Course guide
295113 - 295II133 - Sustainable Materials

Last modified: 14/07/2026

Unit in charge: Barcelona East School of Engineering
Teaching unit: 702 - CEM - Department of Materials Science and Engineering.

Degree: MASTER'S DEGREE IN INTERDISCIPLINARY AND INNOVATIVE ENGINEERING (Syllabus 2019). (Optional subject).
MASTER'S DEGREE IN MATERIALS SCIENCE AND ADVANCED MATERIALS ENGINEERING (Syllabus 2019). (Optional subject).
ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).
ERASMUS MUNDUS MASTER IN HYDROGEN SYSTEMS AND ENABLING TECHNOLOGIES (HYSET) (Syllabus 2024). (Optional subject).

Academic year: 2026 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: TOBIAS MARTIN ABT

Others: Primer quadrimestre:
TOBIAS MARTIN ABT - Grup: T1
NICOLAS CANDAU - Grup: T1
SEYED MAHMOOD FATEMI - Grup: T1
JAVIER GÓMEZ MONTERDE - Grup: T1
NOEL LEÓN ALBITER - Grup: T1
LEANDRO ISIDRO MARTÍNEZ OROZCO - Grup: T1
ROSE MARY RITA MICHELL URIBE - Grup: T1

PRIOR SKILLS

Scientific and technical education in materials science and engineering. Specifically, in the production, the transformation, the processing, the recycling and the storage of all type of materials which take into account sustainability concepts.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMUEII-12. Design technical solutions that guarantee responsible and sustainable management of the materials used to reduce their environmental impact. (Specific competence of the Efficient Systems specialty)
CEMCEAM-06. (ENG) Evaluar el tiempo de vida en servicio, la reutilización, la recuperación y el reciclaje de productos atendiendo a las características de los materiales que lo conforman

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
06 URI. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

LEARNING RESULTS

Skills:
S01. Communicate effectively with others orally, in writing and graphically about learning, thought processes and decision making, and participate in discussions, using interpersonal skills such as active listening and empathy that support teamwork.

Competences:
C01. Recognise the complexity of the economic and social phenomena typical of a welfare society in order to relate welfare to globalisation and sustainability, and use techniques, technology and principles of economics and sustainability in a balanced and compatible way.
C03. Manage the acquisition, structuring, analysis and visualisation of data and information in the field of energy transition and critically evaluate the results of this process.
C02. Work as part of a multidisciplinary team, whether as a team member or in a leadership role, to contribute to the development of projects with pragmatism and a sense of responsibility, undertaking commitments with due regard to the resources available.

TEACHING METHODOLOGY

PM1: Traditional lecture with master classes (practical resources will be available on the UPC intranet Atenea)
PM2: Active learning in small groups with real case projects. Industrial seminars and/or visits are equally considered.
PM3: Collaborative learning with teamwork and teamwork presentation
PM4: Tutoring
PM5: Skills evaluation

It should be noted that this course is mainly based on self-learning (project based learning methodology), with a close tutoring accorded by the professor.

PM: pedagogical method

LEARNING OBJECTIVES OF THE SUBJECT

- Raise student's awareness of reduce, reuse and recycle materials
- Develop student knowledge of circular economy
- Enhancement of analytical and presentational skills
- Improvement of team working abilities and interpersonal communications
- Improvement of decision making attitude and personal initiatives to resolve real-life scientific problems

STUDY LOAD

Type	Hours	Percentage
Hours small group	21,0	14.00
Self study	108,0	72.00
Hours large group	21,0	14.00

Total learning time: 150 h

CONTENTS

Material waste

Description:
Type of plastic wastes and the different alternatives for reusing them.

Specific objectives:
The seminar will provide general knowledge about waste reduction, circular economy and Ecodesign

Full-or-part-time: 25h
Theory classes: 3h
Self study : 22h

Recycling materials

Description:
What challenges face manufacturers who recycle material waste.
Explain the recycling hierarchy indicated by the terms primary, secondary, tertiary and quaternary recycling.
What materials are most commonly recycled from post-consumer sources and why?

Specific objectives:
Introduction of new concepts regarding material recycling together with the real-life issues who face manufactures during recycling process (i.e. separation, degradation, etc.)

Full-or-part-time: 25h
Theory classes: 3h
Self study : 22h

Life cycle Assessment

Description:
Introduction to the concept of life cycle assessment concept in order to assess the environmental impact associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance and recycling.

Related activities:
CES EduPack

Full-or-part-time: 25h
Theory classes: 3h
Self study : 22h

Bio-based polymers

Description:
Bio-based polymers: a sustainable way to minimize plastic pollution?

Specific objectives:
Introduction to bio-based polymers with a complete description of the different types, their productions and their applications.

Full-or-part-time: 25h
Theory classes: 3h
Self study : 22h

Circular economy seminar

Description:
A circular economy seminar will be launched and expert presentations will take place.

Full-or-part-time: 5h 30m
Theory classes: 1h 30m
Self study : 4h

1st project: Plastic waste collection, separation and recycling

Description:
This first project is based in the initial collection of plastic taps followed by their separation according to the plastic type. In a second step, plastic wastes will be grounded, extruded and/or injection-moulded in order to manufacture new plastic items. The 3D printing of a recycled plastic filament may be also largely considered.

Related activities:
Experimental work
Team working
Tutoring
Deliverable reports
Oral presentation and discussion of the obtained results.

Full-or-part-time: 15h
Laboratory classes: 15h

2nd project: characterization of the previously manufactured plastic item

Description:
In this second project, each group will determine the physico-chemical, thermal, mechanical and morphological properties of its recycled plastic item.

Related activities:
Experimental work
Team working
Tutoring
Deliverable reports
Oral presentation and discussion of the obtained results.

Full-or-part-time: 15h
Laboratory classes: 15h

GRADING SYSTEM

Any academic fraud, plagiarism or use or possession of unauthorised means in an assessment activity leads to a mark of zero (0) for the affected test or assignment. Furthermore, in accordance with the University's regulations, if disciplinary proceedings are initiated the subject is recorded as "Pending Assessment" until a decision is reached. These incidents are managed in accordance with the **Action Framework for Academic Integrity in Assessment at the UPC**.

40 % End-of-course evaluation* and 60 % continuous assessment**

* End-of-course evaluation referred to as a written test
**Continuous assessment included collaborative work and oral presentations (25%), delivery of project reports (25%) and attendance to laboratories and industrial seminars (10 %).

EXAMINATION RULES.

It will be indicated for each activity

BIBLIOGRAPHY

Basic:

- European Environment Agency. Circular economy in Europe : developing the knowledge base [on line]. European Environment Agency, 2016 [Consultation: 15/04/2020]. Available on: https://www.eea.europa.eu/publications/circular-economy-in-europe. ISBN 978-92-9213-719-9.
- Ignatyev, Igor; Thielemans, Wim; Vander Beke, Bob. "Recycling of polymers : a review". ChemSusChem: Chemistry and Sustainability, Energy and Materials [on line]. Volume: 7 Issue 6 (2014) [Consultation: 15/04/2020]. Available on: https://onlinelibrary-wiley-com.recursos.biblioteca.upc.edu/doi/full/10.1002/cssc.201300898.- Callister, William D.; Rethwisch, David G. Materials science and engineering : an introduction. 9th ed. Hoboken, New Jersey [etc.]: John Wiley & Sons, cop. 2015. ISBN 9780470419977.