Universidad Zaragoza

Year : 2019/20

60430 - Methods and techniques in Geology

Syllabus Information

Academic Year: 2019/20
Subject: 60430 - Methods and techniques in Geology
Faculty / School: 100 - Facultad de Ciencias
Degree: 541 - Master's in Geology: Techniques and Applications
ECTS: 12.0
Year: 1
Semester: First semester
Subject Type: Compulsory
Module: ---

1.General information

1.1.Aims of the course

The subject and its expected results respond to the following approaches and objectives:

The subject provides a fundamental basis for students who want to pursue studies in any field of geology since it shows a very complete spectrum of the most common techniques used in Mineralogy, Petrology / Petrophysics and Geochemistry, Stratigraphy and Sedimentology, Paleontology, Geology Structural and Geophysical, Geomorphology and Hydrogeology, and its various applications.

The development of any basic or applied research activity in Geology, aimed at obtaining detailed information that can be the subject of advanced studies or the realization of models of geological processes and systems, requires:

1- Have a broad knowledge of the techniques and methods that can be applied to achieve the intended objectives.

2- Know the application requirements of each technique and assess the costs and associated procedures in each case.

3- Assess what results can be obtained by each technique or procedure and with what degree of precision.

4- Design a work plan to obtain the necessary information.

This subject aims to cover these four objectives, covering the widest possible spectrum of techniques and work themes, familiarizing the student in the techniques of sampling, laboratory analysis and interpretation of geological data. The student, regardless of their future perspectives, acquires a broad and integrated vision of the techniques and methods that are currently available, to be able to adapt them to their future needs and to be able to design a work plan adjusted to the requirements and limitations of each case.

1.2.Context and importance of this course in the degree

This subject, along with the "Geology data processing, representation and modeling" and "Scientific and technical communication", constitute the group of compulsory subjects of the degree (all of them taught in the first semester), with a strong transversal character and Basic for the development of the contents of the subjects of the second semester of the degree.

In this subject the student is expected to acquire a broad knowledge of the different techniques and methods, as well as the design and quantification of resources for the elaboration of a work plan.

1.3.Recommendations to take this course

This course is aimed at students who want to acquire advanced training in the different methods and techniques of geology study, both for basic and applied research purposes, as well as the application of this knowledge to the design of geological prospecting campaigns.

This subject consists of three units:

UNIT 1: Instrumental techniques: requirements and applications (4,5 ECTS)

UNIT 2: Geological data dating (4 ECTS)

UNIT 3: Design of geological campaigns (3,5 ECTS)

Since the subject's programming includes a broad syllabus and the classroom sessions have a theoretical-practical nature, a

continuous work dynamics is recommended, allowing adequate progress in the subject and completing the questionnaires or evaluation exercises that allow to verify the acquisition of the competences during the development of the subject.

2.Learning goals

2.1.Competences

Upon passing the subject, the student will be more competent to ...

- Possess knowledge that provides a basis to be original in the development and application of ideas, often in a research context.

- Apply the knowledge acquired and be able to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of ??study.

- Integrate knowledge and face the complexity of making judgments even from incomplete or limited information, including reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.

- Carry out an autonomous learning that allows them to continue studying in a way that will be, to a large extent, self-directed.

- Assess the problems of representativeness, accuracy, precision and uncertainty in the taking of samples and field and laboratory data.

- Have developed sufficient autonomy to participate in research projects and scientific or technological collaborations and, if necessary, direct and / or coordinate work teams within the field of Earth Sciences, in interdisciplinary contexts, where appropriate, with a high component of knowledge transfer.

- Assume responsibility for their own professional development and specialization in one or more fields of study within Geology.

- Recognize and respect the points of view and opinions of the other members of the team and be able to evaluate their own performance as an individual and as a member of a team.

- Manage, discriminate and select sources of bibliographic information.

- Develop the ability to analyze, synthesize and summarize previous geoscientific information in a critical manner.

- Gather and integrate various types of evidence to formulate and test hypotheses, applying the scientific method in the framework of geological investigations.

- Obtain, store, analyze and model geological data, as well as select and use the appropriate field, laboratory and cabinet techniques.

Select and apply the most appropriate methodologies and techniques to plan and carry out geological research works, both fundamental and applied.

2.2.Learning goals

The student, to pass this subject, must demonstrate the following results ...

Identify the main properties of interest (physical, mechanical and chemical) in the characterization of geological materials and know their study methods and their applications.

It is capable of assessing the operational, sampling, economic and administrative requirements of the different techniques and methods applicable in Geology, for prospecting and fundamental and applied research.

Knows how to select the most appropriate laboratory and field techniques and methods to obtain results that are consistent with the objectives of a specific geological study.

Knows and is able to assess the different dating methods in Geology, being able to select the most appropriate to the problem under study.

It has the capacity to plan and manage a geological research campaign, intervening in all its development.

Knows how to economically value a geological study project, appropriately sizing the costs to the planned objectives and / or the methodology to the available budget.
2.3.Importance of learning outcomes

The students, with this subject, acquire the necessary training to be able to successfully tackle the rest of the subjects, more specific, within the degree. The development of new advanced techniques of study in Geology requires that students know the wide range of techniques and methods of study that can be applied to the resolution of geological problems at different scales, as well as the type of expected results of each one of them. . This knowledge, theoretical and practical, is the basis of any subsequent study and is the most significant formative result of this subject.

