VNIVERSITAT DE VALÈNCIA

Course Guide
43806 Transport of pollutants in the environment

COURSE DATA

Data Subject	
Code	43806
Name	Transport of pollutants in the environment
Cycle	Master's degree
ECTS Credits	9.0
Academic year	2020 - 2021

Study (s)

Degree	Center	Acad. year	Period
2227 - M.U. en Ingeniería Ambiental	School of Engineering	1	First term
3132 - Chemical, Environmental and Process Engineering	Doctoral School	0	First term

Subject-matter

Degree	Subject-matter	Character
2227 - M.U. en Ingeniería Ambiental	1 - Fundamentals of environmental engineering	Obligatory
3132 - Chemical, Environmental and Process Engineering	1 - Complementos de Formación	Optional

Coordination

Name	Department
SECO TORRECILLAS, AURORA	245 - Chemical Engineering

SUMMARY

Proffessors UPV: Vicent B. Espert Alemany, Petra Amparo López Jiménez, Enrique Asensi Dasí, Eduardo Cassiraga

In general, the study of the environmental pollutant transport requires, on one hand, the knowledge of the fluid flow that constitutes the receiving system, and on the other hand, the transport of that pollutant by the movement of the receiving flow. Firstly, the general equations of the turbulent flow and the pollutant transport are solved and, from their solutions, particular formulations are derived when they are applied to the different receiving systems: atmosphere, surface water and groundwater.

These formulations are completed with the expressions defining the kinetics of the physical, chemical and biological processes that constitute sources and sinks of the substance studied, according to the system in which it has been discharged. Finally, the characteristics and possibilities of different commercial models of pollutant transport are discussed; this is intended to select those models that are considered the more representative ones in each receiving environment, with the aim of guiding the student in their possible future decisions.

Taking into account this scheme the content of the subject is divided into four modules, with the names:

Module 1. Fluid flow and pollutants transport

Module 2. Transport of pollutants in the atmosphere

Module 3. Transport of pollutants in surface water

Module 4. Transport of pollutants in groundwater

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

It is not necessary to take any Master subject simultaneously.
It is necessary to have previous knowledge of:
Mathematics (resolution of differential equations, resolution of non-linear equation systems)
Basic Fluid Mechanics
Basic Hydraulic

OUTCOMES

2172 - M.U. en Ingeniería Ambiental

- 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.
- 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.
- Apply standard methodologies for the analysis and evaluation of environmental risks.
- Evaluate the environmental quality of water from a global point of view, especially when there is a risk to public health.
- Evaluate the environmental quality of the air from a global point of view, especially when there is a risk to public health.
- Evaluate the environmental quality of soils from a global point of view, especially when there is a risk to public health..

LEARNING OUTCOMES

1 Recognize the phases of the realization and use of pollutant transport models

2 Recognize the systems susceptible to be polluted and their hydraulic characteristics

3 Know the terms of the pollutant transport equations discharged in fluid systems and identify them in the formulation of a simulation model

4 Identify mathematical problems linked to transport models and their possible solutions

5 Be able to find commercial transport models capable of simulating the pollution problems that are being studied

6 Be able to use pollutant transport models applied to different receiving systems

DESCRIPTION OF CONTENTS

1. Fluid flow and pollutants transport

1. Fundamentals of the mathematical modeling of the pollutant transport
2. Theoretical formulation of the hydrodynamic models
3. Theoretical formulation of transport models

2. Transport of pollutants in the atmosphere

1. The atmosphere as a receptor system for pollutants
2. Analytical solution of the transport equation in atmospheric environment
3. Regional wind model
4. Transport of atmospheric pollutants at regional scale

3. Transport of pollutants in surface water

1. Introduction and general concepts
2. General transport equation
3. Water quality models for dissolved oxygen
4. Models of eutrophication

4. Transport of pollutants in groundwater

1. Fundamentals of groundwater flow
2. Equation of groundwater flow in saturated porous medium
3. Equation of mass transport in saturated porous medium
4. The MODFLOW, MODPATH and MT3D codes

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	35,00	100
Computer classroom practice	30,00	100
Classroom practices	20,00	100
Theoretical and practical classes	5,00	100
Development of group work	30,00	0
Study and independent work	40,00	0
Preparation of evaluation activities	30,00	0
Preparation of practical classes and problem	10,00	0
Resolution of case studies	5,00	0
TOTAL	**205,00**	

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, 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 comprise the following types of face-to-face activities:

• Classes of problems and questions in the classroom

• Discussion and problem solving sessions and exercises previously worked by the students

• Laboratory practices

• Oral presentations

• 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 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 written tests consist of four independent open-ended tests, one for each module. Each test will take place at the end of the corresponding module, and will last between 45 and 60 minutes. Each test will cover the contents that have been seen in the corresponding module.

