VNIVERSITAT DE VALÈNCIA

Course Guide
45004 Monitorización y procesado de datos ambientales

COURSE DATA

Data Subject	
Code	45004
Name	Monitorización y procesado de datos ambientales
Cycle	Master's degree
ECTS Credits	4.5
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
2250 - M.D. in Environmental Engineering	School of Engineering	1	Second term

Subject-matter

Degree	Subject-matter	Character
2250 - M.D. in Environmental Engineering	19 - Monitorización y procesado de datos ambientales	Obligatory

Coordination

Name	Department
SECO TORRECILLAS, AURORA	245 - Chemical Engineering

SUMMARY

The subject of Monitoring and Processing of Environmental Data is a compulsory subject of 4.5 credits that is taught throughout the second semester of the first year of the "Master in Environmental Engineering".

With a very practical approach, this subject aims to provide the necessary training to be able to objectively and consistently analyze the available data of an environmental system or an environmental facility to support decision-making and actions based on the information contained in the data.

Technological advances in data measurement, acquisition and storage equipment have resulted in vast amounts of data being available from both environmental systems and environmental facilities. The large amount of data available in many contexts means that we are fully in the era of Big Data. In this subject powerful techniques that are very efficient for the analysis of thousands and even millions of data will be explained and applied, and that allow the extraction of relevant information, greatly facilitating the analysis and visual interpretation of the data.

The extraction of the relevant information contained in the data to improve decision-making and management can be useful for each and every one of the sustainable development objectives (it allows monitoring compliance with discharge limits, tracking deforestation, mapping and predict the spread of infectious diseases, help reduce traffic congestion and associated pollution ...).

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

OUTCOMES

2250 - M.D. in Environmental Engineering

- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Work in a team effectively and with leadership, in a collaborative and inclusive environment, setting goals, planning tasks and meeting objectives.
- Conduct appropriate experimentation, analyse and interpret data and use environmental engineering knowledge to draw conclusions.
- Learn and apply new knowledge, using appropriate learning strategies.
- Develop and apply mathematical models for the simulation, optimisation or control of processes in the field of environmental engineering.

- Apply data mining techniques to extract the relevant information contained in huge databases (Big Data) to facilitate its analysis and visual interpretation.

LEARNING OUTCOMES

1. Being able to objectively and consistently analyze the available data of an environmental system in order to make decisions and actions based on the information contained in the data.

2. Know and be able to apply different data processing techniques as tools for analyzing and interpreting them to help decision-making in the field of environmental engineering.

3. Know the problem of analyzing large-dimension data matrices, with the presence of missing values, with strong multicollinearity between the variables or even with more variables than observations.

4. Know various multivariate projection techniques capable of analyzing this type of large-dimension data matrices: principal component analysis, principal component regression and partial least squares regression.

5. Be able to select and apply the most appropriate data analysis technique depending on the type of problem to be solved: compress vs. classify vs. predict; as well as interpreting the results obtained

6. Use specialized data analysis software with ease.

7. Know and be able to use various data analysis techniques from the field of artificial intelligence - neural networks: multilayer perceptron and self-organizing maps.

8. Know and understand the fundamentals of process monitoring and be able to apply different techniques to monitor the evolution of a process or an environmental system.

9. Know, understand and use their own language and the specific terminology used in the field of data processing and analysis.

DESCRIPTION OF CONTENTS

1. Introduction to the processing and analysis of environmental data

2. Obtaining information and basic data analysis

3. Process monitoring

4. Projection techniques on latent structures

5. Other advanced techniques

WORKLOAD

ACTIVITY	Hours	% To be attended
Classroom practices	22,00	100
Theory classes	20,00	100
Theoretical and practical classes	3,00	100
Development of group work	20,00	0
Study and independent work	15,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	10,00	0
Preparation of practical classes and problem	12,50	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

The training activities will be developed according to the following distribution:

• Theoretical activities.

