

## SUBJECT TEACHING GUIDE

### G102 - Workshop on Modelling

#### Double Degree in Physics and Mathematics

#### Degree in Mathematics

#### Degree in Mathematics

Academic year 2023-2024

#### 1. IDENTIFYING DATA

Degree	Double Degree in Physics and Mathematics Degree in Mathematics			Type and Year	Compulsory. Year 4 Compulsory. Year 3
Faculty	Faculty of Sciences				
Discipline	Subject Area: Modelling Module: Compulsory Subjects				
Course unit title and code	G102 - Workshop on Modelling				
Number of ECTS credits allocated	6	Term	Semester based (2)		
Web	<a href="https://moodle.unican.es/course/info.php?id=12308&amp;lang=es">https://moodle.unican.es/course/info.php?id=12308&amp;lang=es</a>				
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. MATEMATICAS, ESTADISTICA Y COMPUTACION
Name of lecturer	JUAN ANTONIO CUESTA ALBERTOS
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Other lecturers	FRANCISCO SANTOS LEAL DIANA STAN

#### 3.1 LEARNING OUTCOMES

- 1) Students will know the interest of differential equations in order to obtain models in Biology and Health Science .
- 2) Students will use theoretical and numerical results in order to obtain useful information from differential equation models .
- 3) Students will understand the differences between geometrical design using Bézier curves and the notions of approximation and interpolation.
- 4) Students will use Bézier curves and B-splines to geometric aided computer design.
- 5) Students will know statistical simulation in order to evaluate proposals and to understand phenomena in real life.
- 6) Students will be able to do criticisms about hypothesis in simulation and modelization.

#### 4. OBJECTIVES

- 1) Use different mathematical models of several types (deterministic/stochastic, finite/infinite-dimensional, etc) to have a good approximation of real problems.
- 2) Distinguish the most accurate model to study a problem.
- 3) Find or define a new model when the usual models are not accurate to study a problem.
- 4) Obtain results of with models and compare them with real data.
- 5) Use mathematical software to obtain numerical outputs.
- 6) Be able to show the main characteristics and limitations of the used model to a wide audience.

#### 6. COURSE ORGANIZATION

CONTENTS	
1	Simple differential equation models related with population dynamics, in Biology and Health Science.
2	Bernstein polynomials. Baricentric combinations. Bézier curves and de Casteljau's algorithm. B-splines. Applications to geometric aided computer design.
3	Simulation of random phenomena. Random number generation. Validation of statistical models. Applications to problems in real life.

#### 7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
An individual work about Differential Equations.	Work	Yes	Yes	33,33
An individual work about Bézier curves.	Work	Yes	Yes	33,33
An individual work about simulation of random phenomena.	Work	Yes	Yes	33,34
TOTAL				100,00
Observations				
<p>Each student will have to do three written works of a bibliographic and/or computational nature (one on each thematic block). These works will be carried out in groups whose composition will depend on the number of students enrolled in the course. The works will be delivered in a written pdf version and will also be presented orally to the teachers of the course and all the students invited on each date. The dates of the exhibitions will be announced in due course.</p> <p>The overall grade may be increased by up to 10% for active participation during classes.</p> <p>The student passes the subject when the weighted average of the marks is over 5 (where the weights appear in the column "%"), having 4/10 or more in each individual work.</p> <p>The extraordinary exam, if necessary, is about the failed work(s).</p>				
Observations for part-time students				
<p>In each thematic block, the teacher will propose one or more practices whose completion and delivery will be compulsory for the qualification. The explanation of these practices will require the presence of the student. In addition, each student will have to write three bibliographic and/or computational works (one on each thematic block) and will have to present them in class. Students who are unable to attend regular classes may present them to the teacher who has followed them.</p> <p>If you are a part-time student, the assessments are similar.</p>				

## 8. BIBLIOGRAPHY AND TEACHING MATERIALS

### BASIC

R. B. Banks, "Growth and Diffusion Phenomena", Springer-Verlag, 1994.

N. M. Patrikalakis, T. Maekawa, "Shape interrogation for computer aided design and manufacturing", Springer-Verlag, 2010.

J. A. Cuesta Albertos. "Simulación de fenómenos aleatorios". Universidad de Cantabria, 2018.