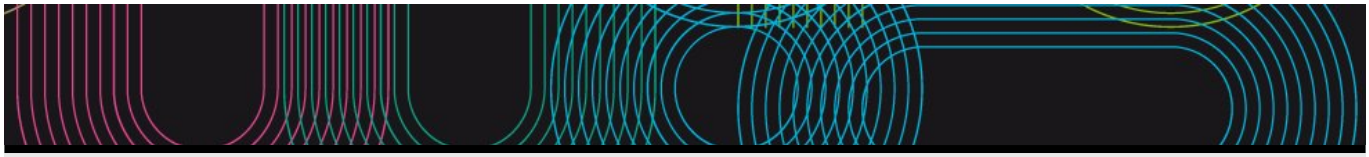

IDENTIFYING DATA				
Environmental technology				
Subject	Environmental technology			
Code	P52G381V01207			
Study programme	(*)Grao en Enxeñaría Mecánica			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	Spanish			
Department				
Coordinator	González Gil, Lorena			
Lecturers	Alfonsín Pérez, Víctor Ángel González Gil, Lorena Maceiras Castro, María del Rocío			
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General description	This syllabus collects the competencies that the students must acquire in this course, the calendar of planned educational activities, the contents and its distribution, an estimate of the volume of work of the student and the specific criteria of assessment. The aim of this subject is to form future graduates in Bachelor Mechanical Engineering with the ability to identify the environmental impacts of industrial and human activities, with the aim to minimize, prevent and solve them. In fact, the increase in legal requirements related to environmental protection, together with the interest of society in the application of more environmentally friendly technological solutions enhance the need for professionals capable of solving environmental problems within multidisciplinary contexts. To achieve this, in this subject it is carried out an approach to Environmental Engineering in combination with other knowledge fields, such as Mechanical Engineering, Chemistry (study of pollutants and their behavior), Biology (biotechnological processes) and Process Engineering (design of physical, chemical and biological processes to mitigate contamination). More specifically, in this subject some technical and practical knowledge about environmental pollution in different ecosystems and their flows of matter and energy will be needed, to later study all the vectors of pollution and evaluate the most appropriate technologies to minimize them, complying whit the current legislation. Lastly, basic knowledge is given on the main policies, tools and indicators developed within the framework of environmental management for the prevention of industrial pollution.			

Competencies	
Code	
B7	Ability to analyze and assess the social and environmental impact of the technical solutions.
C16	Basic knowledge and application of environmental technologies and sustainability.
D1	Analysis and synthesis
D2	Problems resolution.
D3	Oral and written proficiency
D9	Apply knowledge.
D10	Self learning and work.
D12	Research skills.
D17	Working as a team.
D19	Sustainability and environmental commitment. Equitable, responsible and efficient use of resources.

Learning outcomes		
Expected results from this subject	Training and Learning Results	
To know the available environmental technologies for control of gaseous pollutants	C16	D2 D3 D10

To know the basic processes for the conditioning of water and wastewater treatment		C16	D2 D3 D10
To know the performance of wastewater treatment plants		C16	D2 D3 D10
To know the integrated process of industrial waste treatment		C16	D2 D3 D10 D19
To know and be able to apply the different tools for preventing industrial pollution		C16	D1 D2 D3 D9 D10 D12 D17 D19
Ability to analyze and determine the social and environmental impact of the technical solutions to environmental problems	B7		D1 D3 D9 D10 D17 D19
ENAEE LEARNING OUTCOMES. KNOWLEDGE AND UNDERSTANDING LO1.3.- awareness of the wider multidisciplinary context of engineering (level of development this sub-resulted of learning: Intermediate (2))		C16	
ENAEE LEARNING OUTCOME. ENGINEERING ANALYSIS LO2.2.- ability to identify, formulate and solve engineering problems in their field of study; to select and apply relevant methods from established analytical, computational and experimental methods; to recognise the importance of non-technical □societal, health and safety, environmental, economic and industrial □ constraints (Intermediate (2))	B7		D1 D2 D9 D19
ENAEE LEARNING OUTCOME. ENGINEERING DESIGN LO3.1.- ability to develop and design complex products (devices, artefacts, etc.), processes and systems in their field of study to meet established requirements, that can include an awareness of non-technical □ societal, health and safety, environmental, economic and industrial□ considerations; to select and apply relevant design methodologies (Intermediate (2))	B7		D2 D9 D19
ENAEE LEARNING OUTCOMES. INVESTIGATIONS LO4.2.- ability to consult and apply codes of practice and safety regulations in their field of study (Intermediate (2))	B7		
ENAEE LEARNING OUTCOMES. ENGINEERING PRACTICE LO5.1.- understanding of applicable techniques and methods of analysis, design and investigation and of their limitations in their field of study (Intermediate (2))			D9 D12
ENAEE LEARNING OUTCOMES. ENGINEERING PRACTICE LO5.4.- ability to apply norms of engineering practice in their field of study (Basic (1))	B7		D9
ENAEE LEARNING OUTCOMES. ENGINEERING PRACTICE LO5.5- awareness of non-technical - societal, health and safety, environmental, economic and industrial □ implications of engineering practice (Intermediate (2))	B7	C16	D19
ENAEE LEARNING OUTCOMES. MAKING JUDGEMENTS LO6.1.- ability to gather and interpret relevant data and handle complexity within their field of study, to inform judgements that include reflection on relevant social and ethical issues (Intermediate (2))	B7		D19

