UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mineralogy (blended)

2324-2-E3401Q013

Aims

The course aims to provide students with an overview of the most common rock-forming minerals, their constitution and origin, and how they are recognized. Students are introduced to the most common analytical methodologies used in mineralogy, such as optical microscopy, electron microscopy, X-ray powder diffraction, X-ray fluorescence analysis, mass spectrometry, and infrared spectroscopy.

Contents

The course starts with the definition of mineral, the role of mineralogy nowadays and how mineralogy has evolved over time. The central part of the course is devoted to crystal structures, crystal defects, and crystal symmetry and the morphologies and properties that derive from the latter. In parallel, the most common methodologies used in the identification and study of minerals are examined and, finally, the classification of minerals is presented, grouped in igneous, metamorphic and sedimentary minerals.

Detailed program

1. Introduction: what is a mineral, what is mineralogy and how it has evolved over time; 2) Morphological crystallography: symmetry, Bravais lattices, crystal forms, Miller indices; 3) Crystal-chemistry: chemical bonding, electronegativity, oxidation state, coordination number; 4) Crystal structures: metals, ionic and covalent solids, molecular solids, polymorphism, solid solutions; 5) Crystal growth: homogeneous and heterogeneous nucleation, point defects, dislocations, twins; 6) Physical properties: density, hardness, cleavage, color, piezoelectricity, magnetic properties; 7) Optical Mineralogy: the petrographic microscope, refraction index and birefringence, optical indicatrix, parallel light and convergent light microscopy; 8) X-ray powder diffraction: Bragg equation, identification of minerals, quantitative study of a diffractogram; 9)

Analytical methods: X-ray fluorescence, mass spectrometry, infrared spectroscopy; 10) Igneous minerals: silica group, feldspars, pyroxenes; 11) Metamorphic minerals: garnets, amphiboles, mica group minerals; 12) Sedimentary minerals: carbonates, clay minerals, sulphates and halides.

Prerequisites

It is recommended to attend the courses of Introduction to Geology, Mathematics, Physics and Chemistry before tackling the study of Mineralogy.

Teaching form

The course is delivered in Italian as "blended learning", that is, with some lessons delivered online. In particular, will be delivered online practical works of geometric crystallography, powder X-ray diffraction and mineral chemical formulas recalculation. Moreover, auto-evaluation tests about past lessons will be provided. Unless different indications due to health emergency, the lectures will be delivered in the classroom with student. The laboratory of optical mineralogy, where the use of the polarizing microscope is envisaged, will also be delivered in the classroom with students, but on shifts of two or more groups.

Textbook and teaching resource

Lectures notes derived from the most popular Mineralogy books (listed below) and from the teacher personal experience are provided. Further readings: William D. Nesse: "Introduction to Mineralogy", Oxford University Press; Cornelis Klein & Barbara Dutrow: "Mineral Science", John Wiley & Sons, Inc. (available also in Italian); Hans-Rudolf Wenk & Andrei Bulakh: "Minerals, their constitution and origin", Cambridge University Press.

Semester

First semester of the second year, from the beginning of October to the beginning of Christmas holiday, usually with a week of break in November.

Assessment method

The exam is written and oral, both at the end of the course and separated by 10 to 14 days. The written part focuses on laboratory subjects and gives access to the oral part, which mainly focuses on mineral systematics and the rest of the program. Basically, the written parts consists of 5 blocks, basically excercises, multiple-choice questions, true/false questions (physical properties of minerals; analytical methods in Mineralogy; powder X-ray diffraction; recalculation of mineral formulae; optical mineralogy), each contributing up to 6 points (a perfectly done written exam counts 30/30 points). The oral part consists of (five-ten) questions spanning through the mineral systematics, crystal-structures and crystal-chemistry, mineral nucleation and growth, and mineral defects. The final mark is the average of the written and oral evaluation.

Office hours

All working days, by appointment, consistently with the off-site teacher's commitments, institutional commitments, and with the exception of summer, Christmas and Easter holidays.

Sustainable Development Goals