UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Lca and Sustainability Indicators

2627-1-F7503Q031-F7503Q03102

Aims

The teaching of the second module of 6 CFU is aimed at providing the student with the theoretical-practical knowledge useful for evaluating the interaction between production activities and the environment in a sustainability perspective and the tools for operating in the field of innovation.

The topics of this module are closely related to some aspects of the first module, and teaching will, as necessary and beneficial for genral understanding of interconnectivities of taught aspects, see incorporation of parts of the first module.

The students are invited to consult the syllabus of the entire course for details regarding learning- and skill-related objectives, etc.

Contents

• The reactivity of chemical compounds in the environment.
• Regulatory aspects like REACH, concerned with sustainability and control of chemical production and exploitation and use of single chemicals and mixtures.
• Indicators of sustainability, tools for quantifying sustainability.
• Life cycle analysis as environmental sustainability indicator.

Detailed program

• Reactivity of compounds in the atmosphere and consequences for environment, health and cultural heritage.
• Reactivity of compounds in water, including surface waters and oceans.

• Life time and half life of the compounds in the environment.
• Regulatory tools, especially REACH, for implementing sustainability and environmental compatibility in socio-economic contexts and legislation.
• Sustainability indicators: Human development index, Index of Sustainable Economic Welfare.
• Environmental sustainability indicators: emergetic analysis, ecological footprint.
• Life cycle analysis: history, objectives,
• Phases of an LCA analysis: goal and scope definition, inventory (primary, secondary and tertiary data, allocation), impact assessment (midpoint and endpoint impact categories, classification, characterization, normalization, weighing), interpretation.

Prerequisites

• Basic knowledge of organic and inorganic chemistry.
• Basic notions of thermodynamics.

Teaching form

• 8 two-hour lectures, in person, with delivered didactics, (2 credits) by presenting slides.
• 10 four-hour practical classes of interactive teaching in presence (4 CFU) on the most used calculation methods and software in the field of LCA analysis.

Textbook and teaching resource

• B. Marchesini, M. Monari *Il regolamento REACH* Maggioli Editore
• Michael Z. Hauschild, Ralph K. Rosenbaum, Stig Irving Olsen *Life Cycle Assessment Theory and Practice* Springer
• slides
• notes shown during lectures and additional material on selected topics, i.e., scientific articles, made available on the e-learning website of the course.

Semester

I semester (November/December - January)

Assessment method

The final exam consists of a single oral exam at the end of the course, with a score between 18-30 / 30 *cum laude*, which comprises the discussion of various topics covered in the course, with an emphasis also on the connections between concepts and processes, such as to arrive at a critical evaluation of work from the point of view of sustainability in chemistry as a whole.

Given the experimental nature of the hands-on experience using different LCA tools, the concerned module offers a final test that can be validated in the final exam for the part of course concerned with the LCA. N.B.: This written test remains valid for the entire academic year in which the course was carried out. In the event that the student does not take the written exam in progress or opts to take the exam in another academic year, the LCA analysis part is again part of the oral exam program.

The final score will range from 18/30 to 30/30 with honors, based on the overall assessment, taking into account the following criteria:

1. conceptual knowledge and understanding
2. ability to apply knowledge and understanding
3. communication and argumentation skills
4. learning, self-assessment, and self-regulation skills

Grade < 18
Knowledge and Understanding: The student only partially identifies the characteristics of the concepts. The connections between the concepts are fragmented and poorly supported by theoretical knowledge.
Ability to apply knowledge and understanding: The student identifies only a few relevant elements in a phenomenon, unable to integrate them into a coherent analysis.
Communication and Argumentation Skills: In the oral exam, the student develops a basic argument, lacking logical structure and characterized by numerous expository inaccuracies.
Learning, self-assessment, and self-regulation skills: The student is able to reconstruct only some aspects of their learning and professional development journey.

Grade 18-22
Knowledge and Understanding: The student recognizes and explains most of the conceptual features and is able to provide a relatively coherent explanation, albeit with some inaccuracies. Theoretical references are present but not always rigorously.
Ability to apply knowledge and understanding: The student is able to recognize a significant number of elements and provide a partial explanation, while highlighting some gaps in the analysis.
Communication and argumentation skills: In the oral exam, the student constructs a basic argument, with a minimal structure but with some inaccuracies.
Learning, self-assessment, and self-regulation skills: The student demonstrates a basic awareness of their learning path, managing to draw essential connections between learning experiences, albeit with some inaccuracies.

Grade 23-27
Knowledge and Understanding: The student demonstrates a thorough understanding of conceptual characteristics. In the oral exam, explanations are well-articulated and supported by an appropriate use of theoretical references.
Ability to apply knowledge and understanding: The student accurately identifies the essential elements of a phenomenon. The application of knowledge occurs with methodological rigor that is not always solid.
Communication and argumentation skills: In the oral exam, the student develops a coherent and well-organized argument, demonstrating good command of language and a solid logical-argumentative structure. Communication is clear and effective.
Learning, self-assessment, and self-regulation skills: The student analyzes his or her learning journey in a clear and structured manner, highlighting significant relationships between the various developmental stages and demonstrating a good capacity for critical reflection.

Grade 28-30
Knowledge and Understanding: The student demonstrates a thorough mastery of concepts, articulating complex connections and providing comprehensive explanations. Theoretical references are used with relevance and rigor.
Ability to apply knowledge and understanding: The student demonstrates an advanced ability to analyze a phenomenon, comprehensively identifying and interpreting all salient elements. Knowledge is applied with methodological rigor, supported by solid and detailed argumentation.
Communication and argumentation skills: In the oral exam, the student develops a solid and detailed argument, with a rigorous logical structure and a high level of textual coherence. The presentation is fluent and well-

structured.
Learning, self-assessment, and self-regulation skills: The student demonstrates an advanced capacity for self-reflection, developing a detailed and in-depth analysis of their learning and professional development journey. The connections between learning experiences and theoretical concepts are clear, coherent, and rigorous.

Office hours

Always, after scheduling an appointment *via* phone or e-mail.

Sustainable Development Goals

QUALITY EDUCATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE | SUSTAINABLE CITIES AND COMMUNITIES | RESPONSIBLE CONSUMPTION AND PRODUCTION