.3. Surface quality: Roughness 2.4. Other measures: mass, time, temperature, light intensity and electrical quantities.
3. Quality Control	3.1. Introduction to quality control 3.1.1. Historical development of quality control 3.1.2. Maintaining and improving quality 3.2. Basic tools for quality improvement 3.2.1. Data collection. 3.2.2. Diagrams and their types: Pareto, cause and effect, bivariate.
4. Variability in quality control	4.1. Causes of variability 4.2. Probabilistic models. 4.3. Comparison of two treatments. 4.4. Comparison of more than two treatments: Analysis of variance

5. Statistical Process Control	5.1. introduction 5.2. Control charts. 5.3. for variables 5.4. For attributes. 5.5. Other control charts.
Ferramentas e técnicas para o control da calidade	
Control estatístico de procesos	
Introdución á metroloxía	

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A26 B1 B5 B7 B9 C1 C4 C5	30	0	30
Problem solving	A26 B1 B2 B4 B5 B7 B9 C1 C4 C5	17	25.5	42.5
ICT practicals	A26 B1 B2 B4 B5 B7 B9 C1 C4 C5	15	30	45
Supervised projects	A26 B1 B2 B4 B5 B7 B9 C1 C4 C5	15	15	30
Mixed objective/subjective test	A26 B1 B2 B4 B5 B7 B9 C1 C4 C5	2.5	0	2.5
Personalized attention		0	0	0
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Guest lecture / keynote speech	Lectures which will develop the course content
Problem solving	Interactive classes in which they solve exercises representative of content covered in lectures.
ICT practicals	Methodology that allows students to learn through practical activities (demonstrations, simulations, etc.) the theory of a field of knowledge, through the use of information and communication technologies.
Supervised projects	Methodology that allows promoting autonomous learning under the tutelage of the teacher.
Mixed objective/subjective test	It is a test that may contain theoretical test-type questions or questions of reduced length, specific practical questions or problems of medium length.

Personalized attention	
Methodologies	Description
ICT practicals Guest lecture / keynote speech Problem solving	For any aspect that students consider appropriate, in addition to small group tutoring, six hours per week of tutoring in the time published through the UDC website. Students who have an academic exemption will not be required to attend class but must submit the same works and, in general, on the same dates as the other students of the course.

Assessment			
Methodologies	Competencies	Description	**Qualification**

Supervised projects	A26 B1 B2 B4 B5 B7 B9 C1 C4 C5	Each group of two students will analyze using the Statistical Process Control a set of measurements made on different replicas of a piece chosen by them.	50
Mixed objective/subjective test	A26 B1 B2 B4 B5 B7 B9 C1 C4 C5	The student will have to answer a set of theoretical test questions or questions of reduced length, specific practical questions or problems of medium length.	50

Assessment comments
In order to carry out a continuous assessment, in the part corresponding to Metroloxia, 4 objective tests will be carried out during the course, which will weigh 10%, 20%, 30% and 40%, respectively, in the 1st opportunity qualification. At the second opportunity, there will be an objective test that will have a weight of 100% under the evaluation. At the beginning of the course, people enrolled part-time must contact a co-teacher or a teacher who coordinates the subject to program the activities they must carry out to overcome it. Or students with academic dispensation may request to carry out tutorials at a time different from or published on the UDC website.

Sources of information	
Basic	- Sevilla Hurtado, Lorenzo; Martín Sánchez, María Jesúsnzo Sevilla y María José Martín (2008). Metrología dimensional. Universidad de Málaga - Moro Piñeiro, María. (2017). Fundamentos de metrología dimensional. Marcombo - Sánchez Pérez, Angel M. (1999). Fundamentos de Metrología. Universidad Politécnica de Madrid - Prat, Albert; Tort-Martorell, Xavier; Grima, Pere; Pozueta, Lourdes (1997). Métodos estadísticos: control y mejora de la calidad. Edicions UPC - Levinson, William A. (2011). Statistical Process Control for Real World Aplications. CRC Press - Montgomery, Douglas C. (2009). Introduction to Statistical Quality Control. John Wiley and Sons, Inc. - Thomson, James R. ; Joronacki, Jacec (2002). Statistical Process Control. Chapman & Hall / CRC - CEM (2012). Vocabulario Internacional de Metrología VIM, 3ª edición 2012. https://www.cem.es/content/vocabulario-internacional-de-metrolog%C3%ADa-vim-3%C2%AA-edici%C3%B3n-201 - CEM (). Evaluación de datos de medición. Guía para la Expresión de la Incertidumbre de Medida. Edición digital.. - CEM (). LA METROLOGÍA ABREVIADA" traducción al español de edición 3ª. Edición digital. NIPO: 706-09-003-1. - CEM (). Recomendaciones sobre unidades de medida. Vocabulario Internacional de Metrología VIM, 3ª edición 2012https://www.cem.es/content/vocabulario-internacional-de-metrolog%C3%ADa-vim-3%C2%AA-edici%C3%B3n-2012-espa%C3%B1olEvaluación de datos de medición. Guía para la Expresión de la Incertidumbre de Medida. Edición digital.https://www.cem.es/content/evaluaci%C3%B3n-de-datos-de-medici%C3%B3n-gu%C3%ADa-para-la-expresi%C3%B3n-de-la-incertidumbre-de-medida-edici%C3%B3nLA METROLOGÍA ABREVIADA" traducción al español de edición 3ª. Edición digital. NIPO: 706-09-003-1https://www.cem.es/search/node/metrolog%C3%ADa%20abreviadaEl Sistema Internacional de Unidadeshttps://www.cem.es/content/el-sistema-internacional-de-unidades-si
Complementary	- AENOR (2001). Metrología Dimensional. AENOR - Schilling, Edward G.; Neubauer, Dean V. (2009). Acceptance Sampling in Quality Control. CRC Press - Centro Español de Metrología (1998). Metrología disposiciones legales. Madrid : Ministerio de Fomento, Centro Español de Metrología - Bewoor, Annand K.; Kulkarni, Vinay A. (2009). Metrology & Measurement/. McGraw-Hill Education - Jay Bucher, editor (2012). The metrology handbook . American Society for Quality - Kirkup, Les (2006). An Introduction to uncertainty in measurement. Cambridge : Cambridge University Press - Dotson, Connie L. (2016). Fundamentals of dimensional metrology. Boston: Cengage Learning

Recommendations
Subjects that it is recommended to have taken before
Physics I /730G03003 Statistics/730G03008
Subjects that are recommended to be taken simultaneously
Manufacturing Processes/730G03022
Subjects that continue the syllabus
Other comments
To help achieve a sustained immediate environment and meet the objective of action number 5: "Healthy and sustainable environmental and social teaching and research" of the "Green Campus Ferrol Action Plan":The delivery of the documentary works made in this subject:* They will be requested in virtual format and / or computer support* It will be done through Moodle, in digital format without the need to print themIf it is necessary to make them on paper:* Plastics will not be used* Double-sided prints will be made.* Recycled paper will be used.* The printing of drafts will be avoided.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.