

**COURSE DATA****DATA SUBJECT**

**Code:** 43811  
**Name:** Management of contaminated soils and sediments  
**Cycle:** Master's Degree  
**ECTS Credits:** 6  
**Academic year:** 2025-26

**STUDY (S)**

Degree	Center	Acad. year	Period
2250 - Master's Degree in Environmental Engineering	Escola Tècnica Superior d'Enginyeria	1	Second quarter

**SUBJECT-MATTER**

Degree	Subject-matter	Character
2250 - Master's Degree in Environmental Engineering	Gestión de suelos y sedimentos contaminados	COMPULSORY

**COORDINATION**

RIBES BERTOMEU JOSEP

**SUMMARY**

Professors UPV: María Pachés Giner

"Management of contaminated soils and sediments" is an obligatory subject which is imparted during the second semester of the Master in Environmental Engineering. This subject is divided in two main parts according to the media where pollutants are located: soils and sediments.

In the first part, about "contaminated soils management", the student will acquire basic knowledge about contaminated soils concerns and the problems related to groundwater pollution. General aspects about contaminated soils formation, degradation, contamination and characterization are studied, including the establishment of quality criteria based on environmental risks assessment. Finally, the study of the treatment systems for contaminated soils and contaminated groundwater is studied in depth, carrying out practical cases of basic design of treatment facilities.



In the second part, about "sediments management" it is intended that the student acquires the basic knowledge about the problems of pollution of sediments in the natural environment and deepens in the mathematical modelling of the processes in the sediments and the exchange with the water column.

This part of the subject is considered as an extension of the subject "Transport of pollutants in the environment", with which it shares an approach based on the development and application of mathematical models, being in this case water-sediment interaction.

When taking this subject, the student will use the basic knowledge acquired in the subjects "Assessment of environmental quality" and "Transport of pollutants in the environment", mainly in their part related to soil, groundwater and sediments.

The environmental engineering professional must respond to the various problems of environmental degradation that occur today. Among these problems, the degradation and contamination of soils and sediments represents an environmental threat that needs to be addressed. This subject provides the necessary knowledge for the analysis and diagnosis of soil and sediment contamination, as well as the analysis of environmental risks.

It is highly related to the following master's subjects: Environmental Quality Assessment, Waste Management and Treatment, and Transport of Pollutants in the Natural Environment.

## PREVIOUS KNOWLEDGE

### RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

### OTHER REQUIREMENTS

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

It is advisable to have knowledge on the following subjects:

Assessment of environmental quality.

Transport of pollutants in the environment.

## COMPETENCES / LEARNING OUTCOMES

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Apply environmental engineering designs to produce solutions that meet specific needs addressing public health, safety and welfare taking account of global, cultural, social, environmental and economic factors.

Apply tools for environmental assessment and management including environmental impact assessment



and environmental risk assessment.

Carry out a comprehensive assessment of environmental soil quality.

Characterise emissions to land.

Develop and apply mathematical models for the simulation, optimisation or control of processes in the field of environmental engineering.

Develop environmental solutions under the principles of circular economy and the sustainable development goals.

Identify, formulate and solve complex environmental engineering problems by applying engineering, scientific and mathematical principles.

Implement measures for preventing pollution and recovering, protecting and improving environmental quality.

Interpret and apply national and international environmental legislation and adapt environmental solutions to these regulations.

Manage and operate treatment and/or purification systems in the field of environmental engineering

Recognise the ethical and professional responsibilities of environmental engineering and make informed judgements considering the impact of engineering solutions in global, economic, environmental and social contexts.

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.

## DESCRIPTION OF CONTENTS



## **1. Action in contaminated soils: Investigation of soil contamination.**

Unit 1. Introduction. Sources of contamination of soil and groundwater. Types of contaminants present in the soil. Pollution mechanisms. Ground contaminant interactions. Transformation of pollutants.

