UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Low Environmental Impact Materials and Processes

2122-1-F5302Q014

Aims

General aims

The course aims to provide the knowledge and methodological basis to define a process with low environmental impact. The course will then focus on some chemical processes that can currently be defined as having a low environmental impact.

Knowledge and understanding

At the end of the course the student will have a fundamental understanding of:

- The main parameters to be evaluated to define a low environmental impact process.
- The correct definitions of green chemistry and circular economy.
- The scientific problems to move from the oil-based economy to the green economy.

Applying knowledge and understanding

At the end of the course the student will be able to:

- apply the concepts of green chemistry learned in the course that form the basis of sustainable development according to the UN 2030 agenda.
- judge whether a process qualifies as a green and/or sustainable process.

Making judgements

At the end of the course the student will be able to

- apply the acquired knowledge in various contexts.
- transfer concepts and approaches to new fields.
- elaborate the topics of the course.

Communication skills

At the end of the course the student should be able to

- analyse a problem related to the course topics in a clear and concise way.
- explain orally with a suitable language the objectives, the procedures and the results of the elaborations carried out.

Learning skills

At the end of the course the student should be able to apply the acquired knowledge to different contexts than those discussed during the course.

Contents

- Environmentally compatible processes for the production of materials.
- Environmentally compatible processes for the production of fine chemicals.

- Environmentally compatible processes for energy production.
- The concept of green chemistry.
- The concept of biorefinery.
- Biotechnology and energy aspects in the biorefinery context.
- Potentially sustainable concepts for performing chemical reactions.
- Sustainable nanomaterials.

Detailed program

- Evolution of industrial syntheses with low environmental impact on the basis of selected examples.
- The twelve rules of green chemistry.
- Evolution of the concept of green chemistry.
- Carbon economy concept.
- Description of the main renewable sources with particular reference to the structure of lignocellulosic

materials.

- The concept of bio-refinery with examples and applications in Italy and Europe.
- Evolution of the paper industry from an environmental point of view, also looking at the possibilities of using by-products.
- Description of the problems associated with the recycling and reuse of materials.
- Synthesis of new biodegradable and non-biodegradable materials starting from renewable sources with low environmental impact processes.
- Bulk modifications and surface modifications of materials.
- Methods for assessing the environmental impact in the form of carbon-footprint.
- Synthesis of chemicals from renewable sources with low environmental impact processes.
- The integration of low environmental impact processes in the circular economy.
- Older and newer concepts for performing chemical reactions, e.g., flow chemistry or mechanochemistry.
- Synthesis and advantages of sustainable nanomaterials, regulatory aspects.

Prerequisites

- Basic knowledge of organic and inorganic chemistry, and biology
- Basic concepts of thermodynamics.

Teaching form

- Theoretical lessons in the classroom (6 credits).
- In the event of a COVID-19 emergency, the course will be held through remote lessons that will be additionally recorded and uploaded to the elearning
  web-site of the course.

Textbook and teaching resource

- P.T. Anastas
  Green Chemistry - Theory and Practice PT Anastas

Oxfod University Press

- Bruno Rindone
  Introduzione alla Chimica Ambientale B
  Città Studi Edizioni

- M. Aresta, A. Dibenedetto, F. Dumeignil
  Biorefineries - An introduction
  De Gruyter

- Slides shown during the lectures and notes as well as additional material on selected topics, i.e., scientific articles, that will be available on the elearning
  web-site of the course.

Semester

II semester (march - june)

Assessment method

The final exam consists of an oral exam at the end of the course, with a score between 18-30/30, which consists of the discussion of various topics discussed during the lessons, linking the concepts to an industrial process or to a new biorefinery or green chemistry process presented in a scientific article, to arrive at a critical evaluation of the presented process from the point of view of overall sustainability.

The discussion of the exam is based on a short 10-minute powerpoint presentation that must be prepared by the student for the exam; the article and / or documentation of the process to be evaluated will be sent to the student one week before the exam.

In the event of a pandemic emergency, the exam will always be as described above, but held on the Webex platform.

Office hours

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