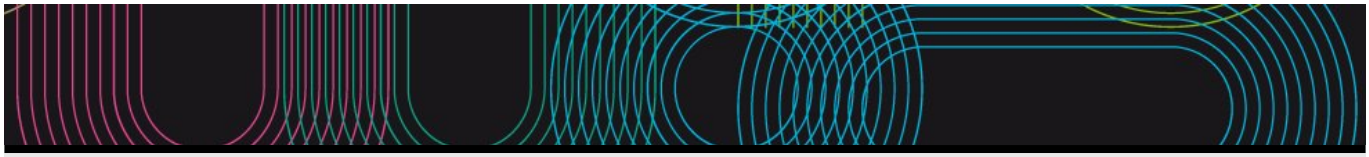

IDENTIFYING DATA				
Numerical Methods for Partial Differential Equations				
Subject	Numerical Methods for Partial Differential Equations			
Code	V05M135V01104			
Study programme	Máster Universitario en Matemática Industrial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Fernández Manin, Generosa			
Lecturers	Fernández Manin, Generosa García Lomba, Guillermo Varas Mérida, Fernando			
E-mail	gmanin@uvigo.es			
Web	http://moovi.uvigo.gal			
General description	In this subjet, we give an introduction to several numerical methods for the resolution of equations in partial derivatives, using simple examples, and we solve, using COMSOL Multiphysics, some real simplified problems. www.m2i.es			

Training and Learning Results	
Code	
B2	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
C4	(*)Ser capaz de seleccionar un conjunto de técnicas numéricas, lenguajes y herramientas informáticas, adecuadas para resolver un modelo matemático.
C8	(*)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.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Knowing the main families of numerical methods for the resolution of differential equations.	B5 C4 C8
Knowing to apply the main methods for numerical resolution of differential equations.	B2 C4
Understanding the degree of approximation obtained by a numerical method.	B2 C4 C8
Understanding the difficulties for solving numerically a partial differential equation	B2 B4 C4 C8

Contents

Topic	
Introduction to the numerical methods for the resolution of Differential Equations: finite differences, finite elements, finite volumes.	Generic description of the methods.
Methods of finite differences and finite elements in one dimensional problems.	Formulation of the methods, discretisation and numerical resolution. Analysis of the convergence and error estimates.
Methods of finite differences and finite elements in several dimensions: elliptical, parabolic and hyperbolic problems.	Discretization, numerical resolution and error estimates.
Practices with COMSOL-MULTIPHYSICS	Numerical resolution and analysis of results: thermal problems, solids, multhiphysics, etc.

Planning

	Class hours	Hours outside the classroom	Total hours
Problem solving	4	12	16
Practices through ICT	12	12	24
Lecturing	26	52	78
Problem and/or exercise solving	2	10	12
Laboratory practice	2	4	6
Problem and/or exercise solving	0	14	14

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Problem solving	The student has to solve and deliver theoretical exercises (CG5, CE4).
Practices through ICT	In the computer laboratory and using COMSOL Multiphysics real simplified cases from several subjects: thermal, linear elasticity, electromagnetism, etc. are solved (CG2, CG4, CG5, CE4, CS1).
Lecturing	These classes are devoted to explain the theoretical contents, to solve some exercise to understand the methods and to introduce the practical tasks (CG2, CG4, CE5, CE4).

Personalized assistance

Methodologies	Description
Lecturing	If any additional explanation is needed the student can demand it at the teacher's office, by email or through the subject web.
Problem solving	If any additional explanation is needed the student can demand it at the teacher's office, by email or through the subject web.
Practices through ICT	If any additional explanation is needed the student can demand it at the teacher's office, by email or through the subject web.

Assessment

	Description	Qualification	Training and Learning Results	
Problem solving	Solved exercises delivered before the deadline are evaluated;	15	B5	C4
Practices through ICT	The practices of laboratory will be face-to-face (in Vigo for students from the Galician universities and in Madrid for other students). All of them mark the same.	30	B2 B4 B5	C8
Lecturing	The answer to 5 telematic activities.	10	B2 B4	
Problem and/or exercise solving	It consists of a written test at the end of the semester.	25		C4 C8
Laboratory practice	Another practice of laboratory which should be done by the student in an autonomous way.	20		C4 C8

Other comments on the Evaluation

Secondo opportunity;

Continuous evaluation: students can deliver the exercises (if they haven done it before) and they must do the final exam.

Exceptional case: students who can not follow the continuous assessment may do a different final exam; they will be marked

with the points obtained in that exam.

more information: www.m2i.es

Sources of information
Basic Bibliography
Johnson, C., **Numerical solution for partial differential equations by the finite element methods**, 2009,
Reddy, J.N., **An introduction to the Finite Element Method**, 2ª y 3ª Ed (1993 y 2006),
Fdez-Manín, G. - García Lomba, Guillermo, **Notas de clase de la asignatura MNEDP**,
Complementary Bibliography
Eriksson, K - Estep, D - Hansbo, P. - Johnson, C., **Computational differential equations**, 1996,
LeVeque,R.J., **Finite Difference Methods for Ordinary and Partial Differential Equations: Steady State and Time Dependent Problems**, 2007,
Samarskii, A.A, **, The Theory of Difference Schemes**, 2001,
Strickwerda, J.C, **Finite Difference Schemes and Partial Differential Equations**, 1999 (2ª Ed 2004),

Recommendations
Subjects that continue the syllabus
Advanced Finite Elements/V05M135V01218
Solid Mechanics/V05M135V01202
Subjects that are recommended to be taken simultaneously
Computer-Aided Design (CAD)/V05M135V01108
Partial Differential Equations/V05M135V01103
Mechanics of Continuous Media/V05M135V01105