Course Syllabus

Subject	THE ENVIRONMENT AND RENEWABLE ENERGY		
Degree	INDUSTRIAL ENGINEERING INTERNATIONAL SEMESTER		
	TRANSVERSAL COURSE FOR THE SEVEN BACHELOR'S DEGREES TAUGHT IN INDUSTRIAL ENGINEERING		
Code	75003		
Semester	Second semester		
Type	Optional		
ECTS credits	6		
Lenguage	English		
Teaching staff (contact information)	*Raquel Lebrero*	*Venue: Doctor Mergelina*	*raquel.lebrero@iq.uva.es*
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Departments	Chemical Engineering and Environmental Technology		
	Electrical Engineering		

1. Sense of the Course

1.1 Contextualization

The subject is part of the Industrial Engineering International Semester. It is one of the three elective subjects that students can take in addition to the final project

1.2 Relationship with other subjects

The elective subjects that the student can choose in the international semester are:

- Creativity and Innovation in Industrial Design
- Science, Technology and Society
- System Dynamics. Modelling and Simulation in Engineering
- **Environment and Renewable Energy**
- Technical Projects Development and Manufacturing Engineering
- Spanish Course.- Language Centre

1.3 Recommended Prior Knowledge

No previous knowledge is necessary to understand the content of the course

2. Competences

2.1 Generic competences

- English language proficiency
- Team Leadership
- Creativity
- Organizational and planning issues
- Information management
- Work in international environments
- Problem solving

2.2 Specific competences

- Capability to understand environmental problems related to air, water and soil
- Ability to demonstrate knowledge on environmental policies and pollution prevention
- Ability to analyse and propose solutions to real environmental problems based on the implementation of BAT, sustainability metrics and DfE
- Design, analysis and planning of photovoltaic components and systems for a general purpose, either autonomous or grid connected.
- Analysis, design and implementation of photovoltaic systems of low-mid level of complexity.

3. Course goals

- Students will be able to identify the environmental impacts of the industrial activity and to suggest different options for waste minimization
- • Students will be able to explain the basis of sustainability, life cycle Assessment and design for the environment and to apply these concepts to real situations.
- Students will be able to explain how the solar photovoltaic energy works and which the main types of PV systems are.
- Students will be able of identifying the component parts of a photovoltaic system.
- Students will be able to describe the differences between an isolated, grid connected and own-consumption photovoltaic system.

4. Learning Units

Unit 1: "Industrial activity and Environment"

Workload in credits ECTS: 2

a. Course goals

- Students will be able to identify the environmental impacts of the industrial activity and to suggest different option for waste minimization.

b. Contents

- Introduction to air, water and soil pollution
- Hazardous waste management
- Natural resources depletion
- Environmental policies
- Pollution prevention and waste minimization
- Best Available Techniques
- Sustainability
- Introduction to sustainability metrics.

c. Bibliography

- Edward S. Rubin. Introduction to Engineering and the Environment. McGraw-Hill International Edition 2001
- Paul L. Bishop. Pollution prevention: Fundamentals and Practice. McGraw-Hill International editions. 2000
- The Sustainability Metrics: Sustainable Development Progress Metrics for use in Process Industries. Institution of Chemical Engineers (www. Icheme.org)
- Best Available Techniques. Reference documents under the IPPC Directive and the IED (http://eippcb.jrc.ec.europa.eu/reference/).

d. Timing

ECTS CREDITS	PLANNED DEVELOPMENT PERIOD
2 credits	First 5 weeks of the semester.

Unit 2: "Life Cycle Assessment and Design for the Environment"

Workload in credits ECTS: 2

a. Course goals

- Students will be able to explain the basis of sustainability, life cycle Assessment and design for the environment and to apply these concepts to real situations.

b. Contents

- Introduction to LCA: History of LCA, objective and structure
- Goal definition and Scoping Stage
- Inventory Analysis
- Impact analysis
- Improvement analysis
- Design for the environment
- Common guidelines in eco-design
- Biomimicry
- Green Chemistry

c. Bibliography

- Paul L. Bishop. Pollution prevention: Fundamentals and Practice. McGraw-Hill International editions. 2000
- http://www.ted.com/
- Guinee et al (2001) Life cycle assessment – an operational guide to the ISO standards. Prepared by CML, Leiden University, The Netherlands.
- Hertwich E (2011), from lectures in NTNU PhD course Life-cycle assessment and Environmental Systems Analysis EP8108, October 2011
- Hertwich EG and Hammitt JK (2001), A Decision-Analytic Framework for Impact Assessment,International Journal of Life Cycle Assessment, 2001, 6(5), pp. 265-271.

d. Timing

ECTS CREDITS	PLANNED DEVELOPMENT PERIOD
2 credits	Second 5 weeks of the semester.

