COURSE DATA

Data Subject	
Code	34769
Name	Environmental pollution engineering
Cycle	Grade
ECTS Credits	6.0
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
1401 - Degree in Chemical Engineering	School of Engineering	3	Second term

Subject-matter

Degree	Subject-matter	Character
1401 - Degree in Chemical Engineering	19 - Engineering of environmental pollution	Obligatory

Coordination

Name	Department
MARTI ORTEGA, NURIA	245 - Chemical Engineering
RUANO GARCIA, MARIA VICTORIA	245 - Chemical Engineering

SUMMARY

The general objective of the subject *Environmental Pollution Engineering* is to know the fundamentals and application of available technologies for the management and treatment of process water and wastewater, solid waste and air emissions. It is a compulsory subject that is taught quarterly basis in the third year of Degree in Chemical Engineering in the second quarter. In the curriculum currently in place consists of a total of 6 ECTS.

The subject is based on previously developed skills in basic subjects and proper Chemical Engineering subjects as well as with the knowledge acquired in the course Environment and Sustainability schedule in the previous year. The subject enters the necessary knowledge to identify and propose solutions to environmental problems from a technical perspective.

The course addresses, in a comprehensive and integrated way, the different systems of water treatment and wastewater treatment, management and treatment of waste, contaminated soil treatment and purification of air emissions.

The overall **objectives** of the course are:

- To describe the criteria for assessing water quality.
- To describe the different physical and chemical water treatment and biological processes for wastewater treatment.
- To ensure that the student understands the problems of sludge production in plants and learns about the alternatives for treatment.
- To describe the criteria for assessing air quality and measurement and control techniques available.
- To describe the different technologies to control air pollution.
- To describe the management techniques and treatment of different types of solid waste.
- To present the sources of soil contamination and its problems.
- To describe the different technologies for soil decontamination.

The course **contents** are divided into four blocks:

- **Management of water quality**. Evaluating water quality. Physical, chemical and biological water treatment. Sludge production and treatment. Treatment schemes.
- **Air pollution**. Measurement techniques and control of air quality. Treatments for the removal of air pollutants.
- **Solid Wastes**. Municipal solid waste management. Treatments for the separation and recovery of solid waste. Systems of waste disposal.
- **Soil contamination**. Origin and problematic. Systems for the treatment and recovery of contaminated soils.

Remarks: Theory classes will be given in spanish, while practical and laboratory classes will be as detailed in the course syllabus shown in the web page of this degree.

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 necessary that the student has acquired the skills of the core subjects of Chemical Engineering (Basis of Chemical Engineering) and the subject Environment and Sustainability course, as well as the contents of Unit Operations and Engineering Chemical Reaction addressed in previous semesters.

OUTCOMES

1401 - Degree in Chemical Engineering

- G4 - Ability to solve problems with initiative, decision-making skills, creativity and critical reasoning and to communicate and transmit knowledge, abilities and skills in the field of industrial engineering.
- G5 - Knowledge to carry out measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and analogous work.
- G6 - Ability to deal with specifications, regulations and mandatory standards.
- G7 - Ability to analyse and assess the social and environmental impact of technical solutions.
- G10 - Ability to work in a multilingual and multidisciplinary environment.
- G11 - Knowledge, understanding and ability to apply the necessary legislation for practising professionally as a qualified industrial technical engineer.
- TE1 - Knowledge of material and energy balances, biotechnology, matter transfer, separation operations, chemical reaction engineering, reactor design, and valorisation and transformation of raw materials and energy resources.
- TE2 - Ability to analyse, design, undertake simulations and optimise processes and products.

LEARNING OUTCOMES

Learning results

- Ability to analyse and assess the social and environmental impact of technical solutions (G7).
- To acquire basic knowledge and application of environmental technologies and sustainability (R10).
- To be able to apply the environmental legislative framework (G6, G7, G11).
- To be able to establish criteria for evaluating water quality (G5, G6, G7, G11, R10).
- To acquire basic knowledge of the different physical and chemical processes for water treatment (G4, R10, TE1, TE2).
- To acquire basic knowledge of the biological processes for wastewater treatment (G4, R10, TE1, TE2).
- To assess the condition of the sludge production in plants, its minimization and treatment (G7, R10, TE1, TE2).
- To know the different types of solid waste, differentiating between urban solid waste and industrial waste. To establish the concept of hazardous waste (G6, G7, R10).
- To understand the management techniques and treatment of different types of solid waste (G4, R10, TE1, TE2).
- To assess the implications of soil pollution (G4, G5, G6, G7, R10).
- To be able to establish the criteria for assessing the air quality. Measurement and control techniques

(G5, G6, G7, G11, R10).
- To know the methods for controlling the air pollution (G4, R10, TE1, TE2).
- To be able to work in a multilingual and multidisciplinary environment (G10).
- To be able to handle specifications, regulations and mandatory standards (G6, G11).

