Sustainability and Green Engineering

Code: 44729
ECTS Credits: 6

2024/2025

Degree	Type	Year
4318303 Reseach and Innovation in Computer Based Science and Engineering	OB	0

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

None in particular.

Objectives and Contextualisation

The main objective of this course is that the student can acquire a global vision of environmental engineering and the fundamental concepts of sustainability. The main sustainability and environmental engineering tools, databases and systems will be worked on in order to quantify the environmental impacts of products and processes (carbon footprint, water footprint, energy efficiency, among others) and thus be able to optimize and minimize them. The content of this course mainly covers issues of life cycle assessment and environmental risk assessment based on environmental management of resources, including the description of the UN sustainable development goals. The concepts are explained with examples and case studies to illustrate the circular economy principle and the applicability of these assessment tools.

Learning Outcomes

1. CA02 (Competence) By the end of the subject, students will know how to apply the principles of the circular economy using applications that take into account environmental, global, cultural, social and economic factors.

2. CA03 (Competence) By the end of the subject, students will be able to handle inventory and process data in a structured and integrated way for decision-making and traceability in the value chain.
3. KA03 (Knowledge) By the end of the subject, students will be able to describe the tools needed to make a project more sustainable.
4. KA04 (Knowledge) By the end of the subject, students will be able to identify environmental management systems based on criteria and processes in order to respect the environment as much as possible and mitigate pollution.
5. KA05 (Knowledge) By the end of the subject, students will be able to list the main environmental concerns associated with a product, process or system.
6. SA06 (Skill) By the end of the subject, students will know how to develop tools that facilitate environmental improvement proposals for a product or process based on the results obtained after applying Life Cycle Assessment (LCA) methodology, and therefore optimise and mitigate its environmental impact.
7. SA07 (Skill) By the end of the subject, students will know how to design the databases needed to apply LCA methodology.

Content

BLOCK 1. CONCEPTS

Introduction to sustainability

- The socio-ecosystem as a complex system.

- Planetary limits

- Concept of sustainability and sustainable development.

- Agenda 2030. Sustainable Development Goals and Indicators

- Introduction to the concept of Green Engineering

Engineering vs economics

- Technosphere: The productive structure

- Metabolism: The material basis of the economy

- International production networks

- Linear and circular economic models

- Butterfly diagram. Donut Economy

BLOCK 2. GREEN ENGINEERING METHODS

Analysis of material and energy flow

- Material balances: from process to economy

- Material flow indicators

- Laws of thermodynamics

- Energy and exergy balances. EROI.

- SOFTWARE: STAN

Life cycle analysis

- History and origins of stroke

- LCA methodology;

- Regulatory framework • UNE-EN ISO 14040:2006. • UNE-EN ISO 14044:2006. • Related regulations.

- Inventories, uncertainty and contribution analysis

- Inventory parameterization

- Impact analysis methods: Characterization Factors, Life Cycle Impact Analysis, Interpretation of results

- SOFTWARE: Brightway2 (Activity Browser & PyCharm)

- Examples of application of the LCA methodology in various economic sectors as a tool to evaluate sustainability

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Ploblems Sessions	22	0.88	CA03, SA06
Theory Sessions	26	1.04	KA03, KA04, KA05
Type: Supervised			
Practices	10	0.4	KA03, KA05
Project	20	0.8	CA02, KA04, SA06, SA07
Type: Autonomous			
Problems Desenvolupment	32	1.28	CA02, SA06
Study	32	1.28	KA05, SA07

The teaching methodology to be followed is oriented to the continuous learning of the subject by the students.

This process is based on the realization of three types of activities that are developed at the end of the course: theoretical classes, problem seminars and practical sessions:

- Theoretical classes: The student acquires the knowledge of the subject by assisting in the master classes and complementing both cases to reinforce the knowledge in the theory classes.

The teacher will provide information on the knowledge of the subject and on strategies to acquire, expand and organize these knowledge. It will encourage the active participation of the students during these sessions, for example by raising discussions in those points that have a higher conceptual content.

