UNIVERSIDADE DA CORUÑA

Teaching Guide				
Identifying Data				2015/16
Subject (*)	Boundary element methods		Code	614855230
Study programme	Mestrado Universitario en Matemática Industrial (2013)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optativa	3
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Matemáticas			
Coordinador	Gonzalez Taboada, Maria	E-mail	maria.gonzalez.taboada@udc.es	
Lecturers	Gonzalez Taboada, Maria Selgas Buznego, Virginia	E-mail	maria.gonzalez.taboada@udc.es virginia.selgas@udc.es	
Web	http://www.m2i.es			
General description	We provide an introduction to boundary element methods. Using as a model a potential problem, we present the direct method and the indirect methods based on single layer and double layer formulations to solve both interior and exterior problems in two and three dimensions. We also discuss the application of boundary element methods to acoustic scattering and radiation problems.			

Study programme competences / results	
Code	Study programme competences / results
A4	Ser capaz de seleccionar un conjunto de técnicas numéricas, lenguajes y herramientas informáticas, adecuadas para resolver un modelo matemático.
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.
A8	Saber adaptar, modificar e implementar herramientas de software de simulación numérica.
A9	Conocer, saber seleccionar y saber manejar las herramientas de software profesional (tanto comercial como libre) más adecuadas para la simulación de procesos en el sector industrial y empresarial.
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.
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 / results		
To know the steps to solve a boundary value problem using the boundary element method	AC4	BJ1 BC3	
To know the advantages and limitations of the boundary element method	AC4	BJ1	
To know the fundamental solutions, the integral representation formula and the boundary integral equations related to the problems considered in this subject	AC4	BJ1 BC3	
To know and be able to apply the direct and indirect methods	AC4	BJ1 BC3	
Given a boundary integral equation, be able to discretize it using the boundary element method and to derive the associated linear system		BJ1 BC3	

Be able to construct Matlab programs that solve an elliptic problem using the boundary element method.	AC4 AC5 AC8 AC9	BJ1 BC3 BR1	

Contents	
Topic	**Sub-topic**
The boundary element method for potential problems	- Interior and exterior problems for the Laplace equation - Fundamental solution of the Laplacian - Representation formula of a harmonic function - Derivation of the boundary integral equations - Direct and indirect methods. Analysis of the variational formulations - Discretization. A priori error estimates - Practical considerations of the numerical solution of the discrete problem
The boundary element method in acoustics	- The wave equation and the Helmholtz equation - Acoustic scattering and radiation problems in harmonic regime - Fundamental solutions of the Helmholtz operator - Green's representation formula. Single and double layer potentials - Boundary integral equations - Direct and indirect methods - Discretization - Implementation

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Guest lecture / keynote speech		14	35	49
Laboratory practice		7	7	14
Supervised projects		1	9	10
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**
Guest lecture / keynote speech	The theoretical contents will be presented through lectures.
Laboratory practice	The implementation in Matlab of the boundary element method to solve the problems considered in the subject will be shown.
Supervised projects	At the end of the course, a project will be proposed to each student.

Personalized attention	
Methodologies	**Description**
Supervised projects	Students can ask to their teachers any questions that arise during the performance of the project that has been proposed to them.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Supervised projects		The understanding of the methods presented during the course and the ability to use them will be assessed.	100

Assessment comments

Sources of information	
Basic	- G. Chen y J. Zhou (1992). Boundary Element Methods. Academic Press - R. Kress (2014). Linear integral equations. Springer - G. Beer (2001). Programming the Boundary Element Method. An introduction for engineers. John Wiley & Sons
Complementary	- C.A. Brebbia y J. Dominguez (1992). Boundary Elements. An introductory course.. McGraw-Hill - W. Hackbusch (1995). Integral Equations. Birkhauser - W. McLean (2000). Strongly elliptic systems and boundary integral equations. Cambridge University Press - J. Saranen y G. Vainikko (2002). Periodic integral and pseudodifferential equations with numerical approximations. Springer - (). .

Recommendations
Subjects that it is recommended to have taken before
Numerical methods and programming/614855201 Numerical methods for partial differential equations/614855204
Subjects that are recommended to be taken simultaneously
Acoustics/614855209
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.