Skills to acquire

The student must be able to:

- Identify the criteria for evaluating the quality of a water supply and a wastewater.
- Describe the physical, chemical and biological treatments to treat the pollution in water supply and in wastewaters.
- Select potential treatments for water, based on their characteristics and their subsequent use, assessing technical, environmental and economic aspects.
- Identify the different air pollutants, their sources and systems for their measuring and monitoring.
- Describe existing technologies for the removal of air pollutants.
- Select the most appropriate technological options for controlling air pollution in terms of pollutants emitted.
- Distinguish the different types of solid waste in their origins and characteristics.
- Identify the various operations involved in waste management.
- Describe the different treatment schemes considering the characteristics of the waste and the technical, environmental and economic conditions.
- Identify the problem of soil contamination from the perspective of protecting the health and the environment.
- Identify technology solutions in the field of treatment and recovery of contaminated soils.
- Select the most appropriate technological alternatives to potential confinement systems and / or treatment of contaminated soils.
- Compile and implement legislation on environmental matters.

DESCRIPTION OF CONTENTS

1. Water quality management

Unit 1. Water quality parameters: Physical, chemical and biological characteristics.
Unit 2. Physical treatment of waters.
Unit 3. Chemical treatment of waters.
Unit 4. Physical and chemical treatment of sludge.
Unit 5. Biological treatment of wastewater: processes of suspended-growth and attached-growth.

2. Air pollution

Unit 6. Air quality: Air pollutants. Measurement and monitoring of air pollution.
Unit 7. Air pollution control: Technologies for removing particles. Technologies for removing gaseous pollutants.

3. Solid wastes

Unit 8. Solid waste management: Classification and origin. Collection and transportation.
Unit 9. Solid waste treatment: Waste separation and processing. Technologies for solid waste recovery: composting, biogas production and incineration. Landfills.

4. Soils contamination

Unit 10. Soil quality: Sources of contamination. Characterization of contamination.
Unit 11. Treatment of contaminated soils: Contaminant immobilization techniques. Techniques for the recovery of contaminated soils.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	32,00	100
Classroom practices	28,00	100
Development of group work	10,00	0
Development of individual work	10,00	0
Study and independent work	15,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	20,00	0
Preparation of practical classes and problem	20,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Lecture sessions: In the theoretical classes, the methodology of master class and flip-flop classroom will be combined. For flip-flop classroom sessions, the students will work on the contents individually and will take questionnaires using Socrative or Kahoot tools. The teachers will correct the questionnaires with the students, solve doubts and reinforce the most relevant contents. The main competences worked on by these activities will be G7, G10, G11, R10 and TE1.

Practical sessions: Practical classes will complement the theoretical activities in order to apply the basic concepts and extend them with the knowledge and the experience that the students acquire during the course. This will be done in the classroom or in small groups and the competences G4, G5, G6, G7, G10, G11, R10, TE1 and TE2 will be worked on. They include the following types of classroom activities:

- Classes of problems in the classroom. The professor will explain a number of sample problems that allow students to acquire the necessary skills to analyse, formulate and solve the problems of each unit. It will enhance students' skills for decision-making.

- Discussion sessions and problem solving. In these sessions, to be held in small groups, we will analyse and discuss a series of exercises or works previously raised by the teacher and the worked by the students in small groups.

Tutorials: The tutorials will arise as voluntary sessions to resolve any doubts arising in the resolution of problems that students must perform on their own. The competences G4, G7, G11, TE1, TE2 and R10 will be strengthened.

EVALUATION

Method of evaluation A:

The evaluation of the student learning will take place through continuous assessment and final evaluation.

- **Continuous assessment**: Achievement of competences G4, G7, G10, G11, R10 and TE1 will be evaluated. It is based on:

- Student participation in the teaching-learning process, given regular attendance at visits to industrial facilities, and the resolution of questions raised in class, individually and / or in small groups (25% of the final grade). Activities not submitted on the scheduled date cannot be submitted later.

- **Final Assessment**: Achievement of competences G4, G5, G6, G7, G11, R10, TE1 and TE2 will be evaluated.

