Teaching Guide				
Identifying Data				2020/21
Subject (*)	Acoustics		Code	614855209
Study programme	Mestrado Universitario en Matemática Industrial (2013)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optional	6
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Matemáticas			
Coordinador	Prieto Aneiros, Andrés	E-mail	andres.prieto@udc.es	
Lecturers	Hervella Nieto, Luis Maria Prieto Aneiros, Andrés	E-mail	luis.hervella@udc.es andres.prieto@udc.es	
Web	Microsoft Teams and Moodle (moodle.udc.es)			
General description	Introduction to the mathematical models and the numerical simulation methods used widely in Acoustics and applied to vibro-acoustic industrial problems			
Contingency plan	1. Modifications of the contents. Content does not change. 2. Methodologies * Teaching methodologies that are maintained All sessions will be kept in their regular schedule synchronously using the video conferencing system of the Microsoft Teams group. * Change in teaching methodologies Face-to-face tutorials and face-to-face personalized attention will be modified and performed asynchronously using the "chat" of the Microsoft Teams platform. 3. Mechanisms of personalized attention to students. * Video conferencing in Microsoft Teams: lectures synchronously * Video conferencing in Microsoft Teams: synchronously through individual / group sessions * Personal chat by Microsoft Teams: individual or group sessions asynchronously 4. Modifications in the evaluation. The assessment does not change. * Evaluation comments: Both the first and second opportunity will have the same form of assessment. In the case of performing the final test on-line, all questions will be answered in writing (sending a photo or scanned copy of the calculations made). 5. Modifications to the bibliography or webography. The bibliography and usage materials that will be available on Microsoft Teams and moodle are not modified.			

Study programme competences	
Code	Study programme competences
A1	Alcanzar un conocimiento básico en un área de Ingeniería/Ciencias Aplicadas, como punto de partida para un adecuado modelado matemático, tanto en contextos bien establecidos como en entornos nuevos o poco conocidos dentro de contextos más amplios y multidisciplinares.

A2	Modelar ingredientes específicos y realizar las simplificaciones adecuadas en el modelo que faciliten su tratamiento numérico, manteniendo el grado de precisión, de acuerdo con requisitos previamente establecidos.
A5	Ser capaz de validar e interpretar los resultados obtenidos, comparando con visualizaciones, medidas experimentales y/o requisitos funcionales del correspondiente sistema físico/de ingeniería.
A6	Ser capaz de extraer, empleando diferentes técnicas analíticas, información tanto cualitativa como cuantitativa de los modelos.
B1	Saber aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios, incluyendo la capacidad de integrarse en equipos multidisciplinares de I+D+i en el entorno empresarial.
B2	Poseer conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación, sabiendo traducir necesidades industriales en términos de proyectos de I+D+i en el campo de la Matemática Industrial
B4	Saber comunicar las conclusiones, junto con los conocimientos y razones últimas que las sustentan, a públicos especializados y no especializados de un modo claro y sin ambigüedades.
B5	Poseer las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo, y poder emprender con éxito estudios de doctorado.

Learning outcomes			
Learning outcomes	Study programme competences		
To know and understand the equations governing acoustic and vibration phenomena and moreover, to know both its mathematical formulation and theoretical analysis.	AC1 AC2	BC1 BC3 BR1	
To know how to apply computational methods to solve numerically the most typical equations in Acoustics and to know the difficulties involved on it.	AC1 AC2 AC6	BJ1	
To be able of developing the full study of an acoustic problem, from the initial modeling phase to the analysis of simplified cases and the numerical computation of its solution choosing a adequate discrete technique..	AC1 AC6	BJ1 BC1 BC3	
To understand some practical concepts which are often applied in experimental acoustic problems.	AC5 AC6	BC3 BR1	

