# Course guide
# 2500225 - GEA0225 - Water Treatment

**Last modified:** 27/05/2024

**Unit in charge:** Barcelona School of Civil Engineering
**Teaching unit:** 751 - DECA - Department of Civil and Environmental Engineering.

**Degree:** BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2020). (Compulsory subject).
BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING / BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING (Syllabus 2024). (Compulsory subject).
BACHELOR'S DEGREE IN MINERAL RESOURCE ENGINEERING AND MINERAL RECYCLING / BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2024). (Compulsory subject).

**Academic year:** 2024 **ECTS Credits:** 6.0 **Languages:** Catalan

## LECTURER

**Coordinating lecturer:** JOAN GARCIA SERRANO

**Others:** ANA ÁLVAREZ GONZÁLEZ, ANA MARIA JOSE CANDELARIA CANO LARROTTA, JOAN GARCIA SERRANO, ROBERTO RIBES MINGUEZ

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**
14451. Apply the fundamental concepts of statistics and randomness of physical, social and economic phenomena, as well as uncertainty and decision-making techniques.
14457. Identify the fundamentals of structure theory, sustainable procedures for construction and dismantling of buildings and civil works; and describe the technology bases of the materials used in construction.
14460. Design and project treatment systems for purification and purification of water resources, and establish the basis for the management of waste generated, describe and assess desalination and reuse processes.
14461. Analyze, design, simulate and optimize processes and systems with environmental relevance, both natural and artificial, and their resolution techniques, as well as recognize techniques for analysis and evaluation of climate change.
14462. Design and project processes for the treatment of contaminated soils and aquifers.
14463. Prepare, implement, coordinate and evaluate urban and industrial solid waste management plans and resource recovery.
14464. Apply measures to prevent and control air quality, quantify noise pollution and its corrective measures and quantify odor emissions and corrective measures.

**Generical:**
14440. Identify, formulate and solve problems related to environmental engineering.
14441. Apply the functions of consulting, analysis, design, calculation, project, construction, maintenance, conservation and exploitation of any action in the territory in the field of environmental engineering.
14442. To use in any action in the territory proven methods and accredited technologies, in order to achieve the greatest efficiency respect for the environment and the protection of the safety and health of workers and users.
14443. Apply the necessary legislation during the professional practice of environmental engineering.
14444. Apply business management techniques and labor legislation.

## TEACHING METHODOLOGY

2 sessions of 2 hours a week that include masterful explanations to the pissarra, projection, resolution of exercises and presentation of practical cases. 12 hours of laboratory practices. Teaching materials available by ATENEA.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

To do the laboratory practices you need the following personal protective equipment (PPE):
* Chemical Kit (white lab coat + protection gloves + safety glasses)

## LEARNING OBJECTIVES OF THE SUBJECT

In this subject, the fundamental principles of water treatment processes will be defined, the operation of the unitary processes applied to water treatment will be described in detail, the unitary processes that a water treatment plant must have will be established in function of the characteristics of the water to be treated and water treatment plants will be calculated and designed, in addition to knowing their operation and maintenance. Therefore, issues of Quality and quantity of drinking water, applicable regulations and Introduction to drinking water sources will be included. Also of the main pretreatment processes: roughing, desanding, discrete sedimentation analysis, oxidation and conventional unitary water treatment processes including: coagulation, flocculation, sedimentation and sand filtration. Compact conventional treatment systems. Study of the concept of velocity gradient G. Analysis of zonal sedimentation. Kynch's theory. Model of Takacs. Determination of filter load losses: Ergun and Carman-Kozeny equations. Study of the expansion of filters.

1. Know the concepts of supply water management, quality criteria and collection techniques and design of treatment stations.
2. Know the techniques of purification of surface water, groundwater and desalination.

Water treatment. The management of supply waters and the criteria to establish their quality and the design of treatment stations will be analyzed in this subject. The techniques of purifying surface water, groundwater and the latest trends in desalination techniques will be studied.

Description The main objective of this subject is the acquisition by the student of the theoretical principles and foundations of water quality parameters and their treatment. For this reason, in-depth treatment processes are studied, in particular those intended for the purification and desalination of water. Quality parameters will be studied mainly through laboratory practices. The knowledge acquired will allow the student to face the design and project of water treatment plants. Plant management and operation will also be studied. The contents of this subject are part of the central training core of Environmental Engineers. This subject interacts with multiple subjects of the curriculum, and very in particular with the subject of Wastewater. Learning outcomes 1. In-depth knowledge of the main parameters of water quality 2. Knowledge of water treatment processes 3. Design and design of treatment plants 4. Operation and management of plants Contents Drinking water. Desalination. Operation and management of treatment plants. Laboratory practices of water quality parameters and experimental treatment processes.