Unit 2. Legal framework. Potentially polluting activities of the soil. Establishment of quality criteria of a soil. Action protocols in contaminated soils.

Unit 3.- Exploration of contaminated soils: Sampling and characterization of the site

Unit 4.- Quantitative risk analysis. Application of predictive tools: modelling the contamination of soil and groundwater

## **2. Systems for the treatment and recovery of contaminated soils.**

Unit 5.- Confinement and containment techniques: barriers; in-situ vitrification; stabilization-solidification.

Unit 6.- Thermal treatments: Thermal desorption.

Unit 7.- Pollution extraction techniques: steam extraction; soil washing in-situ and Ex-situ; solvent extraction; pumping and treat systems for groundwater.

Unit 8.- Elimination of pollutants in the soil I: Chemical oxidation; dehalogenation; electrochemical treatments; permeable reactive barriers.

Unit 9.- Elimination of pollutants in the soil II: Biological treatments (bioremediation and phytoremediation). Natural attenuation of contaminated soil.

Unit 10.- Classification of treatment systems. Evaluation and selection of alternatives.

Combination of treatment technologies. Technical and economic considerations

## **3. Examples of recovery projects: Case studies.**

Unit 11. Recovery of old landfills. Recovery of soils contaminated by accidental discharges.

Recovery of brownfields. Recovery in mining activities. Treatment of soils affected by oil slicks.

## **4. Introduction. Properties of sediments.**

**Sediment transport Equations of the mass balance. Dissemination processes.**

**Basic schemes of sediment modelling.**

Unit 12.- Legislative framework in sediment contamination. Implications of sediments in water quality. Management problem. Sampling techniques and sample conservation.

Unit 13.- Characterization of the sediments: granulometry, humidity, density, porosity, organic matter. Transport and sedimentation of suspended solids.

Unit 14.- Approaches to the modelling of oxygen flow, nutrients: constant flow in steady state, two-layer models, approximations in transient states.

## **5. Oxygen: oxygen demand from sediments, sulphides and methane.**

Unit 15.- Modelling of the transformation of organic matter in sediment. Aerobic and anoxic layer.

Unit 16.- Modelling of anoxic processes in the sediment. The role of sulphides. Methane production. Oxygen demand models.



## 6. Nutrients: ammonium, nitrates and phosphorus

Unit 17.- Modelling the flow of ammonia and nitrates.

Unit 18.- Phosphorus flow modelling.

## 7. Extraction and management of sediments

Unit 19.- Sediment extraction: usual techniques, advanced techniques. Subsequent management: applicable regulations.

### WORKLOAD

#### PRESENCIAL ACTIVITIES

Activity	Hours
Theory	25,00
Theoretical and practical classes	4,00
Group work	5,00
Computer classroom practice	10,00
Classroom practices	16,00
<b>Total hours</b>	<b>60,00</b>

#### NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	6,00
Individual or group project	30,00
Independent study and work	0,00
Preparation of lessons	34,00
Preparation for assessment activities	20,00
Resolution of case studies	0,00
<b>Total hours</b>	<b>90,00</b>

### 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,



analysing 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 students acquire during the realization of the proposed works. They include the following types of classroom activities:

- o Classes of problems and questions in the classroom.
- o sessions for discussion and solving problems previously worked by the students.
- o Computer practices for specific software management.
- o Oral presentations
- o Programmed tutoring (individualized or in groups)

· 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.

· Evaluation

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



The e-learning platform (Virtual Classroom of the Universitat de València and / or PoliformaT of the

Polytechnic University of Valencia) will be used as 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.

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## EVALUATION

The evaluation is unique and consists of five parts:

1 - Written open-ended test (questions to develop) and practical questions with a duration of 2 hours. It takes place on the day assigned in the exam calendar. The percentage of weight on the final grade is 40%. The minimum mark that must be obtained to average with the rest of the evaluation acts is 4. The number of questions and their assessment are weighted to the credits of each of the two parts of the subject: 75% soils, 25% sediments.

