Course guide
2500228 - GEA0228 - Wastewater and Reuse

Last modified: 22/05/2024

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: ESTEL RUEDA HERNÁNDEZ

Others: MARTA FERNANDEZ GATELL, JAUME PUIGAGUT JUAREZ

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

The course consists of 2.3 hours per week of classroom activity (large size group) and 1.2 hours weekly with half the students (medium size group).

The 2.3 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1.2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

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.

LEARNING OBJECTIVES OF THE SUBJECT

This course will describe the different types of wastewater treatment systems, their operation and application, and how to calculate and design the treatment units of a treatment plant. This will be an introduction to sanitation networks, regulations regarding wastewater and reuse. Wastewater flows and their physical, chemical and biological characteristics will also be discussed. There will be an Introduction to carrying out gauging and characterization campaigns, as well as a description and design of autonomous sanitation facilities. Finally, the operation, design and operation of activated sludge processes in all their variants will be shown: complete mixing, piston flow, staggered feeding, prolonged aeration, contact-stabilization and double stage. Nutrient removal. Design of secondary decanters. Main operating problems of the activated sludge process: foams, bulking, dispersed growth.

1. Know the characteristics of urban and industrial wastewater and intensive (conventional) and extensive (natural) treatment systems.
2. Know the water management strategies such as reuse.

Wastewater and Reuse. In-depth study of technologies, tools and techniques in the field of environmental engineering, for the treatment of wastewater and the latest trends in its management, such as reuse. Submarine outfalls and their possible impacts on the coast.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

General concepts

Description:
Introduction to sanitation networks. Regulations regarding wastewater and reuse.
Molecular techniques for characterizing pathogens. Biological characterization of the receiving environment according to the tools proposed in the Framework Directive (Biological Monitoring Working Party - BMWP). Bases and foundations of the adaptation of biological indices to the control and management of treatment plants
There will be problems in class and problems solved on the concepts of the introductory part (water generation, microbiological quality, biological indices).

Specific objectives:
Acquire theoretical and practical concepts of the physical and chemical characterization of water.
Theoretical and numerical foundations of microbiological quality assessment and numerical tools for determining the quality of the receiving environment.
Know how to calculate the amount of water produced in a given scenario and use the numerical tools to determine the quality of the receiving environment.

Full-or-part-time: 21h 36m
Theory classes: 7h
Practical classes: 2h
Self study : 12h 36m

Sanitation

Description:
Description and design of autonomous sanitation facilities. Definition, design and operation of sanitation for small communities: Biofilm processes, both fixed and mobile (percolating filters, biodiscs, etc.). Definition and design of natural purification systems: constructed wetlands, upstream flow anaerobic reactors land application systems and lagooning
Operation, design and operation of activated sludge processes in all their variants: complete mixing, piston flow, staggered feeding, prolonged aeration, contact-stabilization and double stage. Nutrient removal. Design of secondary decanters. Main operating problems of the activated sludge process: foams, bulking, dispersed growth. Up-grade strategies for facilities that have become small (MBBR, Membrane systems)
The sizing of the most common small and large scale sanitation systems will be done.

Specific objectives:
Know at a theoretical and practical level the sanitation systems of small urban centers.
Know the theoretical concepts of sanitation in large urban centers.
Know the numerical approach to the design of sanitation systems

Full-or-part-time: 50h 24m
Theory classes: 16h
Practical classes: 5h
Self study : 29h 24m

Mud line

Description:
Study, design and operation of the sludge line of a treatment plant, including thickening, stabilization, conditioning and dehydration. Deepening in biotechnologies for sludge stabilization: anaerobic digestion and composting
Numerical approximation of sewage sludge treatment systems

Specific objectives:
Know the theoretical concepts related to the management of sludge in a sanitation system.
Know the sizing process of sludge treatment systems

Full-or-part-time: 12h
Theory classes: 3h
Practical classes: 2h
Self study : 7h

Reuse

Description:
Description of the operation of a wastewater regeneration plant. Reuse of regenerated water. Two case studies. KISS CONSORTIUM MODEL - REUSE IN THE COSTA BRAVA. Barcelona aquifer recharge model PLANTA DEL PRAT
Numerical approach to the processes of regeneration and re-use of wastewater

Specific objectives:
Know the process and strategies to use the purified water for beyond the discharge into the receiving environment.
Design regeneration systems.

Full-or-part-time: 36h
Theory classes: 12h
Practical classes: 3h
Self study : 21h

Laboratories

Description:
Determination of kinetic parameters of microbial populations in sludge systems activities by respirometry (OUR test)
Determination of microbial activity in natural treatment systems using the fluorescein diacetate technique

Specific objectives:
Know the practical procedure and calculations to determine the oxygen consumption of a microbial population.
Know the practical procedure and calculations to determine the microbial activity of a population of bacteria.

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

Evaluation

Description:
Visit to the facilities of the El Prat WWTP, which have a wastewater treatment system and water regeneration system.

Specific objectives:
See on foot the concepts and processes learned in class.

Full-or-part-time: 14h 23m
Laboratory classes: 6h
Self study : 8h 23m

GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

EXAMINATION RULES.

If any of the continuous assessment activities is not carried out in the scheduled period, it will be considered as a zero score. To access the re-assessment you must have achieved a minimum grade of 4 in the average of evaluable tests of the course (activities and partial exams)

BIBLIOGRAPHY

Basic:
- Water treatment handbook. 7th ed. Malmaison Cedex: Degrémont, 2007. ISBN 9782743009700.
- Metcalf & Eddy. Wastewater engineering: treatment and reuse. 4th ed. Boston, EEUU: Mc Graw-Hill Higher Education, 2003. ISBN 0070418780.

Complementary:
- American Public Health Association, American Water Works Association, Water Environment Federation. Standard methods for the examination of water and wastewater. 23rd ed. Washington: American Public Health Association, 2017. ISBN 0875532071.
- Agencia Catalana de l'Aigua [on line]. [Consultation: 25/10/2023]. Available on: http://aca.gencat.cat.