## STUDY LOAD

| Type | Hours | Percentage |
|---|---|---|
| Hours small group | 15,0 | 10.00 |
| Hours medium group | 15,0 | 10.00 |
| Self study | 90,0 | 60.00 |
| Hours large group | 30,0 | 20.00 |

**Total learning time:** 150 h

## CONTENTS

### Drinking water

**Description:**
Demand, coefficients, distribution networks, catchments, deposits
Pre-treatment:
Stoke's sedimentation law. Analysis of sedimentation in ideal tanks: Hazen's postulates.
Sizing of presedimentation tanks. Network design
Colloids.
Coagulation-flocculation (continued). Orthokinetic and pericinetic flocculation
Technical aspects of coagulation and flocculation
Application of Hazen postulates to flocculent sedimentation.
Fundamentals of lamellar sedimentation tanks.
CFD of a sedimentation tank
Fundamentals of granular filtration.
Slow filters. Quick filters
Adsorption. Isotherms
Disinfection. Chlorine chemistry
Kinetics of disinfection.
Sludge treatment.
Introduction to special treatments: softening, removal of iron and manganese and fluoridation
Configuration and technical aspects of water treatment plants
Technical visit to a water treatment plant

**Full-or-part-time:** 91h 12m
Theory classes: 22h
Practical classes: 14h
Laboratory classes: 2h
Self study : 53h 12m

### Desalination

**Description:**
Membrane processes.
Desalination plants

**Full-or-part-time:** 9h 36m
Theory classes: 4h
Self study : 5h 36m

### Operation and maintenance

**Description:**
Selection of equipment.
Operation and maintenance. Security
Costs. Contracts

**Full-or-part-time:** 14h 23m
Theory classes: 4h
Practical classes: 2h
Self study : 8h 23m

**Laboratory**

**Description:**
Gravimetric analysis. Terbolesa. Electrical conductivity. pH. Alkalinity. Hardness. DO. BOD. COD. Microbial analysis. Experimental analysis of coagulation, flocculation and sedimentation. Application of reactor theory to flocculation. Experimental analysis of rapid filtration

**Full-or-part-time:** 28h 47m
Laboratory classes: 12h
Self study : 16h 47m

## GRADING SYSTEM

The final grade is obtained as follows: QUIZZ 1 (10%) + QUIZZ 2 (10%) + QUIZZ practices (10%) + First partial (40%) + Second partial (30%). Quizzes will be done during classes. The partials during the hours foreseen by the School.

Solo los alumnos suspensos se pueden presentar a reevaluación. Para poder realizar la reevaluación se necesario haber participado en todas las pruebas de evaluación (*QUIZZS+parciales). Solo causas de fuerza mayor adecuadamente acreditadas pueden justificar la no asistencia a una de las pruebas de evaluación. La *reavalació consiste en un único examen que abarca todo el temario y actividades de la asignatura. Se aprueba con una nota igual o superior a 5. La nota máxima de la reevaluación será 5.

## EXAMINATION RULES.

If any of the laboratory or continuous assessment activities are not carried out in the scheduled period, it will be considered a zero score. The tests will be carried out individually, with multiple choice questions that can be theoretical or problem type questions. The exams can include short questions to be developed by the students and exercises to be solved.

## BIBLIOGRAPHY

**Basic:**
- Crittenden, C.J.; Trussell, R.R.; Hand, D.W.; Howe, K.J.; Tchobanoglous, G. MWH's water treatment principles and design [on line]. 3rd ed. Hoboken, New Jersey: Wiley, 2012 [Consultation: 30/07/2021]. Available on: https://onlinelibrary.wiley.com/doi/book/10.1002/9781118131473. ISBN 9780470405390.
- Droste, R. L. Theory and practice of water and wastewater treatment [on line]. 2nd ed. Hoboken, NJ: John Wiley, 2019 [Consultation: 30/03/2021]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5554617. ISBN 9781119312376.
- AWWA-ASCE. Water treatment plant design. 5th ed. New York: McGraw-Hill, 2012. ISBN 9780071745727.

## RESOURCES

**Other resources:**
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* Chemical Kit (white lab coat + protection gloves + safety glasses)
You can buy them at UPC Shop (upc-shop.com) or any specialty store.
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