UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Principles of Sustainable Chemistry

2526-1-F7503Q031-F7503Q03101

Aims

The teaching of the first module of 6 CFUs is aimed at providing the knowledge and the methodological basis to know and understand the principles that define sustainable and / or green chemistry. The course will focus on some processes and practices currently attributable to the concept of sustainability and respect for the environment in various sectors of society, as examples for specific in-depth discussions on the issues addressed during the course.

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

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

Contents

• The concepts of green chemistry and sustainable chemistry, their commonalities and their differences.
• The concept of biorefinery for the production of sustainable raw materials.
• Responsible and sustainable use of non-renewable resources such as metals, aspects of recycling within a circular economy.
• The reactivity of chemical compounds in the environment.
• Sustainable processes for the production of standard materials, platform chemicals and performance materials.
• Sustainable processes in the field of chemistry for the production of fine chemicals.
• Sustainability in the field of nanomaterials.
• Aspects on sustainable energy.

Detailed program

• Evolution of sustainability in industrial syntheses on the basis of selected examples.
• Evolution of the concepts of green chemistry and sustainable chemistry.
• Common points and differences between green chemistry and sustainable chemistry.
• Description of the main renewable resources suitable for substituting oil as main raw material source for the chemical industry with particular reference to the structure of lignocellulosic materials.
• The concept of bio-refinery with examples and applications in Italy and Europe, also in view of the circular economy.
• Synthesis of chemicals from renewable sources with sustainable processes.
• Sustainable and / or green concepts for performing chemical reactions, for example flow chemistry.
• Sustainable processes in chemistry-related fields: point-of-care-devices, organ-on-a-chip, model organisms.
• Synthesis and advantages of sustainable nanomaterials, and associated regulatory aspects.
• Synthesis of new biodegradable and non-biodegradable materials starting from renewable sources with sustainable processes.
• Recycling, downcycling and upcycling as tools for the circular economy.
• The integration of sustainable processes within the circular economy and their construction.
• Description of the challenges associated with the recycling and reuse of various materials, including precious metals, concept of urban mining.
• Sustainable mining activities.
• Distribution of elements across various environments using (anthro)biogeochemical cycles.
• Case studies.

Prerequisites

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

Teaching form

• 6 CFUs of theoretical lessons in the classroom (48 hours):
-> 20 two-hour lectures, in person, Delivered Didactics;
-> 4 two-hour lectures, in person, reading and discsussing scientific articles in aula, Mixed Didattics, / Seminar.
• Case studies, to be prepared during the lessons by the students in groups according to various schemes, with final discussions together.
• In the event of a COVID-19 emergency, the course will take place via remote lessons which will also be recorded and uploaded to the e-learning webpage connected to the course.

Textbook and teaching resource

• M. Aresta, A. Dibenedetto, F. Dumeignil
Biorefineries – An introduction
De Gruyter
• P.T. Anastas
Green Chemistry - Theory and Practice
Oxfod University Press

• 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 (October - November/December)

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.

Assesment will be based on the following criteria: (1) knowledge and understanding; (2) ability to connect different concepts; (3) autonomy of analysis and judgment; (4) ability to correctly use scientific language.

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