Course guide
480092 - EI - Industrial Ecology

Last modified: 22/05/2026

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

Degree: MASTER'S DEGREE IN SUSTAINABILITY SCIENCE AND TECHNOLOGY (Syllabus 2013). (Optional subject).
MASTER'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2014). (Optional subject).

Academic year: 2026 **ECTS Credits:** 5.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: GEMMA CERVANTES TORRE-MARIN

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. The ability to critically analyse the features and work, business and environmental management methods and strategies of organisations, institutions and key agents for promoting sustainable human development, sustainability and environmental protection, particularly against climate change, by understanding and applying the concepts and theories of business ethics and social responsibility in the fields of engineering and scientific and technical innovation.
2. The capacity to apply the methods and tools used in the identification, information management, planning, management, execution and evaluation of programmes and projects in the fields of sustainability and environmental management to specific problems in a collaborative manner.
3. The ability to design, develop and apply, in an integrated and coordinated manner, the theories and analytical techniques of the social, economic and Earth sciences, as well as management and research-action techniques and approaches based on sustainability science and technology in the fields of biodiversity and natural resources, the built environment and services, and production systems and information.

Transversal:
4. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY

TDuring the development of the subject, the following teaching methodologies and training activities will be used:
• Masterclass or conference (MTC): presentation of knowledge by the teaching staff through masterclasses or by external people through invited lectures.
• Problem solving and case studies (PS): solving exercises collectively, carrying out debates and group dynamics, with the teacher and other students in the classroom; presentation in the classroom of an activity carried out individually or in small groups.
• Directed theoretical-practical work (DW): carrying out an activity or exercise of a theoretical or practical nature in the classroom, individually or in small groups, with the advice of the teacher.
• Project, activity or work of reduced scope (PR): learning based on carrying out, individually or in groups, a work of reduced complexity or extension, applying knowledge and presenting results.
• Independent study (IS): study or expand the content of the subject individually or in a group, understanding, assimilating, analyzing and synthesizing knowledge.
• Assessment Activities (ASS): in the form of individual questionnaires and/or projects that are done and presented in groups

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, the student:
a) Knows and understands the principles of industrial ecology, circular economy and industrial symbiosis and the main applications and methodologies.
b) Efficiently applies advanced data processing techniques and instruments to industrial ecology and circular economy challenges.
c) Develops and applies concepts and theories of industrial ecology, with originality, to the resolution of sustainability challenges and to real projects, identifying and formulating hypotheses or innovative ideas and subjecting them to tests of objectivity, coherence and viability.

STUDY LOAD

Type	Hours	Percentage
Hours large group	22,7	18.15
Self study	80,0	63.95
Hours small group	11,0	8.79
Hours medium group	11,4	9.11

Total learning time: 125.1 h

CONTENTS

1. INDUSTRIAL ECOLOGY CONCEPT. COMPARISON WITH CIRCULAR ECONOMY AND INDUSTRIAL SYMBIOSIS. ORIGIN OF IE

Description:
1.1 Concept of industrial ecology. 1.2 Comparison with circular economy and industrial symbiosis. 1.3 Natural and industrial ecosystems. 1.4 Origin of EI: history and other theoretical bases

Full-or-part-time: 6h
Theory classes: 2h
Guided activities: 4h

2. INDUSTRIAL ECOLOGY DEVELOPMENT IN THE WORLD

Description:
2.1 Map of examples of EI around the world. 2.2 The case of Kalundborg. 2.3 The Devens eco-industrial community. 2.4 The MESVAL project. 2.5 The by-product synergy in Tampico (México). 2.6 IE in agricultural systems. 2.7 Teaching, political, research IE initiatives.

Full-or-part-time: 12h
Theory classes: 4h
Guided activities: 8h

3. IE Methodological tools.

Description:
Description of different tools for the development of IE: Synergy diagrams, Life Cycle Analysis (LCA), Material Flow Analysis (MFA), Industrial Ecology Indicators Systems

Related activities:
Synergy diagrams
Life Cycle Analysis (LCA)
Material Flow Analysis (MFA)
Industrial Ecology Indicators Systems

Full-or-part-time: 4h
Theory classes: 1h
Guided activities: 3h

4. IE Strategies, policies and legal framework

Description:
European Union Green Deal.
Cleaner production (CP) and best available techniques (BATs)
Legal regulations related to EI.
IE policies in the world and global and regional institutions.

Related activities:
Waste and solid legislation; BAT's in waste water treatment

Full-or-part-time: 9h
Theory classes: 3h
Guided activities: 6h

ACTIVITIES

A1. THE ORIGINS OF THE INDUSTRIAL ECOLOGY AND IE FLOW DIAGRAM

Description:
Scientific publication analysis.

Material:
Scientific publications.

Delivery:
Report of the IE origins.

A2. INDUSTRIAL ECOLOGY IN THE WORLD

Description:
Case study.

Delivery:
Presentation of the case by using powepoint.

A3. SPANISH AND EUROPEAN LEGISLATION

Description:
Analysis of the environmental legislation.

Material:
Legislation.

Delivery:
Presentation and discussion.

A4. APPLICATION OF BAT'S TO INDUSTRIAL WASTEWATER TREATMENT

Description:
BAT to industrial wastewater treatment in different industrial sectors.

Material:
BAT's published in Europe.

Delivery:
Report and presentation.

A5. MASS BALANCE ANALYSIS

Description:
Using the web www.materialflows.net to different countries.

Material:
web

Delivery:
Results

A6. LCA

Description:
Life Cycle Analysis Exercise.

Material:
Exercise

Delivery:
Results

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**.

IN-CLASS ACTIVITIES OR HOMEWORK, INDIVIDUAL OR IN-GROUP, SHORT OR LONG, ORAL OR WRITTEN: 60%
FINAL PROJECT: 40%

EXAMINATION RULES.

Failure to attend a session in which an evaluable activity is carried out will result in a zero in that activity. The group activities carried out in class are not recoverable, nor can they be replaced by other individual works.
The final project will be carried out in a group and the same qualification will correspond to all its members.

BIBLIOGRAPHY

Basic:
- Cervantes, G. Ecologia industrial. Barcelona: Fundació Carles Pi i Sunyer d'Estudis Autonòmics i Locals, 2007. ISBN 9788495417749.
- Graedel, T.E.; Allenby, B.R. Industrial ecology. 2nd ed. Upper Saddle River, New Jersey: Prentice Hall, 2003. ISBN 0130467138.
- Graedel, T.E.; Allenby, B.R. Industrial ecology and sustainable engineering. Int. ed. Boston: Pearson, 2010. ISBN 9780138140342.

RESOURCES

Other resources:
Provided in class