UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Chimica Inorganica II e Laboratorio

2526-3-E2702Q073

Aims

Familiarizing the student with the structure, chemical bonding, and properties of inorganic solids, as well as the characteristics of transition metal ions.

Knowledge and Understanding
The course aims to develop a critical mindset focused on examining and understanding the typical processes of inorganic chemistry, enabling students to confidently use concepts and interpretative tools.

Applied Knowledge and Understanding
By the end of the course, students will be proficient in concepts related to the fundamental principles of thermodynamics and kinetics applied to inorganic reactions, the chemistry of transition metals, and the use of crystal field theory and ligand field theory. Additionally, they will understand the practical relevance of inorganic solids in industrial, environmental, and energy-related processes.

Independent Judgment
Through frequent interactions with students in class, the course will encourage the development of independent judgment.

Communication Skills
The course aims to facilitate the development of communication skills. To this end, all exams are conducted in person by the instructor, and students are particularly encouraged to focus on communication aspects during their learning process.

Learning Skills
The course seeks to enhance learning abilities through the use of diverse teaching tools.

Contents

Bonding in inorganic solids. Electronegativity and chemical bonding in solids. Ionic bonding. Ionic solids (structure, lattice energy, Born-Haber cycle, covalent character in ionic solids). Crystal field theory and ligand field theory. Synthesis and properties of a few classes of inorganic materials. Solid state synthesis, sol-gel synthesis, hydrothermal synthesis, CVD synthesis. Periodic properties and reactivity of oxides and inorganic materials. Silicates, silica, intercalation materials, zeolites, oxides for catalysis.

Laboratory activities will deal with the crystalline solid state in chemistry by:

- using program Mercury for visualizing molecules and crystal structures
- point symmetry for molecules by means of symotter.org
- bidimensional space symmetry (programme escher.jar) and basics of tridimensional space symmetry
- introduction to X-ray powder diffraction

Detailed program

Bonding in inorganic solids. Electronegativity and chemical bonding in solids. Ionic bonding. Ionic solids (structure, lattice energy, Born-Haber cycle, covalent character in ionic solids). Crystal field theory and ligand field theory. Synthesis and properties of a few classes of inorganic materials. Solid state synthesis, sol-gel synthesis, hydrothermal synthesis, CVD synthesis. Periodic properties and reactivity of oxides and inorganic materials. Silicates, silica, intercalation materials, zeolites, oxides for catalysis.

Laboratory with interactive teaching in person:

- definition of crystal, unit cell, atomic cell content and evaluation of stoichiometry in crystalline solids
- Mercury CSD software for visualizing of molecules and crystal structures
- point symmetry in molecules
- bidimensional space (wallpaper) symmetry; basics of tridimensional space symmetry
- qualitative analysis with X-ray powder diffraction

Prerequisites

Basic knowldedge of general and inorganic chemistry

Teaching form

The course provides 16 two-hour lectures in person (Delivered Didattics)

Laboratory sessions (Interactive Teaching) are performed with computer sessions using free software suitable for the introductory level of the course. There will be 12 four-hour lab activities, in person with compulsory attendance.

Lectures and laboratory activities will be given in italian.

Textbook and teaching resource

Lecture notes available can be downloaded from the e-learning platform

Semester

Second semester

Assessment method

Oral Exam. Basic knowledge of inorganic solids (structure and properties) and transition metal ions (crystal field theory).

Grade Composition
The final grade results from a weighted and well-considered average between the grade obtained in the laboratory test and the oral exam.

Grading Scale According to Dublin Descriptors:
18-19: Knowledge of a limited number of topics from the course syllabus, with restricted ability in discussion and analysis, which, in the case of the oral exam, emerge only with the teacher's guidance and questions. Expository skills and terminology are not always correct, with limited critical thinking abilities.

20-23: Knowledge of a portion of the topics covered in the course syllabus, independent analytical ability only on purely practical and procedural issues, correct but not entirely precise and clear terminology, with occasional uncertainty in exposition.

24-27: Knowledge of a broad range of topics covered in the course, ability to conduct argumentation and critical analysis independently, capacity to apply knowledge to various contexts and relate topics to concrete cases, correct use of terminology, and proficiency in disciplinary language.

28-30/30L: Comprehensive and thorough knowledge of the topics in the exam syllabus, ability to independently discuss and critically analyze topics, capacity for reflection and self-reflection, and the ability to connect topics to real-world cases and various contexts. Excellent independent and critical thinking skills, full command of disciplinary terminology, a rigorous and well-structured expository ability, and strong argumentative, reflective, and interdisciplinary connection skills.

The exam for the laboratory consists of three written tests during the semester with problem solving about:

1. evaluation of stoichiometry in crystalline solids based on the unit cell content;
2. point symmetry of simple inorganic molecules;
3. qualitative analysis of inorganic binary mixtures from X-ray powder diffraction.
   The tests are on an individual basis and will be performed in the laboratory exploiting the sotware available during the course. The report will be evaluated in thirtieths based on the weighted average of correctly solved problems. The laboratory grade will weight around 50% of the final mark.

It is possible to take the exam in English.

Office hours

By appointment

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY