

**1. General information****Course:** NONLINEAR ANALYSIS AND DIFFERENTIAL EQUATIONS**Type:** ELECTIVE**Degree:** 2351 - MASTER DEGREE PROGRAMME IN PHYSICS AND MATHEMATICS-FISYMAT**Center:** 602 - E.T.S. INDUSTRIAL ENGINEERING OF C. REAL**Year:** 1**Main language:** Spanish**Use of additional languages:****Web site:****Code:** 310938**ECTS credits:** 6**Academic year:** 2020-21**Group(s):** 20**Duration:** C2**Second language:** English**English Friendly:** Y**Bilingual:** N**Lecturer:** JOSE CARLOS BELLIDO GUERRERO - Group(s): 20

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2. Pre-Requisites

Previous knowledge of multivariable calculus, linear algebra, and ordinary and partial differential equations is required

3. Justification in the curriculum, relation to other subjects and to the profession

This course pretends to be a first contact to the field of optimization through mathematical programming, calculus of variations and optimal control. It will be of great help not only for students with mathematical background but also for physicians and engineers interested in modeling some problems as optimization ones.

4. Degree competences achieved in this course**Course competences**

Code	Description
CB06	Possess and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context.
CB07	Apply the achieved knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to the area of study
CB08	Be able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of knowledge and judgments
CB09	Know how to communicate the conclusions and their supported knowledge and ultimate reasons to specialized and non-specialized audiences in a clear and unambiguous way
CB10	Have the learning skills which allow to continue studying in a self-directed or autonomous way
CE03	Have the ability to build and develop advanced mathematical reasoning, and delve into the different fields of mathematics
CG05	Gain the ability to develop a scientific research work independently and in its entirety. Be able to search and assimilate scientific literature, formulate hypotheses, raise and develop problems and draw conclusions from the obtained results
CT03	Develop critical reasoning and the ability to criticize and self-criticize

5. Objectives or Learning Outcomes**Course learning outcomes****Description**

Become familiar with the different techniques of Nonlinear Analysis

Be able to apply the acquired knowledge to treat different non-linear differential equations

To conceive the need for weak derivation in the environment of Sobolev spaces

6. Units / Contents**Unit 1: Linear programming****Unit 2: Non-linear programming****Unit 3: Calculus of Variations****Unit 4: Optimal control****Unit 5: Variational methods for non-linear analysis****7. Activities, Units/Modules and Methodology**

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures		3	75	N	-	
Writing of reports or projects [OFF-SITE]	Assessment tests		3	75	Y	Y	
Total:			6	150			
Total credits of in-class work: 3			Total class time hours: 75				
Total credits of out of class work: 3			Total hours of out of class work: 75				

As: Assessable training activity

Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System			
Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Progress Tests	15.00%	15.00%	Regular tests
Assessment of problem solving and/or case studies	15.00%	15.00%	Exercises to support the main concepts
Theoretical papers assessment	70.00%	70.00%	Oral presentation of a case study
Total:	100.00%	100.00%	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences).

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours
Writing of reports or projects [AUTÓNOMA][Assessment tests]	75
Unit 1 (de 5): Linear programming	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	15
Unit 2 (de 5): Non-linear programming	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	15
Unit 3 (de 5): Calculus of Variations	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	15
Unit 4 (de 5): Optimal control	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	15
Unit 5 (de 5): Variational methods for non-linear analysis	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	15
Global activity	
Activities	hours
Writing of reports or projects [AUTÓNOMA][Assessment tests]	75
Class Attendance (theory) [PRESENCIAL][Lectures]	75
Total horas: 150	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
Pablo Pedregal	Introduction to Optimization	Springer		0-387-40398-1	2004	