UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Meneralogy

2627-2-E3402Q009

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.

Knowledge and understanding
At the end of the course, the student is expected to know the main rock-forming minerals and the basic techniques for studying minerals.
Applied knowledge and understanding
At the end of the course, the student is expected to have the basic knowledge to take on subsequent courses, in particular Petrography and Ore-mineralogy.
Making judgments
At the end of the course, the student is expected to be able to identify the appropriate diagnostic techniques to answer a simple mineralogical question.
Communication skills
At the end of the course, the student is expected to have acquired an adequate mineralogic vocabulary.
Learning ability
At the end of the course, the student is expected to have learned a method that allows him to go further in his knowledge of Mineralogy and Geology.

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 language in "blended learning" mode, i.e. with some lessons delivered online. In particular, the teaching includes:

- 16 2-hour lectures, in person, delivered didactics;
- 6 2-hour laboratory activity, in person, interactive teaching;
- 6 2-hour practical classes, in person, interactive teaching;
- 12 2-hour practical classes, online, interactive teaching.
  In particular, exercises on geometric crystallography, analysis of powder diffractograms and on recalculation of chemical formulas of minerals will be provided online, with the help of a tutor and a discussion forum. Furthermore, tests to verify learning, in the form of true/false questions, multiple choice questions, and open questions, will be provided at the end of each lecture. The optical mineralogy labs, where the use of the polarizing optical microscope is envisaged, will be delivered in person, but in shifts, in two or more groups, depending on the number of students.

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 practical matter and 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:

- 1 exercise on recalculation of chemical formulas;
- 1 exercise on analysis of a powder diffractogram;
- 1 excercise on geometric crystallography;
- 1 exercise with multiple choice questions on analytical techniques;
- 1 exercise with multiple choice questions on optical mineralogy.
  Each excercise contributes 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.
  In addition to the written assignment, during the year, at the end of each topic, a quiz is given (multiple choice, true/false, open questions) and after the topics of: i) Geometric crystallography, ii) X-ray diffraction and iii) Analytical methods, exercises are given. The quizzes and exercises together can account up to 2 points, which add to the written exam grade. The oral exam focuses on Systematics, Crystal chemistry, Crystal structures, Crystal growth. The final grade is the average of the written assignment and the oral exam.

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

QUALITY EDUCATION