UAB
Universitat Autònoma de Barcelona

# Fundamentals of Geochemistry and Crystallography

Code: 107976
ECTS Credits: 6

2025/2026

| Degree | Type | Year |
|---|---|---|
| Chemistry | FB | 1 |

## Contact

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## Teaching groups languages

You can view this information at the end of this document.

## Prerequisites

There are no prerequisites. Having taken a course on Earth Sciences and Environment in high-school can help to follow the course but it's not a prerequisite.

## Objectives and Contextualisation

Contextualization

This is a basic training course that develops a cross-disciplinary view of Geology, with particular emphasis on aspects that closely intersect with Chemistry. In this context, Geochemistry, Crystallography, and isotopic dating methods are especially relevant.

Learning Objectives

1) Understand the main branches of Geology and their goals.

2) Acquire basic knowledge of crystal lattices, crystal symmetry, spatial visualization of crystal structures, and the fundamental and principles of X-ray diffraction.

3) Understand the origin of Earth's chemical elements, types of bonding and ionic radii, close-packed structures, and Pauling's rules, which determine the properties of crystalline materials.

4) Identify the main geological materials (minerals), understand the concept of crystallinity, the tools used to study it, and their stability conditions.

5) Gain a basic understanding of the interaction between minerals and the natural environment, and the processes that drive mineral alteration.

6) Understand the principles and applications of isotopic geochemistry.

7) Acquire basic concepts of industrial geochemistry.

8) Become familiar with the main environmental geochemical problems and their remediation.

## Learning Outcomes

1. CM01 (Competence) Interpret data obtained from experiments or models to propose solutions to problems in the field of general chemistry.
2. CM03 (Competence) Work autonomously in the field of chemistry, integrating knowledge and skills for problem solving, preparing laboratory protocols and delivering exercises and reports.
3. CM03 (Competence) Work autonomously in the field of chemistry, integrating knowledge and skills for problem solving, preparing laboratory protocols and delivering exercises and reports.
4. KM01 (Knowledge) Relate the structure of the atom, chemical bonding, intermolecular forces, and states of aggregation to the properties of matter.
5. KM03 (Knowledge) Describe the symmetry of solids and the physical principles that govern interactions between X-ray radiation and matter.

## Content

1- Crystalline morphology

2- Point and space symmetry

3- Lattice theory

4- X-ray diffraction

5- Origin of elements and geochemical differentiation

6- Crystal chemistry and mineralogy

7- Low-temperature geochemistry

8- Isotopic geochemistry

9- Industrial geochemistry

10- Environmental geochemistry

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Theoretical sessions | 36 | 1.44 | CM01, CM03, KM01, KM03, CM01 |
| Type: Supervised | | | |
| Practical sessions | 6 | 0.24 | CM01, CM03, KM01, KM03, CM01 |
| Sessions of problems | 10 | 0.4 | CM01, CM03, KM01, KM03, CM01 |
| Tutoring | 1 | 0.04 | CM01, CM03, KM01, KM03, CM01 |

| Type: Autonomous | | | |
|---|---|---|---|
| Autonomous assimilation of the acquired knowledge in the practices | 8 | 0.32 | CM01, CM03, KM01, KM03, CM01 |
| Preparation and resolution of problems autonomously | 14 | 0.56 | CM01, CM03, KM01, KM03, CM01 |
| Reading and study of the theory | 54 | 2.16 | CM01, CM03, KM01, KM03, CM01 |
| Search for information | 6 | 0.24 | CM01, CM03, KM01, KM03, CM01 |

Theoretical Classes

Students acquire the course knowledge by attending theoretical classes, which are occasionally complemented with questions and simple exercises interspersed with the explanations. This approach seeks to encourage active student participation and to prevent the class from becoming entirely one-directional.

Tutorials

The learning and competency acquisition process will be supervised by the instructor through individual and/or group tutorials. A formal date will be scheduled for tutorials, but the course instructor will also be available to arrange additional meetings with students to resolve doubts and monitor their progress in acquiring the course's intended knowledge and skills.

