COURSE DATA

Data Subject	
Code	43811
Name	Management of contaminated soils and sediments
Cycle	Master's degree
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
2227 - Master's Degree in Environmental Engineering	School of Engineering	1	Second term
2250 - Master's Degree in Environmental Engineering	School of Engineering	1	Second term

Subject-matter

Degree	Subject-matter	Character
2227 - Master's Degree in Environmental Engineering	3 - Treatment of land, waste and air emissions	Obligatory
2250 - Master's Degree in Environmental Engineering	16 - Gestión de suelos y sedimentos contaminados	Obligatory

Coordination

Name	Department
RIBES BERTOMEU, JOSEP	245 - Chemical Engineering

SUMMARY

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 (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

2227 - Master's Degree 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.
- Identify and apply technologies, tools and techniques in the field of environmental engineering.
- Assume with responsibility and ethics the Environmental Engineer role in a professional context.
- Promote and apply the principles of sustainability.
- Adapt to changes, being able to apply the principles of Environmental Engineering to unknown cases and use new and advanced technologies and other relevant developments, with initiative and entrepreneurial spirit.
- Identify, declare and entirely analyze environmental problems.
- Assess the application of measures for the pollution prevention and the recovery, protection and improvement of environmental quality.
- Carry out theoretical analyzes of environmental systems, both natural and artificial, and develop and apply mathematical models for their simulation, optimization or control.
- Design and calculate engineering solutions to environmental problems, comparing and selecting technical alternatives and identifying emerging technologies.
- Understand and apply environmental national and international legislation, adapting environmental solutions to these regulations.

- Apply standard methodologies for the analysis and evaluation of environmental risks.
- Evaluate the environmental quality of soils from a global point of view, especially when there is a risk to public health..
- Be able to characterize the emissions to soils, coming from the anthropogenic activity.
- Evaluate the treatment of soils to assess different alternatives and obtain the required information for the design of the selected treatment processes.
- Design and manage treatment systems for contaminated soils.

2250 - Master's Degree 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.
- Identify, formulate and solve complex environmental engineering problems by applying engineering, scientific and mathematical principles.
- 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.
- 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.
- Work in a team effectively and with leadership, in a collaborative and inclusive environment, setting goals, planning tasks and meeting objectives.
- Carry out a comprehensive assessment of environmental soil quality.
- Characterise emissions to land.
- Implement measures for preventing pollution and recovering, protecting and improving environmental quality.
- Develop and apply mathematical models for the simulation, optimisation or control of processes in the field of environmental engineering.
- Manage and operate treatment and/or purification systems in the field of environmental engineering

- Interpret and apply national and international environmental legislation and adapt environmental solutions to these regulations.
- Apply tools for environmental assessment and management including environmental impact assessment and environmental risk assessment.
- Develop environmental solutions under the principles of circular economy and the sustainable development goals.

LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)

1 Be aware of the problem of contamination of soil and groundwater.

2 Design, plan and analyse the results of studies about contaminated sites characterisation.

3 Know and identify possible problems of soil contamination based on a historical study of the site.

4 Implement the risk analysis in the decision making about the management of contaminated sites, know the scope of the problem and establish the degree of need for intervention.

5 Know the existing physical, chemical and biological methods for the recovery of contaminated soils and sediments.

6 Know the main alternatives of action in contaminated soils and apply the most used recovery technologies.

7 Select the most appropriate technological alternatives among the possible confinement and/or treatment systems of soils, groundwater and contaminated sediments.

8 Identify the emerging technological solutions in the field of treatment and recovery of contaminated soils.

9 Design, implement and operate at a conceptual level the most used systems for the treatment of contaminated soils.

10 Know the main alternatives of action in the management of contaminated sediments.

11 Study and analyse examples of actions carried out for the recovery of soils and the management of contaminated sediments.

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

ACTIVITY	Hours	% To be attended
Theory classes	25,00	100
Classroom practices	16,00	100
Computer classroom practice	10,00	100
Group work	5,00	100
Theoretical and practical classes	4,00	100
Attendance at events and external activities	6,00	0
Development of group work	30,00	0
Preparation of evaluation activities	20,00	0
Preparing lectures	5,00	0
Preparation of practical classes and problem	29,00	0
TOTAL	**150,00**	

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.

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.

attendance requirements

Activity: Classroom Theory - Maximum absence: 20%
Activity: Computer Practice - Maximum absence: 0% - Observations: Compulsory attendance

REFERENCES

Basic

- - 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. Edafologia para la agricultura y el médio 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).

Additional

- 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., Loredo J., Pendás F. (eds.) Acidificación de suelos y aguas: problemas y soluciones Instituto Geológico y Minero de España Madrid (2005).
B) Sedimentos:
EPA (2000). Bioacumulation 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.