Course guides
240051 - 240051 - Environmental Technology and Sustainability

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

Degree: BACHELOR’S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).
BACHELOR’S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2010). (Compulsory subject).
BACHELOR’S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2020 ECTS Credits: 6.0 Languages: Catalan, Spanish

LECTURER
Coordinating lecturer: JORDI BOU SERRA
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DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
4. Basic knowledge applied to environmental and sustainability technologies.

Transversal:
1. SELF-DIRECTED LEARNING. Detecting gaps in one’s knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one’s knowledge.
2. 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.

TEACHING METHODOLOGY

The subject is based on an exhibition methodology (lecture) using PowerPoint slides as support to teach the theoretical (20%), a participative methodology to teach the part of practical problems related to the theory (16%), active and collaborative learning to carry out different practises along the course (4%) and self-learning (60%):

The practises, which are compulsory to attend, will be done in groups of two people during the class hours dedicated for this activity. Depending on the type of the practice and before it is carried out, the students will have to present an individual report about the practice mentioned beforehand following the indications of its script, the previous inform is required so as to evaluate the practice. By the end of the class, the students will hand in, in groups, a report with the resolution of the problem set in the practice.

LEARNING OBJECTIVES OF THE SUBJECT

The course aims to provide students with a range of expertise to analyze and solve environmental problems and be able to propose sustainable alternatives, especially those aspects related to industrial activity. Therefore, after the course the student should be able to:

1. Assess the environmental impact of an activity.
2. Calculate and design equipment to reduce the environmental impact of an activity.
3. Identify and develop alternatives to minimize the environmental impact of an activity.
4. Describe and evaluate proposals to make more sustainable an activity.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>54,0</td>
<td>36.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>6,0</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

(ENG) -TEMA 1- INTRODUCTION

Description:

Related activities:
(ENG) Theory Classes
Problem Classes
Autonomous Learning

Full-or-part-time: 23h
Theory classes: 5h
Practical classes: 4h
Self study: 14h

(ENG) TEMA 2-THE ENVIRONMENT OF SURFACE WATERS

Description:
The hydrological cycle of water: water use. Water quality: physical, chemical and biological parameters; water quality indicators. Natural mechanisms of water purification: classification of the different mechanisms; BOD and COD; kinetics of aerobic degradation of organic matter; effect of organic matter on rivers; eutrophication. Supply water treatments: drinking and water conditioning. Wastewater treatment: characteristics of wastewater; pretreatments; primary treatments; secondary treatments; tertiary treatments; reuse. Sludge management. The sanitation plan and its financing.

Related activities:
(ENG) Theory Classes
Problem Classes
Practice
Autonomous Learning

Full-or-part-time: 32h
Theory classes: 6h
Practical classes: 7h
Self study: 19h
(ENG) TEMA 3-THE ATMOSPHERIC ENVIRONMENT

Description:
(ENG) Air pollution: types of pollutants; air quality (ICQA). Air pollutants: origin, characteristics and effects. Natural mechanisms of air purification: meteorological factors; pollutant dispersion mechanisms; pollutant dispersion models. Mechanisms for pollution prevention, control and correction: type of equipment and selection; particulate emission control equipment; equipment for the control of the emission of gases.

Related activities:
(ENG) Classes teoria
Classes problemes
Pràctica
Apenentatge autònom

Full-or-part-time: 27h
Theory classes: 5h
Practical classes: 6h
Self study: 16h

(ENG) TEMA 4-SOIL, GROUNDWATER AND ENVIRONMENT

Description:
(ENG) Soil and Groundwater: Groundwater Flow, Darcy's Law. Soil degradation: degradation mechanisms; heavy metals; hydrocarbons; other toxic compounds. Natural mechanisms that affect pollutants in the soil: transport by advection, dispersion and diffusion; retention: adsorption, precipitation and chemical reaction; attenuation. Soil recovery treatments: classification and selection; landfill removal and deposition; stabilization and confinement; physicochemical, biological and thermal treatments. Treatments for groundwater recovery.

Related activities:
(ENG) Theory Classes
Problem Classes
Autonomous Learning

Full-or-part-time: 21h
Theory classes: 4h
Practical classes: 4h
Self study: 13h

(ENG) TEMA 5-SOLID WASTE AND ENVIRONMENT

Description:

Related activities:
(ENG) Theory Classes
Problem Classes
Autonomous Learning

Full-or-part-time: 20h
Theory classes: 5h
Practical classes: 3h
Self study: 12h
(ENG) TEMA 6-ACCIDENTAL ENVIRONMENTAL IMPACT

Description:
(ENG) Introduction: definition of risk, types and measurement parameters. Serious risks: legislation. Risk analysis: methods of risk identification: historical analysis; risk index; HAZOP; fault trees. Types of accidents: fires; explosions; BLEVE-fireball; dispersion of toxic clouds; the danger of inert gases. Consequence assessment: models of vulnerability (Probit)

Related activities:
(ENG) Theory Classes
Problem Classes
Practice
Autonomous Learning

Full-or-part-time: 27h
Theory classes: 5h
Practical classes: 6h
Self study: 16h

ACTIVITIES

(ENG) PRÀCTICA 1. WATER TAXES

Description:
Estimation of water taxes for the discharge of wastewater.

