UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Microbial Aspects of Sustainable Production

2627-2-F7603Q007-F7603Q00703

Aims

The course aims to provide theoretical and practical knowledge and skills regarding the potential of plant biomasses and organic waste from the agricultural and industrial sectors that can be employed as raw materials for the production of bioproducts (including energy-related ones)/sustainable biomaterials through a circular economy approach

1. Knowledge and understanding
   At the end of the course the student will have acquired knowledge and ability to understand (a) the origin and the characteristics of the different types of biomass in relation to their potential use in the valorisation processes (3) the biochemical processes for the extraction and the quantification of functional compounds or bioproducts (eg bioinsecticides) (4) bioenergy production technologies.
2. Ability to apply knowledge and understanding
   At the end of the course the student must be able to apply the knowledge acquired to the resolution of real environmental problems
3. Autonomy of judgment
   The students must be able to process what they have learned during classroom, laboratory and field lessons in order to choose the best approach to use for the valorisation of biomass from a circular economy perspective.
4. Communication skills
   At the end of the course the student will acquire not only the ability to express himself with an appropriate scientific language, but also the ability to relate to external operators in the sector.
5. Learning ability
   By the end of the course, students will have acquired the necessary skills to make informed decisions about the sustainable utilisation of biomass.

Contents

• the potential for biomass utilisation in relation to the technological processes employed.
• main strategies for the production of bioenergy and bioproducts for agriculture and environmental remediation; in particular, the following will be studied in depth:

- microbial metabolisms involved in the valorisation of organic waste (e.g. methanogenesis, fermentation and biosynthetic pathways);
- technologies for the production of biogas, hydrogen and electricity through microbial processes (eg, anaerobic digestion, microbial fuel cells) from organic waste;
- bioelectrochemical technologies for power-to-gas;
- production of substances with high added value through microbial biosynthesis (biosurfactants).

Detailed program

Topics of the lectures:

• Overview of technologies for bioenergy production: thermochemical, biological and physical conversion
• Definition of the essential parameters to be used to choose the suitable technology for the production of bioenergy according to the characteristics of the biomass available
• Microbial processes of methanogenesis and acetogenesis
• Processes and plants for the production of hydrogen, biogas and electricity through the exploitation of microbial metabolisms starting from organic waste
• Traditional and innovative processes and technologies for "power-to-gas"
• Processes and technologies for microbial biosynthesis of high added value substances starting from waste biomass

Prerequisites

Basics of microbiology and organic chemistry

Teaching form

24 h (12 2h-lessons). Delivered Didactics in presence

Textbook and teaching resource

Scientific articles and slides provided through the e-learning platform

Semester

First semester

Assessment method

The final exam consists of an oral exam at the end of the course, with a score between 18-30/30 *cum laude*, which consists of the discussion of various topics discussed during the lessons, linking the concepts.
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.

The final score will range from 18/30 to 30/30 with honors, based on the overall assessment, taking into account the following criteria:
conceptual knowledge and understanding
ability to apply knowledge and understanding
communication and argumentation skills
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

To be arranged by email

Sustainable Development Goals

GOOD HEALTH AND WELL-BEING | AFFORDABLE AND CLEAN ENERGY | SUSTAINABLE CITIES AND COMMUNITIES | CLIMATE ACTION