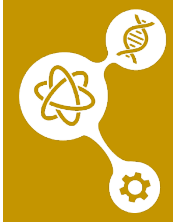
Academic year
2026/2027

Course Guide:

ENVIRONMENTAL ENGINEERING



FACULTY OF
CHEMICAL SCIENCES

1. IDENTIFICATION

Degree Programme	Bachelor's Degree in Chemical Engineering.			Course Code	801562
Course Name	Environmental Engineering			ECTS	6
Subject Area	Sustainability in Chemical Production				
Module	Chemical Technology				
Course Type	Optional	Year	Fourth Year	Semester	First Semester
Department	Chemical and Materials Engineering				

Teaching Staff

Activity	Lecturer	Email	Office
Lectures/Seminars/Tutorials	MERCEDES OLIET PALÁ	moliet@ucm.es	QB-544
Lectures/Seminars/Tutorials	ÁNGELES BLANCO SUAREZ	ablanco@ucm.es	QB-502
Lectures/Seminars/Tutorials	JOSE LUIS SANCHEZ_SALVADOR	Josanc03@ucm.es	QB-501

2. OBJECTIVES

General objective

Provide the knowledge and skills necessary to successfully perform technical functions in the environmental sector, introducing the student to the methodology used in the design and operation of the procedures and equipment used to treat the main pollutants, so that they can apply it to different situations that arise in the industry and in the facilities intended for the management and treatment of these materials and that they are able to select procedures, equipment and operating conditions.

Specific objectives

- Interpret and apply the legal requirements that affect different activities and that condition the obtaining of environmental licenses and authorizations.
- Identify and quantify discharges and wastes in different sectors.
- Identify and evaluate procedures for the reduction, reuse and recycling of contaminants and waste in different facilities.
- Know the technologies used in the treatment of wastewater from different sources.
- Know the waste control and treatment procedures, analysing advantages and disadvantages of different technologies.
- Know the technologies for remediation of contaminated soils, their applications and limitations.
- Model, based on phenomenological knowledge, the main purification equipment used in industrial facilities.
- Evaluate and select technologies, procedures and equipment to treat emissions, discharges, waste and contaminated soils.

3. PRIOR KNOWLEDGE AND RECOMMENDATIONS

Prior knowledge

Proper follow-up of this subject requires that the student has previously acquired the knowledge and skills corresponding to the following subjects: Applied Thermodynamics, Chemical Reaction Engineering, Separation Operations and Environmental Technology. Although enrolment is not formally conditioned by this prior learning, effective mastery of said knowledge is essential to take this subject with reasonable possibilities of achievement.

Recommendations

It is recommended that the student have a basic level of English that allows them to handle bibliography in English, search for information and communicate in writing and orally in that language. Likewise, it is recommended that you be familiar with computer tools and programs for solving complex problems, as well as applications for writing, editing, and presenting technical reports.

4. CONTENTS

Brief description

Uses of water in industry. Urban wastewater treatment methods. Reuse of reclaimed water. Industrial wastewater treatments. Reduction of wastes at source. Reuse, recycling and waste valorization technologies. Controlled waste disposal. Diagnosis and characterization of contaminated soils. Source and effects of soil contamination. Constituents and soil properties in relation to its self-purification. Recovery of contaminated soils.

Course syllabus

1. Concept of Environmental Engineering. Processes and unit operations in Environmental Engineering. Environmental indicators. Environmental legislation.
2. The water cycle. Wastewater generation: sources and characteristics of wastewater.
3. Treatment of liquid effluents. Operations and processes. Review of urban wastewater purification technologies. Industrial water treatments. Advanced treatments. Water reuse. Review of sludge treatments.
4. Wastes. Urban, industrial and radioactive wastes. Generation, manipulation and transfer. Minimization.
5. Waste management. Hierarchy principles. Valorization. Reuse. Recycling. Biological treatments. Heat treatments. Other treatments. Controlled disposal.
6. The soil. Origin and effects of soil contamination. Diagnosis and characterization of contaminated soils. Soil constituents and properties related to the dynamics and transport of contaminants.
7. Recovery of contaminated soils. Risk assessment Selection criteria. Treatment technologies.
8. Eco-efficient processes. Environmental management in industry.

5. COMPETENCES

General competences

CG1-TQ1	Use concepts for the autonomous learning of new methods and theories.
CG1-TQ2	Design and manage applied experimentation procedures, especially for the determination of thermodynamic and transport properties, and for the modeling of phenomena and systems in the field of chemical engineering, systems involving fluid flow, heat transfer, mass-transfer operations, chemical reaction kinetics, and reactors.
CG4-TQ1	Apply concepts of biotechnology, mass transfer, separation operations, and chemical reaction engineering. Evaluate the transformation of raw materials and energy resources.
CG5-TQ1	Analyse, design, simulate and optimise processes and products.