2. Objective written multiple choice test. Duration of 30 minutes. 10% of the final grade. It takes place on the day assigned in the exam calendar.

3. Academic group work related to a real case of management of contaminated soils. The percentage of weight on the final grade is 22.5%.

4. Resolution of an individual exercise on flows from the sediment. It is delivered before the completion of the final exam. The percentage of weight on the final grade is 12.5%.

5. A practical part based on the active participation of the students in the face-to-face activities and the problems carried out throughout the course. The percentage of weight on the final grade is 15%.

Those students who have not achieved the minimum mark required in the evaluation acts 1 and 2 will have a recovery exam of the same characteristics and for act 3 a new delivery of the work.

Copying or plagiarism of any activity that is part of the evaluation will result in the impossibility of passing the course, and the student will then be subject to the appropriate disciplinary procedures indicated in the ACTION PROTOCOL FOR FRAUDULENT PRACTICES AT THE UNIVERSITY OF VALENCIA ([ACGUV 123/2020](#))



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attendance requirements

Activity: Computer Practice - Maximum absence: 0% - Observations: Compulsory attendance

## REFERENCES

- **Básicas:**

A) Suelos:

- Lagrega M.D., Buckingham P.L., Evans J.C. Gestión de residuos tóxicos. Tratamiento, eliminación y recuperación de suelos. McGraw-Hill/Interamericana de España Madrid (1996).
- Mirsal I.A. Soil Pollution. Origin, Monitoring & Remediation. Springer-Verlag. Berlin Heidelberg (2004).
- Nyer Evan K. In situ treatment technology. Lewis Publishers (2001) Porta J., Lopez-Acevedo M., Roquero C. Edafología para la agricultura y el medio ambiente. Mundi-Prensa Madrid (2003).
- Suthersan Suthan S. Remediation engineering: design concepts. CRC-Lewis Publishers, (1997)
- Wong J., Lim C.H., Nolen G.L. Design of remediation systems. CRC/Lewis Publishers (1997)

B) Sedimentos:

- EPA (2001). Methods for Collection, Storage and Manipulation of Sediments for Chemical and Toxicological Analyses: Technical Manual. Office of Water and Technology. U.S. Environmental Protection Agency, Washington D.C. EPA-823-B-01-002.
- Chapra, S.C. (1997). Surface Water Quality Modelling. Mc-Graw Hill. New York.
- Di Toro, D. (2001). Sediment Flux Modeling. John Wiley & Sons, Inc., Wiley-Interscience. New York (USA).
- Erosion and sediment pollution control, Beasley, R.P.
- Programas de gestión de sedimentos contaminados : ejemplo de aplicación en el Estado de Washington (EE.UU.), Llanso, Roberto

**Complementarias:**

A) Suelos:

- Salomons W., Förstner U., Mader P. (Eds.). Heavy Metals. Problems and Solutions. Springer-Verlag Berlin Heidelberg (1995).
- Levin M., Gealt M.A. Biotratamiento de residuos tóxicos y peligrosos. McGraw-Hill/Interamericana de España Madrid (1997).
- Wise D.L., Trantolo D.J. Remediation of hazardous waste contaminated soils. Marcel



Dekker, New York (1994).

- Kobus H., Barczewski B., Koschitzky H.P. (Eds). Groundwater and Subsurface Remediation. Research Strategies for In-situ Technologies. Springer-Verlag Berlin Heidelberg (1996).
- Barrettino D., Loredó J., Pendás F. (eds.) Acidificación de suelos y aguas: problemas y soluciones Instituto Geológico y Minero de España Madrid (2005).

B) Sedimentos:

- EPA (2000). Bioaccumulation testing and interpretation for the purpose of sediment quality assessment. Status and needs. Office of Water. Office of Solid Waste.. U.S. Environmental Protection Agency, Washington D.C. EPA-823-R-00-001.