The written tests will be complemented with an academic work for each module, which can be about a topic related to the subject taught or focus on solving proposed cases in relation to the use of the computer programs worked on in the course development.

The final grade for the course will be a weighting of the marks obtained, out of 10, in the tests corresponding to each module. The weighting coefficients will be 0.20 for Fluid flow and transport of pollutants, 0.24 for Transport of pollutants in the atmospheric environment, 0.28 for Transport of pollutants in surface waters, and 0.28 for Transport of pollutants in groundwater.

To pass the course, the final grade must be equal to or greater than 5.0 points, with a minimum grade in each module of 3.5 points out of 10.

Students who have not passed the course may take a recovery exercise from written tests in which they have obtained less than 5.0 points out of 10.

Nombre	Descripción	N.Acts	Weigth (%)
Written test of open response	Timed test, carried out under control, in which the student constructs his answer. He can be granted or not the right to consult support material	4	70,00
Academic task	Development of a project that can range from short and simple works to extensive and complex works typical of the latest courses and doctoral theses.	4	30,00

Attending requirements:

Actividad	Ausencia máxima	Observaciones
Classroom theory	100%	Class attendance is recommended

Seminar theory	0%	
Classroom Practice	100%	Class attendance is recommended
Laboratory Practice	0%	
Computer Practice	100%	Class attendance is recommended
Field visit	0%	

REFERENCES

Basic

- Surface water-quality modeling(Chapra, Steven C) URL: https://polibuscador.upv.es/primo-explore/search?institution=UPV&query=any,contains,990001054410203706&vid=bibupv

  Dispersión de contaminantes en la atmósfera(Espert Alemany, Vicente | López Jiménez, Amparo | Universidad Politécnica de Valencia Departamento de Ingeniería Hidráulica y Medio Ambiente) URL: https://polibuscador.upv.es/primo-explore/search?institution=UPV&query=any,contains,990001427160203706&vid=bibupv

  Environmental modeling : fate and transport of pollutants in water, air and soil(Schnoor, Jerald L) URL: https://polibuscador.upv.es/primo-explore/search?institution=UPV&query=any,contains,990001237970203706&vid=bibupv

  Modelación de la calidad del agua a escala de cuenca(Andreu Álvarez, Joaquín | Martín Monerris, Miguel | Solera Solera, Abel | Paredes Arquiola, Javier) URL: https://polibuscador.upv.es/primo-explore/search?institution=UPV&query=any,contains,990002505810203706&vid=bibupv

Applied hydrogeology(Fetter, Charles W.)

Contaminant hydrogeology(Fetter, Charles W.; Boving, Thomas; Kreamer, David)

Applied groundwater modeling: Simulation of flow and advective transport(Anderson, Mary P.; Woessner, William W.; Hunt, Randall J.)

Applied contaminant transport modeling(Zeng, Chunmiao; Bennett, Gordon D.)

Additional

- Sun, N.-Z. (1996). Mathematical modeling of groundwater pollution, Springer.
  Zheng, Ch. y Bennett, G. D. (2002). Applied Contaminant Transport Modeling, segunda edición

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

Regarding the workload:

1.-The different activities described in the Teaching Guide are maintained with the planned dedication.

Regarding the temporary planning of teaching

1.- The material for the follow-up of the theory classes / classroom practices allows to continue with the temporary teaching planning both in days and hours (synchronous teaching).

Teaching methodology
In the theory and classroom practices classes will tend to the maximum possible attendance, always respecting the sanitary restrictions. Depending on the capacity of the classroom and the number of students enrolled, it may be necessary to distribute the students into two groups. In this case, the subject will be taught in classrooms with streaming teaching capacity, and there may be students attending online and in-class students.
A rotation system will be established once the actual enrollment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same.
Regarding computer practices, if the capacity and sanitary conditions allow it, the teaching will be face-to-face. Otherwise, they would be done online.
Once the actual enrollment data is available and the availability of spaces is known, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaptation to each subject, establishing in said model the specific conditions in which it will be developed teaching the subject.
If there is a closure of the facilities for sanitary reasons that totally or partially affects the classes of the

subject, these will be replaced by non-face-to-face sessions following the schedules established by synchronous video conferencing, or, if not possible, asynchronous.

Evaluation
The evaluation system described in the Teaching Guide of the subject in which the different evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained.