Deusto
Deusto International Research School

Title of the course

- **230503 Modelling and simulation for problem solving in Engineering**

Organizing center / area leading the course

Deusto International Research School (DIRS) – PhD program in Engineering for the Information Society and Sustainable Development

Training category

AF7. Methodology and research techniques

Professor / Coordinator of the training course

Coordinator: Pablo Garaizar Sagarminaga

Professors: Jon García Barruetabeña, Borja Sanz, Iker Pastor

Priority group

2nd year PhD students, but it can be taken by 1st and 3rd year students too

Competences

SPECIFIC COMPETENCE SC1. To develop, correlate and to simulate engineering problems by means of numerical or analytical modeling.

SPECIFIC COMPETENCE SC2. To develop, correlate and to simulate engineering problems by means of statistical modeling.

SPECIFIC COMPETENCE SC3. To develop, correlate and to simulate engineering problems by means of artificial intelligent modeling.

SPECIFIC COMPETENCE SC4: Understand and apply machine learning techniques to model complex systems and human behaviour

Pre-requisites / prior knowledge

Basic statistical and mathematical knowledge.

Contents

Unit 1. Numerical & Analytical modeling (9 hours – Jon García Barruetabeña). Linear and nonlinear systems of equation, Curve fitting and Interpolation, Numerical Integration and Differentiation, ODE - Initial value Problems, ODE - Boundary Value Problems.

Unit 2. Statistical modeling (6 hours - Josu Najera-Zuloaga) Probability distributions, simulation and estimation methods in R. Statistical modelling in regression framework: linear and generalized linear models, generalized additive models and mixed-effects models.

Unit 3. Artificial Intelligent modeling (6 hours - Borja Sanz/Iker Pastor) Artificial intelligence to model systems and behaviour. How to model industrial process and their applications. Digital Twin. Creating models to simulate different aspects of human behaviour modelling. Chatbots.

Level of the course

Intermediate

Methodology

Next, the methods and techniques used during the course are summarized and the research strategy is defined:

- *Lecture.* The lecturer presents the contents of the course in a detailed and organized manner, within the lecture room. The contents, available during the lectures, will be made available in advance to the students (as slides) and classified by units.
- *Practical cases*: exposition, analysis and sharing of practical cases
- *Individual work.* The students will carry out a set of guided practical activities associated to the course units.

Language of instruction

English

Mode of instruction

In-class

Number of places

PhD students: 24

Personnel: 10

Assessment

Be able to apply the techniques demonstrated in the module to a given exercise proposed by each lecturer at the end of their module

Number of hours

21 hours

Bilbao Campus

- Month when the course begins: April 2024
- Dates:
    - Monday, 22 April 2024 (15:00-18:00)
    - Tuesday, 23 April 2024 (15:00-18:00)
    - Wednesday, 24 April 2024 (15:00-18:00)
    - Thursday, 25 April 2024 (15:00-18:00)
    - Monday, 29 April 2024 (15:00-18:00)
    - Tuesday, 30 April 2024 (15:00-18:00)
    - Thursday, 2 May 2024 (15:00-18:00)