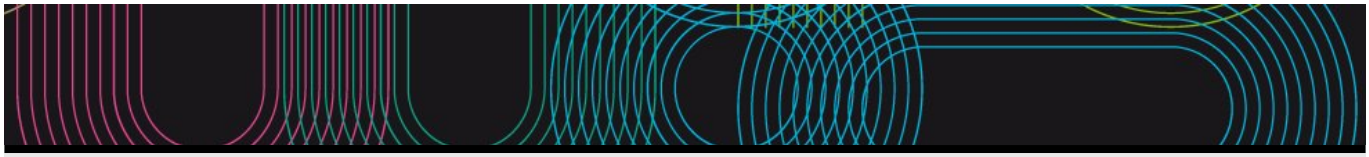

IDENTIFYING DATA				
Mathematical Models for the Environment				
Subject	Mathematical Models for the Environment			
Code	V05M135V01205			
Study programme	Máster Universitario en Matemática Industrial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Durany Castrillo, José			
Lecturers	Busto Ulloa, Saray Durany Castrillo, José Rodríguez Seijo, José Manuel			
E-mail	duranypp@uvigo.es			
Web	http://www.m2i.es/docs/modulos/MESimNumerica/MBasica/5.%20Modelos%20matematicos%20en%20medio%20ambiente.pdf			
General description	This course in focused on the mathematical modelling of environmental processes, including species dynamics and pollution models.			

Training and Learning Results	
Code	
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
C1	(*)Alcanzar un conocimiento básico en un área de Ingeniería/Ciencias Aplicadas, como punto de partida para un adecuado modelado matemático, tanto en contextos bien establecidos como en entornos nuevos o poco conocidos dentro de contextos más amplios y multidisciplinares.
C4	(*)Ser capaz de seleccionar un conjunto de técnicas numéricas, lenguajes y herramientas informáticas, adecuadas para resolver un modelo matemático.
C7	(*)Saber modelar elementos y sistemas complejos o en campos poco establecidos, que conduzcan a problemas bien planteados/formulados.

Expected results from this subject	Training and Learning Results
Know the distinct mathematical models for environmental problems.	C1
Achieve formulate any concrete real problems how problems of control.	C7
Apply correctly the methods to resolve several examples.	C4
Making decisions: having to decide the method to use more convenient to resolve the problem like this as the suitable tools, inside the possible ones, for his presentation.	C4
Use of computers: as a tool of indispensable use to realize the numerical calculations correspondents to the models that study in the subject.	C4
Orientation to the attainment: developing and cultivating the enthusiasm when having achieved the full resolution of the entrusted problems.	B5

Contents
Topic

1. Introduction.	1.1. Role and stages of mathematical modeling. 1.2. Mathematical modeling. 1.3. Numerical simulation. 1.4. Types of models.
2. First steps: modeling of biological populations.	2.1. Models of single species dynamics. 2.2. Models of two species dynamics (competition, mutualism, commensalism, predator-prey, migration...) 2.3. Age-Structured Models of Population Dynamics.
3. Geophysical flows.	3.1. Introduction. 3.2. Transport-diffusion models. 3.3. Shallow water models. 3.4. Adsorption and sedimentation. 3.5. Dispersive flows models. 3.6. Unidimensional models for rivers and channels. 3.7. Pollution. 3.8. GPR model.
4. Transport and diffusion models. Pollution.	4.1. Transport and diffusion. 4.2. Phenomena involved in the study of pollution. 4.3. Some problems of control of the spread of contamination.
5. Models for shallow waters: the Saint-Venant equations.	5.1. Gravitational flow with free surface. 5.2. Shallow water equations. 5.3. Erosion and sedimentation.
6. Water pollution.	6.1. Adsorption and absorption. 6.2. Simplified pollution models.
7. Alternative models for shallow waters.	7.1. Models for dispersive flows. 7.2. Multilayer models.
8. Other models with applications in the environment.	8.1. Models for subsurface waters. Richards equation. 8.2. GPR model for continuum mechanics.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	45	90	135
Problem solving	3	6	9
Problem and/or exercise solving	1	2	3
Essay questions exam	1	2	3
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies

	Description
Lecturing	Presentation of the main theoretical contents of the subject.
Problem solving	Solution of problems and brief introduction to further methods extending the content of lectures from a practical point of view. Small exercises will be proposed to the students aiming at applying the knowledge acquired.

Personalized assistance

Methodologies	Description
Lecturing	The professor will personally attend the doubts and queries of the students both online (videoconference system and moodle) or onsite (during lessons or tutorials).
Problem solving	The professor will personally attend the doubts and queries of the students both online (videoconference system and moodle) or onsite (during lessons or tutorials).

Assessment

	Description	Qualification	Training and Learning Results
Problem and/or exercise solving	Evaluated throught: a) Assistance and active participation at lessons. b) Development of exercises to be proposed by the professor during lessons.	50	C1 C4 C7
Essay questions exam	Final examination of the subject.	50	C1 C4 C7

Other comments on the Evaluation

Sources of information

Basic Bibliography

C.R. Hadlock, **Mathematical modeling in the environment**, Mathematical Association of America, 1998

N. Hritonenko Y. Yatsenko, **Mathematical modeling in economics, ecology and the environment**, Kluwer Academic Publishers, 2013

J. Pedlosky, **Geophysical fluid dynamics**, Springer Verlag, 1987

Complementary Bibliography

S.C. Chapra, **Surface water-quality modelling**, WCB/McGraw Hill, 1997

P.L. Lions, **Mathematical topics in fluid mechanics. Vol. 2: Compressible models**, Clarendon Press, 2013

G.I. Marchuk, **Mathematical models in environmental problems**, North-Holland, 1986

J.C. Nihoul, **Modelling of marine systems**, Elsevier, 1975

L. Tartar, **An introduction to Navier-Stokes equation and oceanography**, Springer Verlag, 2006

R.K. Zeytounian, **Meteorological fluid dynamics**, Springer Verlag, 1991

Recommendations

Subjects that continue the syllabus

Professional Software in Environment/V05M135V01216

Subjects that are recommended to be taken simultaneously

Advances in Finite Volumes/V05M135V01219

Subjects that it is recommended to have taken before

Partial Differential Equations/V05M135V01103
Mechanics of Continuous Media/V05M135V01105
Optimisation and Control/V05M135V01106

Other comments

It is recommended:
1. Assistance and active participation at lessons.
2. Weekly study.