Contents

Topic	
LESSON 1: INTRODUCTION: IMPORTANCE OF ENVIRONMENTAL TECHNOLOGY IN SOCIETY	1. Pollution and environmental impacts 2. Milestones in environmental protection 3. Environmental catastrophes
LESSON 2: MAIN UNIT OPERATIONS USED IN ENVIRONMENTAL TECHNOLOGY	1. Introduction to the unit operations: concept and classification 2. Separation operations controlled by mass transfer 3. Separation operations controlled by heat transfer 4. Separation operations controlled by heat and mass transfer 5. Separation operations controlled by fluid mechanics 6. Membrane separation processes
LESSON 3: MASS BALANCES IN ENVIRONMENTAL ENGINEERING PROCESSES	1. Mass balances in steady state with and without chemical reaction 2. Mass balances in unsteady state with and without chemical reaction

LESSON 4: ATMOSPHERIC POLLUTION	1. Introduction 2. Types of pollutants 3. Effects of the atmospheric pollution 4. Technical solutions to air emission control
LESSON 5: WATER POLLUTION	1. Introduction 2. Types of pollutants 3. Indicators of water pollution 4. Wastewater treatment technologies
LESSON 6: SOIL POLLUTION	1. Introduction 2. Types of polllutants 3. Remediation techniques
LESSON 7: INTRODUCTION TO SOLID WASTE TREATMENT	1. Introduction 2. Types of solid waste 3. Solid waste treatment technologies
LESSON 8: ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT	1. Introduction to the tools for evaluating the environmental impact 2. Life cycle assessment 3. Environmental management system 4. Prevention and control of the industrial pollution: IPPC directive and PRTR regulation
Practice 1. Sedimentation	The objective of this practice is to determine the sedimentation rate of particles contained in a wastewater in order to design a sedimentation tank.
Practice 2: Coagulation - Flocculation	To improve sedimentation efficiency during wastewater treatment, in many cases, it is necessary to previously perform coagulation followed by flocculation. These processes are optimized in the laboratory.
Practice 3: Analysis of the main pollutants in wastewaters	In this practice, some of the key parameters in the contamination of a water are experimentally measured, such as the chemical oxygen demand and the concentration of sulfates, phosphates and chlorides.
Practice 4: Determination of the solids content of a water	The objective of the previous practice is complemented determining the solid content of a wastewater.
Practice 5: Extraction with solvents	This solid-liquid extraction practice is carried out in order to get the student familiarized with the chemical processes used to separate contaminants from a soil.
Practice 6: Introduction to the simulation software DWSIM	In this practice, it is used the chemical process simulator DWSIM (open source). The student will become familiar with the simulation tool and will carry out different examples such as conversion reactors, balance reactors, condensers and simple distillation columns.
Practice 7: Classification and labeling of solid waste	In this practice, the students familiarize with the regulations related to the classification and labeling of both hazardous and non-hazardous solid waste. In addition, it is addressed the importance of waste classification for worker safety and health and for society in general.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	28	45	73
Laboratory practical	14	7	21
Problem solving	7	7	14
Seminars	15	7	22
Objective questions exam	4	0	4
Essay	0	5	5
Systematic observation	0	0	0
Essay questions exam	3	2	5
Essay questions exam	3	0	3
Essay questions exam	3	0	3

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Teaching in the classroom of the key concepts and procedures for learning the syllabus contents. In addition to the information published on the online teaching platform, which contains the file with the lesson slides, the students have in the recommended bibliography the contents of each leasson with a more detailed development.