Unit 3: "Photovoltaic systems"

Workload in credits ECTS: 2

a. Course goals

- Students will be able to explain how the solar photovoltaic energy works and which the main types of PV systems are.
- Students will be able of identify the component parts of a photovoltaic system.
- Students will be able to describe the differences between an isolated, grid connected and own-consumption photovoltaic system.

b. Contents

- Introduction
- General description of PV systems
- Basic concepts of electricity
- PC software package for the study, sizing and data analysis of PV systems (PVSyst).
- PV panel: I-V and P-V curves.
- Laboratory stand alone PV system.
- Laboratory grid connected PV system.
- Laboratory own-consumption PV system.

c. Bibliography

- Solar Energy: The physics and engineering of photovoltaic conversion, technologies and systems by Arno Smets; Klaus Jager; Olindo Isabella; Rene van Swaaij. UIT Cambridge, 2016
- Solar Electricity Handbook – 2019 Edition: A simple, practical guide to solar energy – designing and installing solar photovoltaic systems. Michael Boxwell. Greenstream Publishing; Edition: 2019
- ABB. "Cuaderno de aplicaciones técnicas nº 10: Plantas fotovoltaicas". 2011.
- Lorenzo Pigueras, Eduardo- "Electricidad solar fotovoltaica. 3, Radiación solar y dispositivos fotovoltaicos", Sevilla, Progensa 2006.

d. Timing

ECTS CREDITS	PLANNED DEVELOPMENT PERIOD
2 credits	Last 5 weeks of the semester.

5. Teaching and Learning Methods

The course consists of 3 learning units; each one is divided into theoretical lessons, practices, in-group corrections or checking, concerted tutorials and technical visits.

The lectures will mainly use oral presentation for teaching the fundamental knowledge of the subject. Active student participation will be encouraged.

The practical lessons will support the understanding and assimilation of the concepts provided in theoretical lectures. The assignments will be done individually or in small groups, depending on the activity and the number of students enrolled. Some of the assignments will be done in the classroom and at home. The assignments of each learning unit will be presented to the lecturer and other students and handed in to the teacher within the deadlines indicated in the schedule presented at the beginning of the course

Tutorials will involve personal assistance and will be carried out individually or in small groups in order to monitor the proper development of the work prior to final assignment submission. These tutorials should be previously arranged.

The visits will take place in full-scale industrial facilities in order to understand the differences between real and lab-scale systems.

6. Dedication of the student to the subject

PRESENTIAL ACTIVITIES	HOURS	NON PRESENTIAL ACTIVITIES	HOURS
Unit 1: "Industrial activity and Environment"	20	Student personal work	30
Unit 2: "Photovoltaic systems"	20	Student personal work	30
Unit 3: "Life Cycle Assessment and Design for the Environment"	20	Student personal work	30
Total presential	**60**	**Total non presential**	**90**

7. Activities evaluated and grading system

The Spanish University System provides to the students two calls:

- The first call grading system is based on a continuous assessment and will be held according to the following parameters:
  - Attendance and participation in class activities: 25% (It is obligatory to attend at least 80% of classes).
  - Activities and Assignments made in Learning Unit 1: 25%
  - Activities and Assignments made in Learning Unit 2: 25%
  - Activities and Assignments made in Learning Unit 3: 25%

It is essential to pass each individual unit in order to pass the course. If the students fail in the first call, they have another option to pass the subject in the second call

- The grading of students in the second call will be held according to the following parameters:
  - Exam of the contents presented in lectures: 25%
  - Activities and Assignments made in Learning Unit 1: 25%
  - Activities and Assignments made in Learning Unit 2: 25%
  - Activities and Assignments made in Learning Unit 3: 25%

It is essential to pass each individual unit in order to pass the course

8. Additional Considerations

The course is configured in such a way that it requires the presence of the student for its effective functioning. The means of communication with the students will be the subject page on the Virtual Campus of the University of Valladolid. On this page, information will be provided about its development and support material will be published for the teaching given in the classroom. This material can be used as a guide to the subject matter explained, but it is not intended to be exclusive material for study; the student should complete it with his notes and the recommended bibliography.