UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Macromolecular Chemistry

2526-1-F5402Q005

Aims

Learning of the basic concepts about the structure, synthesis and functionalization of polymers.

Knowledge and understanding
At the end of the course the student knows:

- the stereochemistry, the main methods of macromolecular synthesis and functionalization, the principles of molecular mass distribution.

*Applying knowledge and understanding

At the end of the course the student is able to:

- describe the polymer synthesis that involve the use of step and chain polymerization; living anionic polymerization, block copolymers and functionalized polymers. Cationic polymerization. Homogeneous and heterogeneous Ziegler-Natta polymerization.

Making judgments

At the end of the course the student is able to:

- choose the most appropriate synthesis method for the realization of polymeric materials of interest.

Communication skills

To be able to present the topics of the course in a suitable language.

Learning skills To be able to apply the acquired knowledge to contexts different from those presented during the course, and to understand the topics covered in the scientific literature concerning polymeric materials.

Contents

The course will focus on fundamental and advanced aspects of the structure and synthesis of macromolecules.

Detailed program

Structure and stereochemistry of macromolecules. Molecular mass distribution.

Step-wise polymerization: Molecular mass as a function of the conversion and monomer stoichiometry. Flory distribution for polycondensation. Polyfunctional monomers, mass distribution and cross-linking. Case studies of polycondensation polymers.

Chain polymerization: chemistry of the radical process. Chain-transfer polymerization: degree of polymerization according to Mayo theory.

Kinetics and thermodynamics of propagation. Copolymerization, diagrams, feed/composition diagrams and reactivity ratios.

Living anionic polymerization, block copolymers and functionalized polymers. Cationic polymerization.

Homogeneous and heterogeneous Ziegler-Natta polymerization: reaction mechanism, catalyst symmetry and stereochemical control.

Condensed information will be given on the properties of polymers in the bulk state and in solution such as amorphous and crystalline phases, viscosity ect.

During the course, examples of the polymers whose synthesis has previously been described will be treated, as regards the bulk behavior, with particular attention to the conformational properties of the macromolecular chains. The thermal properties and the fundamental conditions will be defined, based on the structure and the way of aggregation in the phases.

Prerequisites

- Fundamental knowledge of organic chemistry and physical chemistry.

Teaching form

Lectures.

Textbook and teaching resource

Textbook of Polymer Science (III edition) F.W.Billmeyer, Wiley

Video-Recorded lectures.

Semester

First year, second semester.

Assessment method

The oral exam consists of the evaluation of the knowledge acquired by the student in the field of chemistry of macromolecules, with particular attention to the synthetic methods, the structure and properties of polymers.
The score will be assigned as follows:
18-19: preparation on a small number of topics in the course program, with limited discussion and analysis skills that, in the case of the oral exam, emerge only following the teacher's help and questions; expository skills and vocabulary not always correct, with limited critical processing skills;
20-23: preparation on a part of the topics in the course program, independent analysis skills only on purely practical and executive issues, use of correct vocabulary even if not entirely accurate and clear and an expository skill that is at times uncertain;
24-27: preparation on a large number of topics in the course program, ability to independently carry out argumentation and critical analysis, ability to apply knowledge to contexts and connect themes to concrete cases, use of correct vocabulary and competence in the use of disciplinary language;
28 – 30/30L: complete and exhaustive preparation on the topics in the exam program, personal ability to deal autonomously and critically analyze the topics, ability to reflect and self-reflect and to connect the topics to concrete cases and different contexts, excellent ability to think critically and autonomously, full mastery of the disciplinary vocabulary and a rigorous and articulated expository ability, ability to argue, reflect and self-reflect, ability to make connections to other disciplines.

Office hours

By appointment.

Sustainable Development Goals

RESPONSIBLE CONSUMPTION AND PRODUCTION