Teaching Guide				
Identifying Data				**2014/15**
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			
Prerequisites				
Department	Matemáticas			
Coordinador	Gonzalez Taboada, Maria		**E-mail**	maria.gonzalez.taboada@udc.es
Lecturers	Gonzalez Taboada, Maria		**E-mail**	maria.gonzalez.taboada@udc.es
Web	http://www.m2i.es			
General description	Neste curso preséntase unha introdución ao método dos elementos de contorno. Usando como modelo un problema de potencial, estudianse o método directo e os métodos indirectos baseados nas formulacións de capa simple e capa dobre para resolver problemas interiores e exteriores en dúas e tres dimensións. Tamén descríbese a aplicación do método a problemas de dispersión e de radiación acústica.			

Study programme competences	
Code	**Study programme competences**
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		
Subject competencies (Learning outcomes)	**Study programme competences**	
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	Ordinary class hours	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	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
	- J. Saranen y G. Vainikko (2002). Periodic integral and pseudodifferential equations with numerical approximations. Springer
	- W. McLean (2000). Strongly elliptic systems and boundary integral equations. Cambridge University Press

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