UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Physical Chemistry of Complex System

2627-1-F5402Q006

Aims

D1 - KNOWLEDGE AND UNDERSTANDING ABILITY

At the end of this formative activity, the student will have to demonstrate to be able to:
1 Know the basic principles of the thermodynamics of interphases and interfaces
2 Describe the kinetic and thermodynamic processes that lead to the formation of stable complex systems
3 Understand the concepts of electric double layer.

D2 - CAPACITY TO APPLY KNOWLEDGE AND UNDERSTANDING

At the end of this formative activity, the student will have to demonstrate to be able to:
1 Predict the level of stability of a phase based on thermodynamic and kinetic considerations
2 Obtain chemical-physical information from viscosimetry and light scattering techniques
3 Obtain dynamic and structural information from spectroscopic techniques

D3 - JUDGMENT AUTONOMY

At the end of this formative activity, the student will have to demonstrate to be able to:
1 Choose the most useful techniques for the structural analysis of a suspended phase
2 Select the experimental techniques and parameters useful for obtaining specific dynamic and structural information
4 Address a critical discussion on the relationships between structure and functional properties in a complex system

D4- COMMUNICATION SKILLS

To be able to describe in a clear and concise form: i) the objectives, ii) the procedure and iiii) the results of the elaborations carried out.

D5 - LEARNING SKILLS

Expected results:
1 Collect and understand new information useful for rationalizing suspension properties.
2 Collect and understand information about the technological evolution of some spectroscopic techniques.

Contents

First of all, the thermodynamic and kinetic principles underlying the formation and stability of complex systems such as colloids and suspensions will be discussed. We will then describe the chemico-physical, structural and spectroscopic techniques able to provide information on the stability and correlations between structure, dynamics and functional properties in complex systems.

Detailed program

Review of thermodynamics of surfaces and interfaces.
Kinetic and thermodynamic stability of colloidal dispersions.
The concept of electric double layer. Surface charge in colloidal systems.
Diffusion and transport.
The irreversible processes: the Onsager approach.
Quantitative analysis of aqueous solutions: the Derjaguin-Landau-Vervey-Overbeek (DLVO) theory.
Characterization methods for colloidal suspensions and solids isolated from them:
• Static and dynamic radiation diffusion (Static (SDS) and Dynamic Light Scattering, DLS))
• Determination of the zeta potential
• Viscometers and rheology
• Turbidimetry
Structural, morphological and surface characterization of complex systems. In particular, SEM / TEM, TGA / DSC will be discussed

Prerequisites

Basic thermodynamics and kinetics

Teaching form

24 two-hour lectures, in person, Delivered Didactics

Textbook and teaching resource

Lecture notes of the teacher.

Semester

Second semester

Assessment method

1. There are no ongoing tests;

2. Verification of the learning of the results expected from the D1-D5 descriptors is carried out through an interview, during which the student is asked at least two questions on different parts of the program (conductimetry, electrochemistry). The interview, in addition to ascertaining the acquisition of disciplinary knowledge and skills, will tend to verify the student's critical analysis skills, independent judgment and expository skills;

3. The final grade, which refers only to the interview, is graded according to the following criterion:
   18-20: preparation on a limited number of topics present in the course program, with limited discussion and analysis skills that emerge only following the help and questions of the teacher; expository skills and vocabulary not always correct, limited critical processing skills;
   21-23: preparation on some of the topics in the course program, ability to independently analyze only purely practical and executive issues, use of correct vocabulary even if not entirely accurate and clear and an at times uncertain expository ability;
   24-27: preparation on a large number of topics covered 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: complete preparation on the topics in the exam program, personal ability to independently discuss and critically analyze topics, ability to reflect and connect themes to concrete cases and different contexts, ability to think critically and independently, mastery of disciplinary vocabulary and a rigorous and articulated expository ability, ability to argue and reflect, ability to connect to other disciplines;
   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 ability to present, ability to argue, reflect and self-reflect, ability to connect to other disciplines.

Office hours

By appointment.

Sustainable Development Goals

QUALITY EDUCATION | INDUSTRY, INNOVATION AND INFRASTRUCTURE | RESPONSIBLE CONSUMPTION AND PRODUCTION