Problem-Solving Sessions

Interspersed between theoretical classes, these are guided sessions designed to have students tackle problems related to each topic covered in the lectures. These sessions combine mathematical skills with critical thinking.

Practical Sessions

These consist of three 2-hour practical sessions integrated with theoretical and problem-solving classes. The aim is to help students connect theoretical explanations to real geological configurations. The practical activities are structured to promote active learning and foster critical thinking, analysis, and synthesis skills.

Reading and Study of Theory

All lecture presentations used by the instructor are available for download on the Virtual Campus. Reading this material, along with the notes taken during in-person theoretical sessions, should make up the majority of the student's independent study time.

Independent Preparation and Problem Solving

The exercises to be addressed in the problem-solving sessions are available on the Virtual Campus before the scheduled in-person activities. Students are expected to spend time properly completing any pendingexercises to encourage organization and for assessment purposes, as instructors may occasionally collect the problems to individually evaluate students.

Independent Assimilation of Practical Learning

Students are expected to dedicate time to independently consolidate acquired knowledge during practical sessions, to foster organization as well as for assessment purposes, as lecturers may occasionally collect student's work-sheets to carry out individual evaluations.

Information Search

Student-produced materials and the resources available on the Virtual Campus can be supplemented with additional research, using the recommended bibliography or alternative information sources. Preparation of the Problems sessions may also require further information gathering.

Note: 15 minutes of one lecture session, within the academic calendar set by the institution/program, will be reserved for students to complete instructor's evaluation surveys as well as the course/module surveys.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

## Assessment

## Continous Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| Final Assessment (2nd chance 1st Midterm Exam) | 45 | 2 | 0.08 | CM01, CM03, KM01, KM03 |
| Final Exam (2nd chance 2nd Midterm Exam) | 45 | 2 | 0.08 | CM01, CM03, KM01, KM03 |
| Single Assessment Exam | 90 | 2 | 0.08 | CM01, CM03, KM01, KM03 |
| Single Assessment Exam (reevaluation) | 90 | 2 | 0.08 | CM01, CM03, KM01, KM03 |
| Virtual Test Single Assessment | 10 | 1 | 0.04 | CM01, CM03, KM01, KM03 |
| Virtual Test 1 | 5 | 0.5 | 0.02 | CM01, CM03, KM01, KM03 |
| Virtual Test 2 | 5 | 0.5 | 0.02 | CM01, CM03, KM01, KM03 |
| 1st Midterm Exam (practical) | 4 | 0.5 | 0.02 | CM01, CM03, KM01, KM03 |
| 1st Midterm Exam (problems) | 11 | 1 | 0.04 | CM01, CM03, KM01, KM03 |
| 1st Midterm Exam (theory) | 30 | 1 | 0.04 | CM01, CM03, KM01, KM03 |
| 2nd Midterm Exam (practical) | 4 | 0.5 | 0.02 | CM01, CM03, KM01, KM03 |
| 2nd Midterm Exam (problems) | 11 | 1 | 0.04 | CM01, CM03, KM01, KM03 |
| 2nd Midterm Exam (theory) | 30 | 1 | 0.04 | CM01, CM03, KM01, KM03 |

The assessment of the course is based on the continuous evaluation of the student's progress in acquiring knowledge and competencies. It will consist of the following components:

- Progress tests on the course content via the Virtual Campus (two tests will be administered, coinciding with the dates of the two in-person midterm exams).

- First in-person midterm exam (3 hours), which will assess:

    - The theoretical content from the first part of the course (defined according to the progress of the syllabus).

    - The problem-solving sessions from the first part of the course.

- The practical sessions completed up to that point (depending on the schedule, this may include only session 1 or both sessions 1 and 2).

- Second in-person midterm exam (3 hours), which will assess:

  - The theoretical content from the second part of the course (defined according to the progress of the syllabus).

  - The problem-solving sessions from the second part of the course.

  - Practical sessions completed (depending on the schedule, this may include sessions 2 and 3 or only session 3).

- Final in-person exam (optional for students who have passed the midterms overall), which is intended for grade improvement or reassessment. This exam will consist of two parts, corresponding to the two midterm exams. Students may choose to perform one or both exams.