Specific competences

CE16-SPQ4	Describe the basic concepts relating to environmental issues concerning air, water, waste, and soils.
CE16-SPQ5	Recognise and characterise water systems, waste and soils.
CE16-SPQ6	Analyse and describe the technologies available for the treatment and control of water effluents.
CE16-SPQ7	Analyse and describe the technologies available for waste management and soil decontamination.

Cross-cutting competences

CT1-TQ1	Develop capacity for analysis and synthesis.
CT2-TQ1	Solve problems in the area of Chemical Technology.
CT4-TQ1	Communicate in Spanish using standard audiovisual media.
CT5-TQ1	Consult, use and analyse bibliographic sources in the area of Chemical Technology.
CT5-TQ2	Consult, use and analyse specialised databases and resources accessible through the Internet.
CT6-TQ1	Use computer tools and programs to calculate, simulate, and approximate.
CT8-TQ1	Demonstrate capacity for critical and self-critical reasoning.
CT11-TQ1	Learn autonomously.
CT12-TQ1	Develop sensitivity to the social and environmental repercussions of engineering solutions.

6. WORKLOAD DISTRIBUTION BY ACTIVITY.

Activity	In-class (hours)	Self-study (hours)	Credits
Lectures	35	65	4
Seminars	10	15	1
Tutorials/guided work	4	6	0.4
Coursework and examination preparations	6	9	0.6
Total	**55**	**95**	**6**

7. METHODOLOGY

The contents of the subject are presented to students in face-to-face classes, divided into two types:

The so-called **Lectures** (face-to-face theory sessions) will be delivered to the entire group, and in them the content of the subject will be made known to the student. At the beginning of each topic, the content and main objectives of said topic will be clearly stated. At the end of the topic, a brief summary of the most relevant content will be made and new objectives will be proposed that will allow the content already studied to be interrelated. During the presentation of contents, questions will be proposed that exemplify the concepts developed or that serve as an introduction to new content. To facilitate the student's monitoring of face-to-face classes, the part deemed necessary of the teaching material used by the teacher will be provided, either in photocopy or on the Virtual Campus. The presentation of each of the topics will be done using the blackboard and presentation software, simulation, numerical calculation, etc.

The **seminars** will be delivered to the entire group. They will have a double purpose. First, delve into some specific aspects of the subject treated more generally in theory classes. Secondly, the student will be introduced to the specific bibliographic search and the evaluation and discussion of current technical articles related to environmental engineering.

In the **guided activities**, students must carry out some work throughout the course, on topics specific to the subject, which will be evaluated as autonomous or non-face-to-face work activities. The general objective of these works is for students to learn to carry out bibliographic searches to obtain the information necessary to solve an open problem oriented towards industrial reality, to analyse it, evaluate it and apply it. The works proposed to each student contain, in addition to the bibliographic work, the preparation of the corresponding report, including the analysis and interpretation of information and/or results, and the conclusions. It would be convenient, if the number of students allows it, for the student to present their work in class once finished, also responding to the questions raised by the teacher and classmates.

Tutorials will be scheduled individually or with small groups. In them, the doubts raised by the students will be resolved and the problems and questions raised by the teacher related to the subject's syllabus will be discussed, as well as specific practical cases.

The **Virtual Campus** will be used to ensure fluid communication between teachers and students and as a tool to make available to students the material that is considered necessary and used in both theoretical and problem classes. It can also be used as a forum in which some complementary topics are presented whose content, although important in the subject, is not considered appropriate to present in face-to-face classes. Part of the recommended bibliography and the support material that is deposited in the virtual campus for the development of the teaching activities of this subject will be in English.

8. BIBLIOGRAPHY

Basic bibliography

- Henry J.G. and Heinke, G.W.: "Environmental Engineering", 2nd Ed., Pearson-México, 1999.
- Kiely, G.: "Environmental Engineering". 1st Ed., John Wiley, 2nd Ed., 2000.
- Corbitt, R.A.: "Reference Manual of Environmental Engineering", Ed. McGraw-Hill, Madrid, 2000.