Contents	
Topic	Sub-topic
Lesson 1. Continuous modelling.	1.1. Introduction. Harmonic oscillator. 1.2. Basic elements of Algebra, Vector and Tensor Calculus. 1.3. Kinematics. 1.4. Mass and momentum. 1.5. Constitutive laws. 1.6. Lineal models. 1.7. Vibrations in continuum media. 1.8. Elements of structural acoustics (vibro-acoustics).
Lesson 2. Acoustic propagations in one dimension.	2.1. One-dimensional models 2.2. Wave equation in 1D. 2.3. Harmonic regime. 2.4. Coupling boundary conditions. Thin layer models. 2.5. Time-harmonic wave propagation in a multilayered.
Lesson 3. Elements of applied acoustics	3.1. Sound thresholds. Decibels. Pressure, intensity, and power levels 3.2. Reflection. Absorption and transmission coefficients. 3.3 Total absorption and surface or volume averages.
Lesson 4. Acoustic propagation in three dimensions.	4.1. Three-dimensional wave equation 4.2. Time-harmonic solutions. Three-dimensional Helmholtz equation.

Lesson 5. Numerical solutions.	5.1. Helmholtz problems in bounded domains. 5.2. Structural-acoustic problems 5.3. Helmholtz problems in bounded domains.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A2 B2 B1	42	84	126
Multiple-choice questions	A6 B4	3	0	3
Problem solving	A5 A6 B5 B4	0	20	20
Personalized attention		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	
Methodologies	Description
Guest lecture / keynote speech	Lectures will be taught by a video-conference system in campus classrooms of A Coruña, Santiago, Vigo and Madrid. The course teachers will explain the contents of the course using slides and lecture notes. Students will be highly encouraged to ask and question about any topic explained during the lectures.
Multiple-choice questions	Once the lecture period is over, a writing exam will be scheduled, where the students will to solve questions and problems with the help of books (included in the course bibliography) or their own lecture notes. In this test, the students should show the knowledge accomplished on the course topics.
Problem solving	During this course, some exercises and problems related to the course contents will be assigned. They will have to be solved and submitted taking into account a prescribed deadline.

Personalized attention	
Methodologies	Description
Guest lecture / keynote speech Problem solving	If it is required by the students, further support will be provided to complete adequately the course assignments. This additional assistance will be on-line (using e-mail or Microsoft Teams) or in-campus (at the Faculty of Computer Science in A Coruña).

Assessment			
Methodologies	Competencies	Description	**Qualification**
Guest lecture / keynote speech	A1 A2 B2 B1	It will be taken into account the active attendance to the lecture sessions, and the student involvement during the lecture recitations.	20
Multiple-choice questions	A6 B4	The writing exam will include all the topics studied in this course. It will be allowed the use of books (included in the course bibliography) or student lecture notes.	50
Problem solving	A5 A6 B5 B4	During the lecture period, some exercises and problems will be assigned to the students. These assignments should be completed individually and submitted before the final exam takes place.	30

Assessment comments

For
those students which were using the second opportunity to pass their assessments, the deadline
for the submission of their assignments will be the final exam date
of this second opportunity. If the assignments would not be submitted
in this second period, only the assignments submitted in the period
of the first opportunity would be evaluated.

Sources of information	
Basic	- M.E. Gurtin (1981). An Introduction to Continuum Mechanics. Academic Press, San Diego - F. Ihlenburg (1998). Finite Element Analysis of Acoustic Scattering. Springer-Verlag, Berlin
Complementary	- H.J.-P. Morand, R. Ohayon (1995). Fluid-Structure Interaction. John Wiley & Sons, New York - D.T. Blackstock (2000). Fundamentals of Physical Acoustics. John Wiley & Sons, New York - R. Dautray, J.L. Lions (1990). Mathematical Analysis and Numerical Methods for Science and Technology. Springer-Verlag, Berlín - F. Fahy (1994). Sound and Structural Vibration: Radiation, Transmission and Response. Academic Press, London

Recommendations
Subjects that it is recommended to have taken before
Partial differential equations/614855203 Continuum mechanics/614855205
Subjects that are recommended to be taken simultaneously
Professional software in acoustics/614855216
Subjects that continue the syllabus
Other comments

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