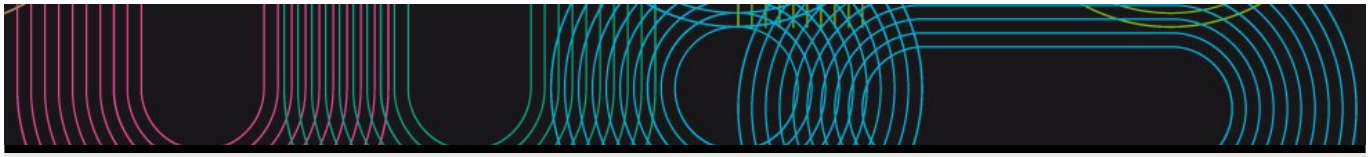

IDENTIFYING DATA

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			
E-mail	manin@dma.uvigo.es			
Web	http://www.m2i.es/docs/modulos/FBasica/3.Metodos%20Numericos%20Ecuaciones%20Derivadas%20Parciales.pdf			
General description	In this matter, using simple examples, we give an introduction to several numerical methods for the resolution of equations in partial derivatives and we solve, using COMSOL Multiphysics, some real simplified problems.			

Competencies

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.

Learning outcomes

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
Troubleshooting and / or exercises	4	12	16
Practice in computer rooms	12	12	24
Master Session	26	52	78
Long answer tests and development	2	10	12
Practical tests, real task execution and / or simulated.	2	4	6
Troubleshooting and / or exercises	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
Troubleshooting and / or exercises	The student has to solve and deliver theoretical exercises of understanding the methods, practical application for solving them with some numerical simulation software: Matlab or Comsol Multiphysics.
Practice in computer rooms	In the computer laboratory and using COMSOL Multiphysics solve real simplified cases from several subjects: thermal, linear elasticity, electromagnetism, etc.
Master Session	These classes are devoted to explain the theoretical contents, to resolve some exercise to understand the methods and to introduce the practical task.

Personalized attention

Methodologies	Description
Master Session	If any additional explanation is needed the student can demand it at the teacher's office, by email or through the subject web.
Troubleshooting and / or exercises	If any additional explanation is needed the student can demand it at the teacher's office, by email or through the subject web.
Practice in computer rooms	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	
Troubleshooting and / or exercises	Solved exercises delivered before the deadline are evaluated; this deadline matches with the exam date, at the end of the course.	25	B5	C4
Practice in computer rooms	The practices of laboratory will be face-to-face (in Vigo for students from the Galician universities and in Madrid for other students) and will take place on Tuesdays, December 5 and 13. All of them mark the same.	30	B2 B4 B5	C8
Master Session	attendance and participation are marked.	5	B2 B4	
Long answer tests and development	t consists in a two hours written test at the end of the semester. According to the planned schedule, it will take place in Vigo and Madrid on 10th January 2018.	20		C4 C8
Practical tests, real task execution and / or simulated.	Another practice of laboratory which should be done by the student in an autonomous way the same day of the long answer test; according to the foreseen schedule it will be held on 10th January.	20		C4 C8

Other comments on the Evaluation

Continuous evaluation: students can do the exercises (if do not delivered before) and they must to do the final exam.

Exceptional case: students who can not follow the continuous assessment may do a different final exam and they will be graded with the points obtained in the exam.

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

Variational Analysis of Partial Differential Equations/V05M135V01211
Computer-Aided Design (CAD)/V05M135V01108
Mechanics of Continuous Media/V05M135V01105