Course guide
295560 - 295EQ122 - Industrial Water Technologies

Last modified: 27/05/2024

Unit in charge: Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2019). (Optional subject).

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

LECTURER

Coordinating lecturer: Oriol Gibert

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:
CGMUEQ-01. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the matter undergoes changes in its composition, state or energy content, characteristic of the chemical industry and other related sectors among which are the pharmaceutical, biotechnological, materials, energy, food or environmental
CGMUEQ-02. To conceive, project, calculate and design processes, equipment, industrial facilities and services, in the field of chemical engineering and related industrial sectors, in terms of quality, safety, economy, rational and efficient use of natural resources and environment conservation
CGMUEQ-06. Have the capacity to analyze and synthesize the continuous progress of products, processes, systems and services using safety, economic viability, quality and environmental management criteria
CGMUEQ-07. Integrate knowledge and face the complexity of making judgments and decisions, based on incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice

Transversal:
02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

The following activities will be carried out, either in or outside the classroom, in the development of the course:

1. Lectures by the professor(s) and optionally by guest speakers
2. Autonomous and cooperative learning
3. Problem solving and case studies
4. Project based learning (PBL)
5. Visits to plants

In the project based learning (PBL) teams (made up of 4-5 students, depending on the groups size) will be required to propose a treatment system for a given water to achieve a specified end use. The students will need to tackle the challenge and plan and develop a solution by applying the knowledge during the course. Each team will be required to deliver a final report and present it in class at the end of the course.

Details regarding dates/times, contents, formats, deadlines, plant visits… for each activity will be given in advance.

LEARNING OBJECTIVES OF THE SUBJECT

Upon successful completion of this subject the student will be able to:
• To define key concepts and principles related to the water cycle as well as the challenges and underlying philosophy associated to the new paradigm of circular economy in the water sector.
• To demonstrate knowledge of the water quality characteristics (physico-chemical and biological) and principal contaminants associated to different types of water: wastewater, drinking water and reclaimed water.
• To comprehend the scientific/engineering principles behind the main water treatment processes and conduct basic design of treatment units.
• To critically select appropriate water treatment processes depending on the nature of impurities to be removed for specific water quality challenges and formulate a basic outline of a whole treatment train.
• To learn which routes and technologies are available today for the reclamation and reuse of wastewater in a circular economy context.

STUDY LOAD

Type	Hours	Percentage
Hours small group	21,0	14.00
Self study	108,0	72.00
Hours large group	21,0	14.00

Total learning time: 150 h

CONTENTS

Introduction

Description:
The natural and the man-made water cycles. Current water resources and uses. Water footprint. The need for action. Water treatment in different contexts: wastewater, drinking water and reclaimed water. Alternative hydric resources. The shift from linear to circular economy model: the need of a new paradigm.

Specific objectives:
• To define key concepts and principles related to water cycle as well as to get familiarised with the basic terminology.
• To demonstrate basic understanding of the challenges and underlying philosophy associated to the new paradigm of circular economy in the water sector.

Related activities:
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Full-or-part-time: 8h
Theory classes: 8h

Technologies and systems for water treatment

Description:
Physico-chemical and biological water components. Characteristics of the different types of water. Overview of the different technologies for water treatment. Multibarrier concept. Pre-treatment. Primary treatment (coagulation, flocculation, sedimentation, flotation, aeration). Secondary treatment (biological processes for nutrients removal). Tertiary treatment (adsorption, ion-exchange, chemical oxidation, photolysis, disinfection). Membrane-based technologies for water treatment (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Natural treatment systems. Innovative hybrid systems.

Specific objectives:
• To demonstrate knowledge of the water quality characteristics (physico-chemical and biological) and principal contaminants associated to different types of water: wastewater, drinking water and reclaimed water.
• To comprehend the scientific/engineering principles behind the main water treatment processes and conduct basic design of treatment units.
• To critically select appropriate processes depending on the nature of impurities to be removed for specific water quality challenges and formulate a basic outline of a whole treatment train.

