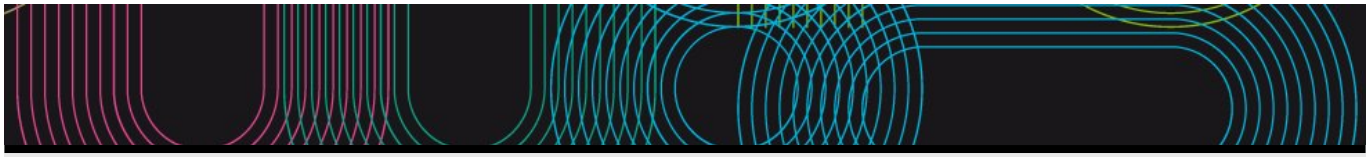

| IDENTIFYING DATA | | | | |
|---|---|---|---|---|
| **Mathematical Models for the Environment** | | | | |
| Subject | Mathematical Models for the Environment | | | |
| Code | V05M135V01205 | | | |
| Study programme | University Master's Degree in Industrial Mathematics | | | |
| Descriptors | ECTS Credits | Choose | Year | Quadmester |
| | 6 | Optional | 1st | 2nd |
| Teaching language | Spanish | | | |
| Department | | | | |
| Coordinator | Álvarez Vázquez, Lino José | | | |
| Lecturers | Álvarez Vázquez, Lino José<br>Fernández Varela, Miguel Ángel | | | |
| E-mail | lino@dma.uvigo.es | | | |
| Web | http://www.m2i.es/docs/modulos/ModelosMedioAmbiente.pdf | | | |
| General description | The objective of the course is aimed to the student in the application of mathematical methods for modeling different problems related to environment, having special interest in the models related to the pollution of water. | | | |

| Competencies | |
|---|---|
| Code | |
| 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 |
| 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. |

| Learning outcomes | |
|---|---|
| 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 |
| Verbal communication and writing: when having to explain and present reports written correspondents to some of the exercises to realize in the Laboratory. | B4 |
| Orientation to the attainment: developing and cultivating the enthusiasm when having achieved the full resolution of the entrusted problems. | B5 |

**Contents**

| Topic | |
|---|---|
| Subject 1. Introduction. | 1.1. The paper of the mathematical models in the environmental sciences.<br>1.2. Analysis/control of environmental problems.<br>1.3. Election of the mathematical tools. |
| Subject 2. The first steps: Models of biological communities. | 2.1. Communities of a species.<br>2.2. Communities of two species (competition, symbiosis, commensalism, prey and predator, migrations...)<br>2.3. Distribution of ages in populations. |
| Subject 3. Models of propagation of the pollution. | 3.1. Mathematical models related to the aerial media.<br>3.1.1. Basic notions.<br>3.1.2. Models of transport and diffusion.<br>3.2. Mathematical models related to the aquatic media.<br>3.2.1. Classification of models.<br>3.2.2. General models of adsorption and sedimentation.<br>3.2.3. Three-dimensional models.<br>3.2.4. Two-dimensional models for shallow waters.<br>3.2.5. One-dimensional models for rivers and channels.<br>3.2.6. Zero-dimensional models. |
| Subject 4. Control of environmental processes. | 4.1. Formulations.<br>4.2. Realistic examples. |

## Planning

| | Class hours | Hours outside the classroom | Total hours |
|---|---|---|---|
| Master Session | 45 | 90 | 135 |
| Troubleshooting and / or exercises | 3 | 6 | 9 |
| Troubleshooting and / or exercises | 1 | 2 | 3 |
| Long answer tests and development | 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 |
|---|---|
| Master Session | The professor will expose in this type of kinds the theoretical contents of the subject. |
| Troubleshooting and / or exercises | In these hours of work the professor will resolve problems of each of the subjects and will enter new methods of resolution no contents in the master sessions from a practical point of view. The student also will owe to resolve problems proposed pole professor with the objective to apply the knowledges purchased. |

## Personalized attention

| Methodologies | Description |
|---|---|
| Master Session | The professor will attend personally the doubts and queries of the students. Will attend doubts so much of direct form, especially in the classes of problems and laboratories, as of indirect form by means of the platform Faitic. |
| Troubleshooting and / or exercises | The professor will attend personally the doubts and queries of the students. Will attend doubts so much of direct form, especially in the classes of problems and laboratories, as of indirect form by means of the platform Faitic. |

## Assessment

| | Description | Qualification | Training and Learning Results |
|---|---|---|---|
| Troubleshooting and / or exercises | In this point will value two aspects:<br><br>a) Assistance and active participation in the classess (25 % of the qualification).<br><br>b) Individual theoretical exercises: Small exercises that the professor will go mandating along the development of the contained in the hours of classroom (25 % of the qualification). | 50 | C1<br>C4<br>C7 |
| Long answer tests and development | Final examination of the subject. | 50 | C1<br>C4<br>C7 |

## Other comments on the Evaluation

## Sources of information

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

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

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

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, Partial differential equation models in oceanography, Carnegie Mellon Univ., 1999
- R.K. Zeytounian, Meteorological fluid dynamics, Springer Verlag, 1991

## Recommendations

### Subjects that continue the syllabus

Professional Software in Environment/V05M135V01216

### 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 to the students:
1. The assistance to the classes.
2. A level of minimum weekly study.
3. The active participation in the classes.