To be eligible to take the final exam, students must have participated in assessment activities throughout the course that account for at least two-thirds (2/3) of the total course grade.

If a student has been assessed in no more than one-third (1/3) of the activities and subsequently withdraws, thefinal mark will be NOT ASSESSED.

If a student requests the single assessment option (according to the conditions and deadlines set by the Faculty), they will take a 3-hour exam that evaluates:

- The theoretical content from the entire course. This section will account for 60% of the final grade.

- The Problem-solving content from the entire course (including oral exercises). This section will account for 22% of the final grade.

- The practical content from the three sessions. This section will account for 8% of the final grade.

- To complete the single assessment process, students must also take a test on course content via the Virtual Campus. This test will account for 10% of the final grade and cannot be retaken.

If the final grade is below 5 out of 10, the student will have a second opportunity to pass the course through the reassessment exam, scheduled by the programme coordinator.

Evidence of students' classroom engagement will be collected and may be used to adjust final grades in borderline cases (e.g. between fail/pass, pass/good, or good/excellent). Additionally, regular attendance and especially active class participation will be considered as positive contributions in the final assessment.

## Bibliography


Albarède. F. (2003), Geochemistry, An Introduction, Cambridge University Press.

Allègre, C.J., and Michard, G. (1974), Introduction to Geochemistry, D. Reidel Publishing Company, Dordrecht-Holland.

Bauer, A., and Velde B.D. (2014), Geochemistry at the Earth's Surface, Springer.

Brochardt-Ott, W. (2012), Crystallography: an introduction, Springer.

Evans, R.C., An introduction to Crystal Chemistry. Cambridge University Press.

Faure, G. (1998), Principles and Applications of Geochemistry, Prentice Hall.

Faure, G. (1989), Principles of Isotope Geology, John Wiley & Sons.

Galí, S. (1993), Cristal·lografia: Teoria Reticular, Grups Puntuals i Grups Espacials. Edicions de la Universitat de Barcelona.

Klein, C., and Hurlbut, C.S. (1996), Manual de mineralogia. Wiley.

Klein, C., and Philpotts, A. (2016), Earth Materials, Introduction to Mineralogy and Petrology. Cambridge University Press.

Schlesinger, W.H., and Bernhardt, E. (2013), Biogeochemistry : an analysis of global change, Academic Press.

Walther, J.V. (2005), Essentials of Geochemistry, Jones and Bartlett Publishers.

Presentacions molt didàctiques sobre diversos temes de Geologia: http://www.ig.uit.no/webgeology/

Material didàctic sobre grups de simetria puntual:

http://www.uab.cat/web/la-divulgacio/grups-puntuals-de-simetria-1345664584325.html

## Software

No specific software is required. Mastering basic spreadsheet software (Excel or Origin) to treat and plot data would be useful.

## Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

| Name | Group | Language | Semester | Turn |
|---|---|---|---|---|
| (PAUL) Classroom practices | 1 | Catalan | second semester | morning-mixed |
| (PAUL) Classroom practices | 2 | Catalan | second semester | morning-mixed |
| (PAUL) Classroom practices | 3 | Catalan | second semester | afternoon |
| (PAUL) Classroom practices | 4 | Catalan | second semester | afternoon |
| (PLAB) Practical laboratories | 1 | Catalan | second semester | morning-mixed |
| (PLAB) Practical laboratories | 2 | Catalan | second semester | morning-mixed |
| (PLAB) Practical laboratories | 3 | Catalan | second semester | morning-mixed |
| (PLAB) Practical laboratories | 4 | Catalan | second semester | morning-mixed |
| (PLAB) Practical laboratories | 5 | Catalan | second semester | afternoon |
| (PLAB) Practical laboratories | 6 | Catalan | second semester | afternoon |
| (PLAB) Practical laboratories | 7 | Catalan | second semester | afternoon |
| (TE) Theory | 1 | Catalan | second semester | morning-mixed |

| | | | | |
|---|---|---|---|---|
| (TE) Theory | 2 | Catalan | second semester | afternoon |