Related activities:
Solving problems related to the unit content (in the classroom and/or as homework assignment)

Full-or-part-time: 12h
Theory classes: 12h

Wastewater treatment

Description:
Past and current practices. Wastewater flows and characteristics. Wastewater collection systems. Contaminants of concern in wastewater treatment. Wastewater regulations. Common technologies in wastewater treatment plants (WWTP). Recovery of components from wastewater. Materials and energy pathways in the water sector.

Specific objectives:
• To demonstrate understanding of the principal contaminants associated with wastewater.
• To acquire general knowledge of the conventional unit operations employed in wastewater treatment plants (WWTP).

Related activities:
Visit to a wastewater treatment plant (WWTP)
Oral exposition (using power point) of a case study (carried out individually or in small groups)

Full-or-part-time: 12h
Theory classes: 12h

Drinking water treatment

Description:
Past and current practices. Drinking water flows and characteristics. Health and aesthetic aspects of drinking water. Contaminants of concern in drinking water treatment. Drinking water regulations. Common technologies in drinking water treatment plants (DWTP). Desalination.

Specific objectives:
• To demonstrate understanding of the principal contaminants associated with drinking water.
• To acquire general knowledge of the conventional unit operations employed in drinking water treatment plants (DWTP).

Related activities:
Visit to a drinking water treatment plant (DWTP)
Oral exposition (using power point) of a case study (carried out individually or in small groups)

Full-or-part-time: 12h
Theory classes: 12h

Water reclamation and reuse. Circularity in the water sector

Description:
Past and current practice. Industrial symbiosis and potential circularity in the water sector. Common technologies for water reclamation. Water reuse applications: agricultural, industrial, urban, environmental uses. Problems and pressures derived from the reuse of wastewater. Health risk analysis in water reuse applications. Water reuse regulations and guidelines. Water reuse implementation. Examples of water reuse projects.

Specific objectives:
• To learn which routes and technologies are available today for the reclamation and reuse of wastewater in a circular economy context.
• To identify opportunities and formulate hypothesis and/or innovative ideas on routes and technologies by applying concepts and theories learned in the previous units.

Related activities:
Visit to a site with a project on water reclamation

Full-or-part-time: 16h
Theory classes: 16h

GRADING SYSTEM

The assessment is based on the following task (with corresponding weighing):

• Mid-term test: 20%
• Short activities (critical reading and discussion of an article, solving problems posed by the teacher, short-answer questionnaires, homework assignments, short quizzes…): 10%
• Oral exposition of case studies: 10%
• Project development and oral exposition: 30%
• Final test: 30%

BIBLIOGRAPHY

Basic:
- Hammer, Mark J.; Hammer, Mark J. Jr. Water and wastewater technology. 5th ed. Upper Saddle River: Prentice Hall/Pearson Education International, cop. 2004. ISBN 0131911406.
- American Water Works Association. Water quality and treatment : a handbook on drinking water. 6th ed. New York: McGraw-Hill, 2011. ISBN 9780071630115.
- Binnie, Chris; Kimber, Martin; Water, Atkins. Basic water treatment. 4th ed. London: Thomas Telford, 2009. ISBN 9780727736086.
- Crittenden, John [et al.]. MWH's water treatment principles and design [on line]. 3rd ed. Hoboken, New Jersey: Wiley, cop. 2012 [Consultation: 12/05/2020]. Available on: https://onlinelibrary.wiley.com/doi/book/10.1002/9781118131473. ISBN 9780470405390.
- Judd, Simon (ed.). Process science and engineering for water and wastewater treatment. London: IWA Publishing, 2002. ISBN 1900222752.
- Asano, Takashi [et al.]. Water reuse : issues, technologies, and applications. New York: McGraw-Hill, cop. 2007. ISBN 9780071459273.