UAB
Universitat Autònoma de Barcelona

Structural Geology I

Code: 101047
ECTS Credits: 6

2025/2026

Degree	Type	Year
Geology	OB	3

Contact

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Teachers

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Teaching groups languages

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

Prerequisites

It is recommended to have passed the first-year subjects "Fonaments de Geologia" and "Treball de Camp de Geologia Regional" and taken the course "Geological Cartography"

Objectives and Contextualisation

- Recognise and interpret the main brittle deformation structures, and their relationship with the tectonic settings.
- Provide a basic framework to interpret the machinal behaviour of rocks as function of physical parameters.
- Use the main techniques of the structural geology (map, cross-section, stereographic projection, sketch, etc) to process, interpret and graphical represent the structural data.
- Acquire and correctly communicate the structural information (oral, written and graphical)

Competences

- Display understanding of the size of the space and time dimensions of Earth processes, on different scales.
- Draw up and interpret geological maps and other means of depicting geological information (columns, correlation frames, geological cross-sections, etc.)

- Learn and apply the knowledge acquired, and use it to solve problems.
- Obtain information from texts written in other languages.
- Process, interpret and present field data using qualitative and quantitative techniques, and suitable computer programmes.
- Recognise, depict and reconstruct tectonic structures and the processes that generate them and relate types of rocks and structures to geodynamic environments.
- Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
- Synthesise and analyse information critically.
- Use concepts from physics when solving problems in geology.
- Work independently.

Learning Outcomes

1. Discern the deformation processes on different scales.
2. Draw up structural subsoil models, based on geological cross-sections and three-dimensional block diagrams.
3. Formulate and verify hypotheses of a structural and tectonic nature.
4. Interpret the mechanical behaviour of geological materials in accordance with physical parameters.
5. Learn and apply the knowledge acquired, and use it to solve problems.
6. Obtain information from texts written in other languages.
7. Process, interpret and present structural data.
8. Recognise and depict the principal tectonic structures.
9. Relate deformation structures to tectonic stress.
10. Relate the principal tectonic structures to structural and petrogenetic processes.
11. Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
12. Synthesise and analyse information critically.
13. Work independently.

Content

PROGRAM

Unit 1. STRUCTURAL GEOLOGY. Structural geology and tectonic: concepts and scales of study. Typology of structural data and structural analysis. Experimentation and modeling in Structural Geology.

Unit 2. STRESS. Concepts of force and stress. State of stress at a point. The stress tensor. The Mohr circle for stress. Medium stress, deviatoric and effective stresses. Hydrostatic and lithostatic stresses. Types of stress states. Measurement of stress. Stress fields. Tectonic stress. Stress patterns on a global scale.

Unit 3. DEFORMATION. Concepts of deformation and strain, its components. Homogeneous and heterogeneous deformation. Basic parameters of 2D deformation.

Unit 4. RHEOLOGY. Relationships between stress and deformation. Elasticity, plasticity and viscosity: rheological models. The experimental deformation. Types of experiments and control parameters. The role of pressure, temperature, deformation rate and fluid pressure. Deformation by creep. Extrapolation of experimental data to natural conditions. Rheology of the lithosphere. The brittle-ductile transition.

Unit 5. BRITTLE DEFORMATION. Typology of the fractures developed in rocks subjected to stress. Shear fractures: Coulomb criterion and the Mohr envelope. Tension fractures. Theory and the Griffith criterion. Nucleation and propagation of fractures. Factors that influence fracturing. The frictional sliding. Beerley's Law. Reactivation of discontinuities. Influence of anisotropy. Mechanisms of brittle deformation. Deformation bands and fractures in porous rocks.

Unit 6. JOINTS. Growth and morphology of joints. The origin of joints. Propagation of joints into the regional stress field. Disposition of joints in relation to other structures.

