



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Inorganic Chemistry II and Laboratory

2223-3-E2702Q073

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#### Aims

Familiarize the student with structure, chemical bonding and properties of inorganic solids and nature of transition metal ions.

#### 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.

Lectures in the **laboratory** will deal with the following topics:

- relevance of the study of the crystalline solid state in modern chemistry
- introduction to Mercury CSD software & visualization of molecules, elementary cell content, crystal structure)
- point symmetry
- bidimensional space symmetry and basics of tridimensional space symmetry
- short introduction to X-ray diffraction: Bragg equation and qualitative analysis of inorganic crystalline solids
- reminder on intermolecular forces with emphasis on the hydrogen bond

#### 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.

Lectures in the **laboratory** will deal with the following topics:

- relevance of the study of the crystalline solid state in modern chemistry
- definition of crystal, unit cell, atomic cell content and evaluation of stoichiometry in crystalline solids
- crystallographic fractional coordinates
- Mercury CSD software; visualization of molecules, cell content, crystal packing with applications to simple molecular systems
- point symmetry: algorithm for classifying molecules in terms of point symmetry
- examples of point symmetries with simple organic and inorganic molecules
- bidimensional spaceal symmetry; interpretation of bidimensional periodic drawings (wallpaper)
- tridimensional space symmetry; basics of tridimensional elements of symmetry
- short introduction to X-ray diffraction: Bragg equation
- qualitative analysis of inorganic crystalline compounds by means of X-ray diffraction of microcrystalline powders; relevance in the chemical industry
- reminder on intermolecular forces with emphasis on the hydrogen bond
- analysis of intramolecular geometries and intermolecular interactions (hydrogen bond) of simple inorganic solids

## Prerequisites

Basic knowledge of general and inorganic chemistry

## Teaching form

Laboratory sessions will be performed with computer sessions using free software suitable for the introductory level of the course. Attendance is compulsory.

## Textbook and teaching resource

Lecture notes available in the elearning platform

## Semester

Second semester

## Assessment method

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

The exam for the laboratory consists of a written report developing the description of the crystal structure (from the chemical point of view, not from the mathematical one) of a simple coordination compound. For the preparation of the report, formatting guidelines will be provided to be followed. The report is individual and must be delivered before a deadline provided by the teacher. The report will be evaluated in thirtieths and will weight as 50% of the final mark.

It is possible to take the exam in English.

In the event of a Covid-19 emergency, oral exams will only be carried out using the WebEx telematic platform.

## Office hours

any time by appointment

## Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY

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