Laboratory practical	Application of the knowledge acquired to the resolution of problems of environmental technology. A series of practices have been designed in accordance with the content of the subject in order to fix concepts explained in this class.
Problem solving	The student must solve exercises and problems that will be posed and corrected by the teacher. Also, the lecturer will suggest exercises to perform individually.
Seminars	Intensive 15-hour course for those students who have failed the subject on the first call, prior to the exam on the second call. Group tutoring with the lecturer.

Personalized assistance

Methodologies	Description
Laboratory practical	Academic tutoring and personalized tutoring.
Lecturing	In the scope of the tutorial action, it can distinguished between academic tutoring actions and personalized tutoring. Both types of tutorial action are combined to compensate for the different learning rhythms and thus paying attention to diversity. The professors of the subject will solve the questions and queries of the students in person or online (via email, videoconference, FAITIC forums, etc.) at the time scheduled on the website of the center or by appointment.
Seminars	Academic tutoring and personalized tutoring.
Problem solving	Academic tutoring and personalized tutoring.

Assessment

	Description	Qualification	Training and Learning Results
Laboratory practical	Evaluation of the work in the laboratory and of the summary report with the data obtained in the practices, its analysis and discussion. At the end of each practice, the student must prepare a detailed report including aspects such as: objectives and theoretical fundaments of the practice, experimental procedure, materials used, the results obtained and their discussion. In addition, the comprehension of the practice, the student's synthesis capacity, the writing style and the presentation of the report, as well as the student's personal contribution, are evaluated. These reports will be compulsory and rated, each of them, on 10 points.	15	B7 C16 D1 D3 D9 D12 D17 D19
Objective questions exam	The theoretical and practical knowledge acquired by the student during the masterclasses and seminars will be monitored. There will be two continuous assessment tests of theory and problems (P1 and P2), with a weight of 15% each. Such tests will be compulsory and scored on 10 points.	30	B7 C16 D1 D2 D3 D9 D10 D12 D17
Essay	The students, in pairs or groups of 3, will carry out a written essay on contents related to Topic 8 "Environmental impact assessment and management" or on key aspects of other lessons that it is appropriate to further study. Part of the work will focus on seeking the real application of the addressed topic in different industrial or social fields, evidencing the multidisciplinary application of environmental engineering. Moreover, the students will have to reflect on the ethical and social implications of the studied content. Finally, each group will present their work orally and the peer-assessment among students will be encouraged.	7	C16 D1 D3 D9 D10 D12 D17 D19
Systematic observation	During class hours, individual tasks (IT, 5%) and other tasks (TO, 3%) that may be in groups will be proposed in order to monitor the contents taught. These activities will be compulsory and scored, each of them, on 10 points.	8	C16 D1 D3 D9 D10 D12 D17 D19
Essay questions exam	Final Exam (FE) At the end of the course, the knowledge acquired by the student will be evaluated by means of a written test with theoretical contents (4 points) and problems (6 points). Such exam will be compulsory and scored on 10 points.	40	B7 C16 D1 D2 D3 D9 D10 D12 D17

Essay questions exam	Ordinary Exam If the students do not pass the continuous evaluation, they will have an ordinary exam after the final exam. In this exam the students will be evaluated of all the contents taught, both theoretical and practical. It will be necessary to obtain a grade higher than 4 points out of 10 in each of the parts (theory and problems) in such exam. Besides, there will be a test related to the laboratory practices (with a weight of 10%).	100	B7 C16	D1 D2 D3 D9 D10 D12 D17
Essay questions exam	Extraordinary Exam The student will be examined of all the theoretical / practical contents taught in the subject during the ordinary course. In addition, it will be necessary to obtain a grade higher than 4 points out of 10 in each of the parts (theory and problems) evaluated in such exam.	100	B7 C16	D1 D2 D3 D9 D10 D12 D17

Other comments on the Evaluation

Minimum requirements to pass the continuous evaluation: the student must obtain a minimum of 5 in his/her total grade. In addition, the students will have to attend to the ordinary exam to pass the course in the following cases:

- If the weighted average of tests P1, P2, TI and FE is less than 5.
- The non-completion or delivery of any of the proposed tests/activities.
- If the obtained grade is lower than 4 points out of 10 in some of the parts (theory and problems) of the Final Exam.

Those students that do not fulfil any of the previous requirements will have a maximum grade of 4.0 in the continuous evaluation. All those students that have passed the continuous evaluation, but wish to improve their qualification, could attend to the ordinary exam.

