



Course guide

240051 - 240051 - Environmental Technology and Sustainability

Last modified: 16/05/2023

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

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Compulsory subject).
BACHELOR'S DEGREE IN AUTOMOTIVE ENGINEERING (Syllabus 2017). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JORDI BOU SERRA

Others: ROSA MARIA DARBRA ROMAN - JUAN JESUS PEREZ GONZALEZ - JOAQUIM OLIVE DURAN -
NÚRIA SAPERAS PLANA - MARTI PUIG DURAN - MARTI HORTOS LOBERA - ALBERT SORET
MIRABET - ELISABETH BOU PETIT

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 (25%), a participative methodology to teach the part of practical problems related to the theory (20%), active and collaborative learning to carry out different practises along the course (5%) and self- learning (50%):

The practises, which are compulsory to attend, will be done 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 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

| Type | Hours | Percentage |
|-------------------|-------|------------|
| Self study | 90,0 | 60.00 |
| Hours large group | 54,0 | 36.00 |
| Hours small group | 6,0 | 4.00 |

Total learning time: 150 h

CONTENTS

(ENG) -TEMA 1-INTRODUCTION

Description:

(ENG) Sustainability: Carrying capacity, concept and variables. Definitions of sustainability. Sustainable development, sustainable triangle. Technology role: equation IPCP. Sustainability indicators: ecological / bio-capacity demand. Environmental Management: responds to the principles of sustainability, principles and evolution of environmental management, critical points of environmental management. Product impact. Environmental impact of the Regulation. Tools of environmental management. LCA. Ecodesign. Environmental impact indicators.

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:

(ENG) Definition of waste: the problem of solid waste. Waste classification. Waste management: minimization, recovery, reuse and recycling, energy use. Municipal solid waste treatment (MSW): characteristics of MSW; selective collection; biological treatment: composting; thermic treatment; landfills. Industrial waste and its treatment: characteristics; the waste catalog; physicochemical and biological treatments; heat treatments; landfills.

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.
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.
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.

Full-or-part-time: 4h

Practical classes: 2h
Self study: 2h



(ENG) PRÀCTICA 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.

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.

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.

Full-or-part-time: 4h

Practical classes: 2h

Self study: 2h

(ENG) PRÀCTICA 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.

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.

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.

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.

Delivery:

Answers to exam questions

Related competencies :

CE16. Basic knowledge applied to environmental and sustainability technologies.

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.

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.

Full-or-part-time: 50h

Theory classes: 1h

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.

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.

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.

Full-or-part-time: 93h

Theory classes: 3h

Self study: 90h



PRACTICE 4. WATER QUALITY

Description:

Determination in a laboratory of some pollutants in water and evaluation of its quality

Material:

Environmental chemistry laboratory with sensors and spectrophotometers for the detection and quantification of contaminants

Delivery:

Previous written work and practice report

Related competencies :

CE16. Basic knowledge applied to environmental and sustainability technologies.

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.

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.

Full-or-part-time: 4h

Practical classes: 2h

Self study: 2h

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: $NF = 0,1 \cdot NP + \max(0,9 \cdot NEF ; (0,6 \cdot NEF + 0,3 \cdot NEP))$

NP: Average mark of the practices

NEP: Mark of the partial exam

NEF: Mark of the final exam

In case of doing the re-evaluation exam, the mark obtained on it will constitute the 90% of the final mark, keeping the 10% corresponding to the mark obtained from the practices during the academic year or in previous academic years.

EXAMINATION RULES.

The exams, both partial and final exams, are written and they can be done with authorized documentary material, for example: notes from class, crib sheets, collection of problems,... The partial exam is a test which lasts 1 hour. 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:

- Arnaldos, Josep [et al.]. Tecnologia del medi ambient : fonaments, problemes i qüestions. Barcelona: Kit-Book, 2016. ISBN 9788494576225.
- Davis, Mackenzie Leo ; David A. Cornwell. Introduction to environmental engineering. 5th ed. New York: McGraw-Hill, 2013. ISBN 9780071326247.
- Glynn, Henry J. ; Heinke, Gary W. Ingeniería ambiental. 2a. México: Prentice-Hall, 1999. ISBN 9701702662.
- Kiely, Gerard. Environmental engineering. Boston: McGraw-Hill, 2007. ISBN 0070634297.
- Peavy, Howard S. Environmental engineering. Nova York: McGraw-Hill, 1985. ISBN 0070491348.

Complementary:



- Edzwald, James K. Water Quality and Treatment : A Handbook on Drinking Water. 6th. Nova York: Mc Graw-Hill, 2011. ISBN 9780071630115.
- Dorf, Richard C. Technology, humans and society: toward a sustainable world [on line]. San Diego: Academic Press, 2001 [Consultation : 30/03/2023]. Available on : <https://www.sciencedirect-com.recursos.biblioteca.upc.edu/book/9780122210907/technology-humans-and-society>. ISBN 9780122210907.
- Casal, Joaquim. Análisis del riesgo en instalaciones industriales [on line]. Barcelona: Edicions UPC, 1999 [Consultation: 08/09/2020]. Available on: <http://hdl.handle.net/2099.3/36154>. ISBN 9701502930.
- Torres López, A. L. Medi ambient i tecnologia : guia ambiental de la UPC [on line]. Barcelona: Edicions UPC, 1998 [Consultation: 09/09/2022]. Available on: <https://upcommons.upc.edu/handle/2099.3/36198>. ISBN 8483012782.
- Casal, Joaquim. Evaluation of the Effects and Consequences of Major Accidents in Industrial Plants [on line]. 2nd ed. Amsterdam: Elsevier, 2017 [Consultation : 08/09/2020]. Available on : <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5056836>. ISBN 9780444638830.
- LaGrega, Michael D. Gestión de residuos tóxicos : tratamiento, eliminación y recuperación de suelos. Madrid: McGraw-Hill, 1996. ISBN 8448107128.
- Metcalf & Eddy, Inc. Wastewater engineering : treatment and resource recovery [on line]. 5th ed. New York: MacGraw-Hill, 2014 [Consultation : 29/03/2023]. Available on : <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pg-origsite=primo&docID=5662641>. ISBN 9780073401188.

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/>