- A partial test, which will be qualifying in case students get 5 points (out of 10), will be done once completed Block 1 (Water quality management). This exam will consist of both theoretical and practical issues such as problems in order to ascertain whether they have assimilated the basic concepts of the water quality block.
- A final test of all unsurpassed contents, which will consist of both theoretical and practical issues and problems in order to ascertain whether they have assimilated all the basic concepts of the course, will be done.
- To average the scores obtained on tests, it must be obtained in each of the parts (theory and problems) of any exam at least 3 points (out of 10).
- The final assessment will be a 75% of the final grade. In this assessment the scores in tests will be considered.

To qualify for this type of evaluation, the student must attend 75% of the activities.

In the resits, the students will be examined of all the blocks of the subject, independently of the qualifications obtained in the previous examinations.

Method of evaluation B:

Alternatively to the evaluation method described above, the evaluation may be performed by a final exam counting 100% of the final mark. The minimum requirements in each of the parts of the exam are the same as in Method A.

In both evaluation methods, to pass the subject it is necessary to obtain an average rating of 5 out of 10, provided on the final exam to obtain a grade equal to or greater than 5 points (out of 10).

Anyhow, the evaluation system will be based on the guides stated in the “Reglament d’Avaluació i Qualificació de la Universitat de València per a Graus i Màsters” (http://links.uv.es/xB38OW0).

REFERENCES

Basic

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- Ferrer, J., Seco, A. (2008) Tratamientos de Aguas. Tomo 1. Introducción a los Tratamientos de Aguas, Servicio de Publicaciones de la Universidad Politécnica de Valencia, Nº 309, Valencia.

- Metcalf & Eddy (2003) Wastewater Engineering. Treatment and Reuse, 4ª Ed., McGraw-Hill, New York.
- De Nevers, N. (1998) Ingeniería de Control de la Contaminación del Aire. McGraw-Hill Interamericana, México.
- Vallero, D. (2008) Fundamentals of Air Pollution. 4ª ed., Academic Press, San Diego, CA. Libro electrónico: http://site.ebrary.com/lib/universvaln/detail.action?docID=10329503
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- Tchobanoglous, G., Theisen, H., Vigil, S.A. (1996) Gestión Integral de Residuos Sólidos. McGraw-Hill Interamericana de España, Madrid.
- Mirsal, I.A. (2008) Soil Pollution. Origin, Monitoring & Remediation. 2ª ed., Springer-Verlag Berlin, Heidelberg.
- Kiely, G. (1999) Ingeniería Ambiental, Fundamentos, entornos, tecnologías y sistemas de gestión. McGraw-Hill Interamericana de España, Madrid.
- Barat, R., Ferrer, J., Seco, A., Segura, F. (2008) Gestión de Residuos Sólidos. Tomo I. Servicio de Publicaciones de la Universitat Politécnica de Valencia, Nº 128, Valencia.

Additional

- APHA-AWWA-WEF (American Public Health Association - American Water Works Association - Water Environment Federation) (2005) Standard Methods for the Examination of Water and Wastewater. 21ª ed., American Public Health Association, Washington D.C.
- Mackenzie, L.D. (2010) Water and Wastewater Engineering. McGraw-Hill, New York.
- Davis, W.T. (2000) Air Pollution Engineering Manual. 2ª ed., John Wiley & Sons, New York.
- Wang, L.K., Pereira, N.C., Hung, Y. (2004) Air pollution control engineering. Humana Press, Totowa
- Nemerow, N.L. (2007) Industrial Waste Treatment. Contemporary Practice and Vision for the Future. Butterworth-Heinemann, Burlington, MA. Libro electrónico: http://site.ebrary.com/lib/universvaln/detail.action?docID=10166994
- Wise, D. L. (2000) Remediation engineering of contaminated soils. Marcel Dekker Inc., New York.

ADDENDUM COVID-19

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

Contents

The contents initially established in the Course Guide are maintained.

Workload and planning of teaching

Workload:

The activities described in the Course Guide with their time dedication are maintained.

Planning of teaching:

The material for the follow-up of the classes allows to continue with the teaching time planning both in days and in time, whether the teaching is face-to-face in the classroom or not.

Teaching methodology

If it is required by the sanitary situation, the Academic Committee of the Degree will approve the Teaching Model of the Degree and its adaption to each subject, establishing the specific conditions in which it will be developed, taking into account the actual enrolment data and the space availability.

Evaluation

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

If there is a closure of the facilities for sanitary reasons that affect the development of any face-to-face evaluable activity, it will be replaced by a test/activity of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the course will remain unchanged, as established in this guide.

References

The recommended references in the Course Guide are maintained, since they are available.