- Seminars on problems: apply the knowledge acquired to the theoretical classes through practical cases. In the classroom practices there must be an understanding of the concepts introduced in the theoretical classes.

The students have to participate actively to consolidate the knowledge acquired by resolving, presenting and debating problems that they are related to. The students will work individually or in groups depending on the activity.

- Practies Sessions: the students have to work in teams of various people in the resolution of mathematical problems to serve computational purposes. After hauran present-them mitjançant oral and written reports.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Activities	50	4	0.16	KA03, KA04, SA07
Project	50	4	0.16	CA02, CA03, KA05, SA06

The evaluation of the subject will be done progressively and continuously throughout the semester.

The evaluation system is based on the following deliveries:

A) Activites. Individual or group deliverables (50%)

Individual or group exercises that vary between critical comments, programming exercises, or poster or video design. The final grade for this activity will be the average of the grades obtained in each deliverable.

B) Group project (50%)

Development of a project, to promote the consolidation of all the material worked on in the course. This activity counts for 40% of the final grade for the subject and will have an intermediate follow-up point in the form of a poster conference.

In order to pass the subject it is essential to have:

- A minimum grade of 4 in each of the evaluable parts

Must take into account:

- In the event that the evaluation of any of the parties does not ultimately exceed the minimum required, the numerical grade of the file will be the lowest value between 4.5 and the weighted average of the grades.
- A student will be considered non-assessable (NA) if he or she has not participated in a set of activities whose weight is equivalent to a minimum of two thirds of the total grade for the subject.

RECOVERY

If any of the deliveries are suspended, you will have the opportunity to recover the partial grade by resending the corrected document before the day determined by the teacher.

GRADE REVIEW

For each evaluation activity, a review place, date and time will be indicated in which the student can review the activity with the teacher. In this context, complaints may be made about the grade of the activity, which will be evaluated by the teaching staff responsible for the subject. If the student does not attend this review, this activity will not be reviewed later. Grade revisions can change it to increase or decrease.

HONOR REGISTRATIONS.

Awarding an honors grade is solely the decision of the teaching staff responsible for the subject. UAB regulations indicate that MH may only be granted to students who have obtained a final grade equal to or greater than 9:00 and in an amount not exceeding 5% of the number of students.

IREGULARITIES, COPYING AND PLAGIARISM

Without prejudice to other disciplinary measures that are deemed appropriate, and in accordance with current academic regulations, irregularities committed by the student that may lead to a variation in the grade of an evaluation act will be graded with a zero. Therefore, plagiarizing, copying or allowing any evaluation activity to be copied will mean failing it with a zero and cannot be recovered in the same academic year.

DATES AND SCHEDULING

The dates corresponding to the course activities and evaluation activities will be announced on the Virtual Campus. It is necessary to regularly consult this platform where various information about the operation of the subject will also be provided.

Bibliography

- Masters, G. M.; Ela, W.P. Introducción a la ingeniería medioambiental, Pearson Educación, Madrid, 2008
- Mihelcic, J.R., Fundamentos de Ingeniería Ambiental, Ed. Limusa Wiley, Méjico, 2001
- Klöpffer, W., & Grahl, B. (Birgit). (2018). Life cycle assessment (LCA): a guide to best practice.
- Matthews, H.S., Hendrickson, C.T., Matthews, D.H., 2014. Life Cycle Assessment: Quantitative Approaches for Decisions that Matter.
- Sonnemman G, Castells F, Schuchmacher M., Integrated Life-Cycle and risk assessment for industrial proceses, 2003 Editorial: lewis publishers, ISBN: 1-5667-0644-0 2

Software

Databases

- Ecoinvent https://www.ecoinvent.org/
- GaBi http://www.gabi-software.com/spain/index/

Software

1. OpenLCA http://www.openlca.org/
2. SimaPro https://simapro.com/
3. STAM https://mc-stan.org/

Language list

Name	Group	Language	Semester	Turn

(SEMm) Seminars (master)	1	English	first semester	afternoon
(TEm) Theory (master)	1	English	first semester	afternoon