Material:
Practice statement. Class notes. Slides

Delivery:
Prior report before doing the practice.
Report with the resolution of the problem proposed in practice at the end of the class

Related competencies:
CE16. Basic knowledge applied to environmental and sustainability technologies.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
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.

Full-or-part-time: 4h
Practical classes: 2h
Self study: 2h
**PRÁCTICA 2. ESTIMATION OF EMISSIONS IN SOLVENT STORAGE TANKS**

**Description:**
Application of EPA TANKS software to estimate solvent emission from storage tanks.

**Material:**
Practice statement. Class notes. Slides. TANKS Software

**Delivery:**
Prior report before doing the practice.
Report with the resolution of the problem proposed in practice at the end of the class

**Related competencies:**
CE16. Basic knowledge applied to environmental and sustainability technologies.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal.
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.

**Full-or-part-time:** 4h
Practical classes: 2h
Self study: 2h

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**PRÁCTICA 3. SIMULATION OF THE DISPERSION OF TOXIC AND FLAMMABLE GASES USING ALOHA SOFTWARE**

**Description:**
Study of the evolution of the dispersion of toxic and flammable gases using the ALOHA software of the EPA.

**Material:**
Practice statement. Class notes. Slides. Problems solved. ALOHA software

**Delivery:**
Prior report before doing the practice.
Report with the resolution of the problem proposed in practice at the end of the class.

**Related competencies:**
CE16. Basic knowledge applied to environmental and sustainability technologies.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal.
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.

**Full-or-part-time:** 4h
Practical classes: 2h
Self study: 2h
(ENG) PARCIAL EXAM

Description:
Test type exam

Material:
Class notes. Slides. Problems solved. Supporting bibliographic material.

Related competencies:
CE16. Basic knowledge applied to environmental and sustainability technologies.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
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.

Full-or-part-time: 50h 15m
Theory classes: 1h 15m
Self study: 49h

(ENG) FINAL EXAM

Description:
Final exam of the subject with a test-type part and the other problem-solving part.

Material:
Class notes. Slides. Problems solved. Supporting bibliographic material.

Delivery:
Answers to the questions and to the problems

Related competencies:
CE16. Basic knowledge applied to environmental and sustainability technologies.
07 AAT. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
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.

Full-or-part-time: 93h
Theory classes: 3h
Self study: 90h
GRADING SYSTEM

The final mark of the subject will be the one obtained as follows, taking into account that the final exam covers the entire course and that the partial exam does not release subjects for the final exam:

FINAL MARK: \( NF = 0.1 \times NP + 0.1 \times NAC + 0.3 \times NEP + 0.6 \times NEF \)

NP: Average mark of the practices
NAC: Average mark of the continuous evaluation
NEP: Mark of the partial exam
NEF: Mark of the final exam

If at the beginning of the course the academic situation is normalized, then the final grade will be: \( NF = 0.1 \times NP + 0.3 \times NEP + 0.6 \times NEF \).

In case of doing the re-evaluation exam, the mark obtained on it will constitute the 80% of the final mark, keeping the 10% corresponding to the mark obtained from the practices during the academic year or in previous academic years. Likewise, 10% of the NAC obtained during the course or in any previous course will be maintained. In the event that the reevaluation is carried out on the basis of a normal situation, the reevaluation exam will have a value of 90% and the mark of the practices will have a value of 10%.

EXAMINATION RULES.

The tests, both partial and final exams, can be done with all bibliographic material available: notes from class, consulting books, collection of problems! The partial exam is a test which lasts 1 hour and a quarter. The final exam consists of a test part with a value of the 30% of the final mark of the exam and with duration of 1 hour, and another part of problems with a value of the 70% of the final exam mark and lasting 2 hours.

BIBLIOGRAPHY

Basic:

Complementary:
RESOURCES

Audiovisual material:
- Tecnologia Medi ambient i Sostenibilitat. Transparències part teòrica. Resource
- Tecnologia Medi Ambient i Sostenibilitat. Problemes i pràctiques. Resource

Hyperlink:
- http://www20.gencat.cat/portal/site/mediambient
- http://www.epa.gov/
- http://www.eea.europa.eu/