Unit 7. FAULTS. Geometry of faults, displacement distribution. Formation and propagation of faults. Kinematic criteria. Fault anatomy (fault rocks). Faults and fluids (connectivity and sealing). Interpretation of the stress field from fractures.

Unit 8. SEISMICITY. The global distribution of earthquakes. Seismicity at plate and intraplate edges. Theoretical phases and mechanism of earthquakes. Magnitude and intensity. The seismic cycle, recurrence. Prediction of earthquakes and hazard analysis. Induced seismicity. Liquefaction.

Unit 9. THRUSTS. Terminology. Geometry of thrusts. Folds related to thrusts. Thrust systems and their evolution. Thrust emplacement. The Coulomb wedge model: its evolution. Gravitational models.

Unit 10. NORMAL FAULTS. Extensional faults: Geometry. Normal faults systems. Rift formation and metamorphic core complexes. Models of normal faults at crustal scale.
Unit 11. STRIKE SLIP FAULTS. Geometry of strike slip faults. Terminations of strike slip faults. Transfer and transform faults. Transcurrent faults. Transpression and transtension.

Unit 12. SALT TECTONICS. Properties and rheology of salt. Salt flow and parameters of control. Geometry of salt accumulations: structures related to salt diapirs. Salt diapirism in different tectonic regimes. The role of salt as a mechanically weak décollement.

PRACTICE PROGRAM
- LABORATORY
I. Force and stress. Concept of stress tensor and Mohr circle.
II. Stress Mohr circle. Calculation of the state of stress from "in-situ" measurements.
III. Experimental deformation. Obtention of the stress-deformation curve from experimental data: material properties.
IV. Interpretation of graphs on the rheology of materials. The role of pressure, temperature, fluids and deformation rate in the rheology of rocks.
V. The fracture envelope. The use of Mohr circles to study the formation of faults and fractures. Physical parameters in the formation of fractures. Influence of the anisotropy in fracture development.
VI. Structures related to the displacement of thrusts and normal faults.
VII- VIII. Interpretation of geological maps and drawing of geological cross-sections.
IX. Analysis and interpretation of field data. Obtention of the stress field orientation from faults.

- FIELD WORK
Fault system of the Vallès-Penedès (1 day)
Fault recognition in the field and data collection. Kinematic criteria. Fault rocks. Interpretation of the structures and their representation in sketches and stereographic projections. Interpretation of the geodynamic context. Elaboration of a field report.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Field work	7	0.28	12, 5, 2, 3, 7, 8, 9, 11, 13
Laboratory Practices	21	0.84	12, 5, 2, 3, 4, 6, 7, 9, 11, 13

Theory	23	0.92	12, 5, 1, 3, 4, 9, 10
Type: Autonomous			
Study, reading of bibliography and use of the Virtual Campus	32.5	1.3	1, 3, 4, 6, 9, 10, 13
Treatment and interpretation of structural data and interpretation of geological maps	44.5	1.78	12, 5, 2, 7, 8, 11

This subject consists of a theoretical part (23 hours), in which the topics will be explained, and some study guidelines will be given in order that the student can carry out the learning in an autonomous way. Occasionally there will be exercises to be carried out by the student autonomously.

The laboratory practices (21 hours) will be taught in sessions of 2 hours and their content will be closely related to the theory. The practices will consist of exercises, elaboration of graphs and interpretation of experimental and field data, as well as the reading and interpretation of geological maps at different scales.
This work will be done by the student under supervision. The work not completed during the practice session, will have to be completed autonomously by the student. Occasionally the exercises will be collected to be corrected and evaluated.

The field work will consist of a day trip to study the Vallès-Penedès fault system. Attendance at the field trip is mandatory to pass the subject. Before the practice, the students will elaborate autonomously a summary based on bibliography, on the location and main structural elements of the zone.
The field work will consist in the observation and explanation of several outcrops, followed by data collection by the students. Subsequently, there will be a laboratory practical session to interpret the field data and provide guidelines for the preparation of the field report.

