

## Boundary Element Methods

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**ECTS:** 3 ECTS

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**COORDINATOR:** Maria Gonzalez Taboada (maria.gonzalez.taboada@udc.es)

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**UNIVERSITY WHERE THE COORDINATOR IS:** UDC

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**HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES?** No

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**LECTURER 1:** Virginia Selgas Buznego (selgasvirginia@uniovi.es)

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**UNIVERSITY WHERE THE LECTURER 1 IS:** UDC

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**HAVE YOU GIVEN PERMISSION TO RECORD YOUR CLASSES?** No

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### SUBJECT CONTENTS

1. Introduction to the boundary element method. Potential problems.

1.1 Interior and exterior problems for the Laplace equation

1.2 Fundamental solution for the Laplace operator

1.3 Representation formulae of an harmonic function

1.4 Integral equations on the boundary

1.5 Direct and indirect methods. Analysis of the variational formulations

1.6 Discretization. A priori error estimates

1.7 Some practical considerations on the numerical solution of the discrete problem

2. Boundary element methods in acoustics

2.1 The wave equation and Helmholtz equation

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- 2.2 Acoustic scattering and radiation problems in harmonic regime
  - 2.3 Fundamental solutions of the Helmholtz operator
  - 2.4 Green representation formulae. Single and double layer potentials
  - 2.5 Boundary integral equations
  - 2.6 Direct and indirect methods
  - 2.7 Discretization of the equations
  - 2.8 Implementation
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## METHODOLOGY

The contents of the course will be presented in keynote sessions. In addition, there will be some lab sessions in which students will be shown how to implement the boundary element method using Matlab.

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**LANGUAGE USED IN CLASS:** Spanish, Will depend on the audience.

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**IS IT COMPULSORY TO ATTEND CLASS?** Students can attend via conference system.

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## BIBLIOGRAPHY

1. G. Beer, Programming the Boundary Element Method. An Introduction for Engineers, John Wiley & Sons, 2001.
  2. C.A. Brebbia & J. Domínguez, Boundary Elements. An Introductory Course, McGraw-Hill [1992].
  3. G. Chen & J. Zhou, Boundary Element Methods, Academic Press [1992].
  4. W. Hackbusch, Integral Equations, Birkhauser [1995].
  5. R. Kress, Linear Integral Equations, Springer [2014].
  6. W. McLean, Strongly Elliptic Systems and Boundary Integral Equations, Cambridge University Press, 2000.
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## SKILLS

### Basic:

CG3: To be able to integrate knowledge in order to state opinions using information that even incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge.

CG5: To have the appropriate learning skills to enable them to continue studying in a way that will be largely self-directed or autonomous, and also to be able to successfully undertake doctoral studies.

Specific:

CE4: To be able to select a set of numerical techniques, languages and tools, appropriate to solve a mathematical model.

Numerical simulation specialization:

CS2: To adapt, modify and implement software tools for numerical simulation.

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**WILL YOU BE USING A VIRTUAL PLATFORM?** Yes. Moodle (UDC).

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**WILL YOU BE USING ANY SPECIFIC SOFTWARE?** Yes. MATLAB.

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**CRITERIA FOR THE 1ST ASSESSMENT OPPORTUNITY**

We will take into account the solution of the exercises posed during the keynote sessions as well as the final project carried out by the students.

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**CRITERIA FOR THE 2ND ASSESSMENT OPPORTUNITY**

The same as in the 1<sup>st</sup> assessment opportunity.

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