Complementary bibliography

- Lee, C.C. and Lin, S.D.: "Handbook of Environmental Engineering Calculations", 2nd Ed., Ed. McGraw-Hill, Madrid, 2007.
- Hernández, A.: "Uralita Sanitation Manual: Water Sanitation Quality System", Ed. Paraninfo, Madrid, 2003.
- Dunnivant, F. M.: "*A Basic Introduction to Pollutant Fate and Transport: An Integrated Approach With Chemistry, Modelling, Risk Assessment, And Environmental Legislation*", Ed. John Wiley & Sons, 2006.
- Metcalf and Eddy: "Wastewater Engineering", Ed. McGraw-Hill, Madrid, 3rd Ed., 1995.
- Gray, N. F.: "Biology of wastewater treatment (vol. 4)". 2nd Ed., Imperial Collage Press Ed., London 2004.
- LaGrega, M.D., Buckingham, P.L. and Evans, J.C. Toxic waste management. Soil treatment, disposal and recovery. Ed. McGraw Hill (1996).
- Rodríguez, J.J. and Irabien, A. (Ed.): "Hazardous Waste. Characterization, Treatment and Management", Ed. Síntesis, 1999.

9. EVALUATION

The student's academic performance and the final grade of the subject will be computed in a weighted manner based on the following percentages, which will be maintained in all calls:

❖ WRITTEN EXAMINATIONS: 70%

A final exam will be carried out, divided into three blocks (Water, Waste and Soil), which will contribute 70% to the final grade. To pass the subject it will be necessary to obtain a minimum score of 3.0 points out of 10.0 in each of the blocks of the final exam and a minimum score of 5 points out of 10 in the exam. This last criterion will be maintained for the extraordinary call.

❖ PERSONAL WORK AND GUIDED ACTIVITIES: 30%

The evaluation of the individual learning work carried out by the student will be carried out taking into account:

- The evaluation obtained in the questionnaires carried out at the end of each seminar.
- The evaluation of the group work developed.
- Assessment of work in face-to-face theory classes, seminars and tutorials.

❖ ATTENDANCE AND PARTICIPATION IN CLASSES

To be able to access the global evaluation of the subject, the student must have participated in at least 70% of the face-to-face classroom activities (theory and seminars. Attendance at tutorials is mandatory.

The final grade will result from the weighted average of the evaluable activities. However, to pass the subject it will be necessary to achieve the minimum grade established in each of them. If this requirement is not met, the final grade will be the weighted average obtained, with a maximum of 4.5 out of 10.

The grades of the activities planned for the evaluation of the subject (midterm exams, tutorials, delivery of problems, etc.) will be communicated to the students sufficiently in advance before the final exam, so that they can adequately plan the study of this or other subjects. In any case, the minimum period of ten days will be respected between the publication of the grades and the date of the final exam of the subject.

ACTIVITY SCHEDULE

UNIT	ACTIVITY	HOURS	GROUPS	START	END
1. Concept of Environmental Engineering	Lectures	1	1		
2. The water cycle	Lectures	4	1		
3. Treatment of liquid effluents	Lectures	10	1		
	Seminars	4	1		
	TutorialS	2	1		
4. Waste	Lectures	4	1		
	Seminars	1	1		
5. Waste management	Lectures	7	1		
	Seminars	2	1		
	TutorialS	1	1		
6. The ground	Lectures	3	1		
7. Recovery of contaminated soils	Lectures	5	1		
	Seminars	3	1		
	TutorialS	1	1		
8. Eco-efficient processes	Lectures	1	1		

SUMMARY OF ACTIVITIES

TEACHING ACTIVITY	ASSOCIATED COMPETENCES	TEACHING ACTIVITY	STUDENT ACTIVITY	EVALUATION	P	NP	TOTAL	C
Theory classes	CG1-TQ2, CG4-TQ1, CG5-TQ1, CE16-SPQ4, CE16-SPQ6, CE16-SPQ7, CT12-TQ1	Develop sensitivity to the social and environmental repercussions of engineering solutions.	taking notes	Mandatory attendance at 70% of contact hours	35	65	100	
Seminars	CG1-TQ1, CG1-TQ2, CG4-TQ1, CE16-SPQ5, CT1-TQ1, CT5-TQ1, CT5-TQ2	Application of theory to the resolution of exercises and environmental problems	Taking notes. Performing exercises. Formulation of questions and doubts	Qualification of the answers (approach and result) made in writing for the resolution of practical exercises and numerical problems	10	15	25	**10%**
Tutorials	CG5-TQ1, CE16-SPQ6, CE16-SPQ7, CT1-TQ1, CT4-TQ1, CT5-TQ1, CT5-TQ2, CT6-TQ1	Helps the student direct his study and work with explanations and bibliographic recommendations. Correct and evaluate the work done by the student	Consult the teacher about the conceptual and methodological difficulties encountered when studying the subject. Preparation of the work proposed by the teacher	Work evaluation	4	6	10	**20%**
Exams	CT1-TQ1, CT8-TQ1	Proposal, supervision and correction of the exams. Student qualification.	Preparation and completion of the exams		6	9	15	**70%**

P: In-class activities

NP: Non-classroom activities (self-study)

C: Assessment weighting