

**COURSE DATA****Data Subject**

<b>Code</b>	36486
<b>Name</b>	Water treatment technologies
<b>Cycle</b>	Grade
<b>ECTS Credits</b>	4.5
<b>Academic year</b>	2020 - 2021

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. year</b>	<b>Period</b>
1401 - Degree in Chemical Engineering	School of Engineering	4	First term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
1401 - Degree in Chemical Engineering	23 - Optional subjects	Optional

**Coordination**

<b>Name</b>	<b>Department</b>
JIMENEZ BENITEZ, ANTONIO LUIS	245 - Chemical Engineering
RUANO GARCIA, MARIA VICTORIA	245 - Chemical Engineering

**SUMMARY**

The subject Water Treatment is an elective four-monthly subject that is taught in the fourth year and first semester of the Degree in Chemical Engineering. The subject is part of the group of subjects focused on Environmental Engineering taught in the Chemical Engineering Degree and complete the knowledge acquired in the subjects Sustainability and Environment and Environmental Pollution Engineering, both compulsory and taught in the second and third degree course respectively.

The subject, of 4.5 ECTS, includes theoretical and practical tasks, so that the theoretical knowledge is complemented by the resolution of problems and by carrying out different assignments.



This subject aims to provide students with the knowledge and skills necessary for the preliminary design of water treatment facilities for human consumption or provision of facilities and treatments applied in the purification of urban and industrial wastewater.

To do this, firstly, the most common physical and chemical methods for treatment of water and wastewater are developed in detail.

This is followed by a thorough study of the biological treatments, which are widespread used in the treatment of urban and industrial wastewater. The complexity of these processes justifies the importance of a detailed study of them.

Aspects concerning the process microbiology, kinetics and stoichiometry of biochemical reactions, types of processes, process schemes, applicability, etc. are included in. Emphasis will be placed on technologies aimed at the simultaneous removal of organic matter and nutrients.

Finally, the problem of sludge production and the existing treatment methods are studied.

The knowledge will be consolidated through class exercises involving the completion of the preliminary design of various water treatment plants.

The theory classes will be taught in Spanish and the practical classes as stated in the course sheet available on the web of the 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**

No enrollment restrictions have been specified with other subjects in the curriculum. In order to successfully tackle the subject, it is advisable that the student has passed or is studying the subjects Environment and Sustainability and Environmental Pollution Engineering, as well as other fundamental subjects of Chemical Engineering such as Basis of Chemical Engineering I, Unit Operations of Chemical Engineering and Chemical Reaction Engineering addressed in previous semesters.



## OUTCOMES

### LEARNING OUTCOMES

Know the possibilities of the use of wastewater as a resource (Competence O1).

Know and apply the various physical, chemical and biological water treatments (Competence O1).

Evaluate various treatment alternatives from a technical, economic and social point of view (Competence O1).

Acquire the ability to plan, design and operate facilities for water treatment (Competence O1).

Understand and apply advanced technologies for the treatment of persistent and emerging contaminants (Competence O1).

Understand and apply advanced technologies to minimize sludge production and its valorisation (Competence O1).

Understand the importance of control in treatment plants (Competence O1).

Acquire an overview of a treatment plant integrating the various processes involved in the different treatment lines (Competence O1).

### DESCRIPTION OF CONTENTS

#### 1. Water treatment introduction

Importance of water treatment. Legislation. Water treatment methods. Treatment schemes. Sustainable management of water quality. Water and MDG.

#### 2. Physical treatment of waters

Screening. Flow equalization. Mixing. Flocculation. Sedimentation. Flotation. Aeration. Filtration. Membrane processes.

#### 3. Chemical treatment of waters

Precipitation. Coagulation. Adsorption. Oxidation. Ion exchange. Disinfection.

**4. Physical and chemical treatment of sludge**

Thickening. Stabilization. Dehydration. Minimization.

**5. Biological methods for wastewater treatment**

Introduction to biological treatments. Microbiology of treatment processes. Kinetics and stoichiometry of the reactions.

**6. Suspended-growth biological processes I**

Activated sludge. Organic matter removal. Nitrification. Denitrification. Advanced treatment: aerobic/anaerobic membrane bioreactors, SHARON process, ANAMMOX, BABE. Biological phosphorus removal. Wastewater treatment plants for biological nutrient removal. Water resource recovery facilities for nutrient recovery.

**7. Suspended-growth biological processes II**

Aerobic digestion of sludge. Anaerobic suspended-growth treatments. Anaerobic membranes bioreactors. Anaerobic digestion of sludge.

**8. Attached-growth biological processes**

Trickling Filters. Rotating biological contactors. Peat beds. Anaerobic attached-growth processes.

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	25,00	100
Classroom practices	20,00	100
Development of group work	10,00	0
Development of individual work	10,00	0
Study and independent work	15,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	7,50	0
Preparation of practical classes and problem	5,00	0
Resolution of case studies	5,00	0
<b>TOTAL</b>	<b>112,50</b>	



## TEACHING METHODOLOGY

The development of the subject is structured around four axes: the lecture sessions, practical activities, the fulfilment of an individual project and tutorials:

**Lecture sessions:** the teacher will give an overview of the issue impacting on the key to understanding it. Also will recommend adequate resources for the further deepening of the subject by the student (Competence O1).