For this subject, the use of Artificial Intelligence (AI) technologies is permitted exclusively for support tasks (i.e., bibliographic or information search, text summarization, comparison of readings, text correction, translations). Students must clearly identify which parts have been generated with this technology, specify the tools used, and include a critical reflection on how these have influenced the process and the final result of the activity. The lack of transparency in the use of AI in this assessable activitywill be considered academic fault and may result in partial or total penalties in the grade of this subject, or more severe sanctions in serious cases.

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
Correction of practical exercises	15%	1	0.04	12, 5, 1, 2, 4, 7, 8, 10, 11
Examination to recover the first and/or second exams	máx. 60%	3	0.12	12, 5, 1, 2, 3, 4, 7, 8, 9, 10, 11
Field Work Memory	20%	11	0.44	12, 5, 3, 6, 7, 8, 11, 13

First partial exam of theoretical and practical contents	30%	3	0.12	1, 3, 4, 6, 8, 9, 10, 11
Papers reading, practical exercises in theory classes	5%	1	0.04	12, 2, 3, 4, 7, 8, 10, 11, 13
Second partial exam of theoretical and practical contents	30%	3	0.12	12, 5, 1, 2, 3, 4, 8, 9, 10, 11

Degree of compulsory nature of face-to-face teaching

In order for a student to be evaluated, the following minimum requirements must be met:

- Attend to the 80% of the theoretical sessions

- Attend to the 80% of the laboratory practices.

- Attend to the field trip.

Evaluation

Two partial exams of theoretical and practical content will be carried out. The evaluation will be completed with the evaluation of the other activities in the manner indicated below.

Assessment system for the acquisition of skills and qualifications system:

- Evaluation of laboratory practices by presenting a dossier (15%)

- Papers reading, practical exercises in theory classes (5%)

- Evaluation of a fieldwork report (20%)

- Partial and final exams based on the theoretical and practical contents (60%)

Only the activities evaluated through partial exams are recoverable. Students must take the exam for all those activities not passed during the course. The recovery will be made through an examination.

If a student has carried out evaluation activities that exceed 35% of the total of the subject, he / she could not be graded as NOT PRESENTED.

Single evaluation

The assesment of the course will be done by means of a theorical exam (25%), practical problem exam (35%), submission of the laboratory-practical dossier (15%) and the field trip report (25%). The last two activities are not recoverable during the final reavaluation exam.

Bibliography

Reference textbook:

Fossen, H. 2016. ***Structural Geology 2nd edition***. Cambridge University Press. Edimburg. 463 pp. https://doi.org/10.1017/9781107415096 (Digital and hardback format)

Allmendinger, R. W. Modern Structural Practice (online, https://www.rickallmendinger.net/download)

Additional bibliography:

Bastida, F. 2005. *Geología. Una visión moderna de las Ciencias de la Tierra (vol.2).*Edic. Trea. Gijón.

Hatcher, R.D. 1990. *Structural Geology*. Merrill Publishing Co. Columbus. 531 pp.

Hobbs, B.E., Means, W.D. & Williams P.F. 1981. *Geología Estructural*. Omega. Barcelona. 518 pp.

Twiss, R.J. & Moores, E. M. 1992. *Structural Geology.* W.H. Freeman and Co. New York. 532 pp.

Van der Pluijm, B.A. & Marshak, S. 1997. *Earth Structure, An introduction to Structural Geology and Tectonics* .WCB/McGraw-Hill. 495 pp.

Software

Stereonet (free online, https://www.rickallmendinger.net/stereonet)

MohrPlotter3 (free online, https://www.rickallmendinger.net/mohrplotter)

Google Earth Pro (desktop version)

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
(PCAM) Field practices	1	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	1	Catalan	first semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan	first semester	morning-mixed
(TE) Theory	1	Catalan	first semester	morning-mixed