Description: In the theoretical classes the topics will be developed providing a global and integrating vision, analyzing in greater detail the key aspects and of greater complexity, promoting, at all times, the participation of the student.

• Practical activities.

Description: They complement the theoretical activities in order to apply the basic concepts and expand them with the knowledge and experience that they acquire during the realization of the proposed works. They include the following types of face-to-face activities:

- Classes of problems, questions in the classroom and resolution of practical cases
- Discussion sessions and problem solving and exercises previously worked by the students
- Laboratory practices Visits to water treatment facilities
- Conferences and seminars

- Programmed tutoring (individualized or in groups)

- Realization of individual evaluation questionnaires in the classroom with the presence of the teacher.

• Student's personal work.

Description: Realization (outside the classroom) of monographic works, directed bibliographic search, issues and problems, as well as the preparation of classes and exams (study). This task will be carried out individually and tries to promote autonomous work.

• Work in small groups.

Description: Realization, by small groups of students (2-4) of work, issues, problems outside the classroom. This task complements the individual work and fosters the capacity for integration in work groups.

The e-learning platform (Virtual Classroom of the Universitat de València and / or PoliformaT of the Polytechnic University of Valencia) will be used as a communication support with the students. Through it you will have access to the didactic material used in class, as well as the problems and exercises to solve.

EVALUATION

The evaluation of the subject will be carried out as follows:

- A written exam that can include both theoretical questions and the resolution of numerical exercises. It will be valued with 30% of the final grade (minimum grade 4).

- Evaluation of practical activities: It will be carried out from the evaluation of the corresponding reports made throughout the semester. It will be valued with 60% of the final grade (minimum grade 4).

- Observation of classroom work throughout the semester: based on attendance, it will regulate face-to-face classes, participation and degree of involvement of the student in the teaching-learning process. It will be valued with 10% of the final grade.

The final grade for the course will be obtained by weighing the grades obtained in each of the parts described above. To pass the course, it is necessary to obtain an average grade greater than or equal to 5. For those students who do not pass the course, a final recovery test will be carried out.

The intentional fraud in an evaluation act implies the qualification of this with zero points, without prejudice to the disciplinary measures that could be derived.

Name	Description	Quantity	Weight
Open-response	test Timed test, carried out under control, in which the student	1	30,00%

written test	constructs his answer. You may or may not be granted the right to consult supporting material.		
Academic work	work Development of a project that can range from short and simple assignments to extensive and complex assignments typical of final courses and doctoral theses.	2	60,00%
Observation	Strategy based on the systematic collection of data in the learning context itself: execution of tasks, practices ...	1	10,00%

Activity	Maximum absence	Observations
Classroom Theory	20%	
Classroom Practice	20%	

REFERENCES

Basic

- Análisis de datos experimentales (Soria Olivas, Emilio | Martín Guerrero, José David| Aguado García, Daniel | Serrano López, Antonio José)
  Quimiometría (Ramis Ramos, Guillermo)
  Minería de datos : técnicas y herramientas (Pérez López, César)
  Regresio¿n y disen¿o de experimentos (Peña, Daniel)
  Ciencia de datos : técnicas analíticas y aprendizaje estadístico : en un enfoquepráctico (García Herrero, Jesús - Molina López, José Manuel - Berlanga de Jesús,Antonio - Patricio Guisado, Miguel Ángel - Luis Bustamante, Álvaro - Padilla,Washington R)
  Applied multivariate statistical analysis (Johnson, Richard A.)
  Introducción al big data (Aldana Montes, José Francisco | Baldominos Gómez,Alejandro | García Nieto, José Manuel | Gonzálvez Cabañas, Juan Carlos | MochónMorcillo, Francisco | Navas Delgado, Ismael)
  Assessment of treatment plant performance and water quality data : a guide forstudents, researchers and practitioners (Sperling, Marcos)

Introduction to statistical quality control (Montgomery, Douglas C.)