**Practical activities:** activities will complement the lecture sessions with the aim of applying the basics and expand the knowledge and experience acquired during the realization of the work proposed. These activities include one or more of the following types of classroom activities: classes of problems, discussion sessions, problem solving exercises and solving of previously worked problems by the students. Also, a visit to one or more wastewater treatment plants in the area of Valencia will be planned (Competence O1).

**Fulfilment of projects:** Students must take a compulsory project that will be delivered on the agreed date (Competence O1).

**Tutorials:** The tutorials will arise as sessions to resolve any doubts arising from the resolution of the problems or work that students must perform on their own. In addition, the teacher will guide the student on the most appropriate methodology for learning basic knowledge of the subject. Tutorials will be conducted both individually and at the group level with the frequency that the teacher deems appropriate. In the latter, the main difficulties encountered in solving a number of problems that students have solved and delivered previously will discuss (Competence O1).

## EVALUATION

### Method of evaluation A:

Assessment of learning by the students will take place through continuous assessment and a final assessment that will include:

**Individual project:** the student must fulfil an individual project proposed by the teacher which will be valued at 45% of the final grade (minimum grade to pass the subject is 5) (Competence O1).





Final exam: the student must take a final exam which will evaluate the fundamental concepts of the subject. The exam is valued at 35% of the final grade (minimum grade 5.0) (Competence O1).

Continuous assessment: based on participation and level of student involvement in the teaching-learning process, taking into account the resolution of the exercises proposed (20%) (Competence O1).

### **Method of evaluation B:**

Alternatively to the evaluation method described above, the evaluation may be performed by a final evaluation which include the fulfilment of a project counting 55% of the final mark and a final exam counting 45% of the final mark (Competence O1).

In both evaluation methods, to pass 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 5.0 points (out of 10) and 5 points (out of 10) on the project. The final mark will be the maximum of both evaluation methods, if A evaluation method can be applied.

In any case, the evaluation system will be governed by what is established in the Evaluation and Qualification Regulations of the Universitat de València for Degrees and Masters (<https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639>).

## **REFERENCES**

### **Basic**

- Ferrer Polo, J. y Seco Torrecillas, A. Introducción a los tratamientos de aguas. Editorial UPV (309), 2011
- Ferrer Polo, J., y Seco Torrecillas, A. Tratamientos físicos y químicos de aguas residuales. Editorial UPV (197), 2011.
- Ferrer Polo, J., Seco Torrecillas, A. y Robles Martínez, A. Tratamientos biológicos de aguas residuales. 3ª edición. Editorial UPV (358), 2018.
- Metcalf & Eddy. Wastewater engineering: treatment and reuse. 4th Ed. McGraw Hill, New York, 2003



### **Additional**

- Water Environmental Federation. Wastewater Treatment Plant Design. WEF and IWA Publishing, Alexandria, 2003.
- American Public Health Association, American Water Works Association and Water Environment Federation. Standard Methods for the Examination of Water and Wastewater 20th edn, Washington DC, USA, 2005.
- Cervantes, F., Pavlostathis, S., van Haandel, A. Advanced Biological Treatment Processes for Industrial Wastewaters. Principles & application. IWA Publishing, 2006.
- IWA. Process Science and Engineering for Water and Wastewater Treatment. IWA Publishing, London, 2002.
- Seviour, R. And Nielsen, P.H. Microbial Ecology of Activated Sludge. IWA Publishing, London, 2010.
- Gabriel Bitton. Wastewater microbiology. Wiley-Liss, cop. New York. 2005.

### **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 collected in the teaching guide are maintained.

#### **Volume of work and temporary planning of teaching**

Regarding the workload:

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

Regarding the temporary planning of teaching

The material for the follow-up of the theory/practical lessons allows to continue with the temporary teaching planning both in days and hours, both if the teaching is in the classroom or not.

#### **Teaching methodology**



In theory and practical lessons in the classroom, maximum possible attendance will be the rule, always respecting the sanitary restrictions that limit the capacity of the classrooms to 50% of their usual occupation. Depending on the capacity of the classroom and the number of students enrolled, it may be necessary to distribute the students into two groups. If this situation arises, each group will attend theory and practical sessions with physical presence in the classroom by rotating shifts, thus ensuring compliance with the criteria for occupying spaces. The rotation system will be established once the enrollment data is known, guaranteeing, in any case, that the attendance percentage of all the students enrolled in the subject is the same. For classroom sessions and theory sessions that are not face-to-face, there will be a preferably synchronous online teaching model, as long as compatibility with other scheduled activities allows. Online teaching will be carried out by synchronous videoconference respecting the schedule, or, if not possible, asynchronous.

Once the 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 the specific conditions in which it will be taught.

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 online sessions following the established schedules.

## **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 mark of the subject is maintained.

If there is a closure of the facilities for health reasons that affect the development of any face-to-face evaluable activity of the subject, it will be replaced by a test 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 mark for the course will remain unchanged, as established in this guide.

## **Bibliography**





The bibliography recommended in the Teaching Guide is kept as it is accessible.