ETHICAL COMMITMENT:

It is expected that the students have an adequate ethical behaviour.

- If it is detected an unethical behaviour (copy, plagiarism, use of unauthorised electronic devices or others) during the final or partial exams, the student will be punished with the impossibility to pass the subject by the modality of continuous evaluation, obtaining a qualification of 0.0.
- If this type of behaviour is detected in the ordinary or extraordinary exam, the student will obtain a qualification of 0.0.
- In the case of the documents delivered to evaluate the laboratory practices, the total or partial copy in the report (according to the opinion of the teachers of the subject), will be penalized in the final grade of the practices with a qualification of 0.0.

INTENSIVE COURSE:

In the case that the students do not pass the ordinary exam, they have to do the extraordinary examn in July. The Defense University Center proposes for these students an intensive course during the months of June and July of 15 hours during three weeks to prepare this exam. It will be elaborated a specific educational guide for such course. In the extraordinary exam, the student will be evaluated of all the practical/theoretical contents taught in the subject during the ordinary course. In addition, it will be necessary to obtain a grade higher than 4 points out of 10 in each part (theory and problems) of the exam.

Sources of information

Basic Bibliography

Guillermo Calleja, Francisco García, Antonio de Lucas, Daniel Prats, José M. Rodríguez, **Introducción a la Ingeniería Química**, Sintesis, 2008

Juan J. Rodríguez Jiménez, **La Ingeniería Ambiental: Entre el reto y la oportunidad**, Sintesis, 2002

Stanley E. Manahan., **Introducción a la Química Ambiental**, Reverté, 2007

Castells et al, **Reciclaje de reidusos industriales: residuos sólidos urbanos y fangos de depuradora**, 2ª ed., Díaz de Santos, 2009

Complementary Bibliography

Domingo Gómez Orea, **Evaluación de Impacto Ambiental**, 2ª ed., Mundi-Prensa, 2003

David M. Himmelblau, **Principios Básicos y Cálculos en Ingeniería Química**, 6ª ed., Prentice Hall Inc., 1997

Gerard Kiely, **Ingeniería Ambiental: Fundamentos, entornos, tecnologías y sistemas**, Mc Graw Hill, 1999
Glynn Henry, Gary W. Heinke, **Ingeniería Ambiental**, 2ª ed., Prentice Hall Inc., 1999
Metcalf & Eddy Inc., **Wastewater Engineering: Treatment and Resource Recovery.**, 5ª ed., Mc-Graw Hill, 2013
Tang Zhongchao, **Air Pollution and Greenhouse Gases: From Basic Concepts to Engineering Applications for Air Emission Control**, (eBook), Springer, 2014

Recommendations

Subjects that it is recommended to have taken before

Physics: Physics 1/P52G381V01102
Physics: Physics II/P52G381V01106
Chemistry: Chemistry/P52G381V01108

Contingency plan

Description

MODIFICATIONS IN CASE OF SUSPENSION OF PRESENTIAL ACADEMIC ACTIVITY

== ADAPTATION OF THE CONTENTS ==

Practices 1-5 are designed to be carried out in laboratories, since they require specific equipment, reagents and materials. In order for the students to achieve the competences associated with these practices, as far as possible, demonstrative content, virtual visits, videos and other audiovisual media will be provided. In addition, some of the practices can be complemented with small domestic experiments. At the same time, the students will be provided with data mimicking what they could experimentally obtain in the laboratory, thus they can process them and draw conclusions. In the event that it is not possible to perform any of these practices in a demonstrative manner, practices similar to 6 will be carried out using a computer software to strengthen concepts of process and equipment design for treating pollution.
The order of the practical contents may be altered to favour their adaptation to the online teaching, which may also lead to variations in the order of the theoretical lessons.

== ADAPTATION OF THE TEACHING METHODOLOGY ==

A new teaching methodology is added:
Synchronous online meeting (theory or practical session): taught through an online conferencing platform. Each virtual classroom contains a variety of display panels and components, whose layout can be customized to best suit the needs of the session. In the virtual classroom, teachers (and those authorized participants) can share their screen or files, use a whiteboard, chat, stream audio and video, or participate in interactive online activities (surveys, questions, etc.).

== ASSESSMENT ADAPTATION ==

The evaluation test/activities will be carried out by combining the FAITIC-Moodle remote teaching platform and the Campus Remoto of the University of Vigo.