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3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

The student must demonstrate that he has achieved the expected learning outcomes through the following assessment activities.

Continuous assessment

In the face-to-face development of the subject, the evaluation will be carried out through a series of continuous assessment activities, as detailed below:

1. **Written exam** (40% of the final grade). There will be several written tests of the contents of Units 1 and 2 throughout the semester. The tests will have the format of theoretical-practical questionnaires that will be answered at the end of each topic or block of topics. The weight of each individual questionnaire in the final grade will be proportional to the teaching hours covered by the topic or block of topics.
2. **Papers and reports** (60% of the final grade, the weight of each practice assessment being proportional to its face-to-face teaching load). Throughout the semester, in Units 1 and 2 (40% of the final grade of the subject) several practice assignments related to the contents of each theoretical-practical session will be carried out. As a general rule, these assignments will begin in class and each student should complete and hand them in on specific dates that will be announced at the beginning of each of the course units. Unit 3 (20% of the final grade of the subject) is evaluated by means of geological prospecting reports.

Global assessment

For those students who do not pass the course by continuous assessment or who opt for this mode of evaluation, a theoretical and practical examination will be conducted to evaluate the achievement of the expected learning results (100% of the final grade).

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

This course is intended for students to acquire advanced training in various methods and techniques of Geology, both for basic and applied research, and the application of this knowledge to the design of geological survey campaigns.

This course is aimed primarily at students with a background in Geology, but it is also appropriate for students trained in other disciplines (Engineering geology or mining, Biology, Physics, Environmental Science, Geography, ...) that require knowledge of the most commonly used methods in various fields of Geology.

The course uses the following teaching methods:

- 1. Lectures (6.1 ECTS: 61 hours).
- 2. Practice sessions (5.1 ECTS: 51 hours).
- 3. Field work (0,8 ECTS: 8 hours).

4.2.Learning tasks

The course has a similar number of teaching hours allocated to theory lessons and practice sessions. Several learning activities have been designed in order to achieve the learning objectives:

1. **Theory lessons**. These are lectures where the fundamentals of the topics covered during the course are explained using ICTs, engaging the student in active participation.
2. **Problem solving sessions**. Practice sessions where real-world problems are formulated and solved by means of general or specific software.
3. **Laboratory sessions**. Practice sessions carried out in the laboratory using specific methodologies, techniques and instruments.
4. **Seminars**. Discussion and debate on specific topics or case studies based on work done by students.
5. **Field work**. Two one-day field trips to put into practice geological prospecting techniques and to gather data to be used in practice sessions in the lab.

In order to optimize coordination between theory lessons and practice sessions, the course is taught in 2.5 hour sessions combining participative lectures, problem solving tasks and computer-based case studies.

4.3.Syllabus

The course will address the following topics:

Unit 1: Instrumental techniques: requirements and applications

1.1- Determination of physical and mechanical properties

1.1.1. Porosity, permeability, density. Interaction with water and induced physical changes.

1.1.2. Surface analysis and color measurement. Study techniques.

1.1.3. Indirect measurements of physical properties: Ultrasonic pulses, methodology and possibilities.

1.1.4. Fundamentals of Magnetism of Rocks. Magnetism techniques of rocks.

1.1.5. Most relevant geotechnical and geomechanical tests: excavations, soundings, sampling and witnessing; lab and in-situ tests in Soil Mechanics; lab and in-situ tests in Rock Mechanics.

1.2- Introduction to mineral and chemical characterization techniques: Mineral-chemical characterization; Chemical characterization techniques; Isotopic techniques; Other techniques: ATD / ATG, infrared spectrometry

Unit 2: Dating of geological materials

2.1- Radioisotope techniques

2.2- Techiques in recent materials

2.3- Thermochronology

2.4- Cyclostratigraphy

2.5- Geochronological applications of paleomagnetism

2.6- Biochronological methods

2.7- Chronostratigraphy and Geochronology

Unit 3: Campaign design exploration and geological prospecting

3.1- Design of a campaign of prospecting and paleontological dig

3.2- Design of a campaign of prospecting mineralogy-petrology

3.3- Design of a campaign to basin analysis

3.4- Design of a research cruise in structural geology and geophysical prospecting

3.5- Design of a campaign-geomorphological hydrogeological survey

Practice sessions:

Unit 1:

Session 1- Determination of petrophysical properties: density, porosity, permeability (6h)

Session 2- Magnetism o rocks practice techniques (3h)

Session 3- Planning a sampling campaign based on objectives. Choice test (2h)

Interpretation of logs 4- Dynamic penetration, correlation with SPT and applications (2h)

Unit 2:

Session 5- Dating series with sedimentary cyclicity (4h)

Session 6- Magnetostratigraphy practice session (4h)

Session 7- Application of qualitative techniques of construction and calibration of biochronological scales (2h)

Session 8- Exercises of quantitative and statistical biostratigraphy (2h)

Unit 3:

Session 9- Design of a paleontological campaign: prospecting and excavation (5h)

Session 10- Design of a petrology - mineralogy campaign (5h)

Session 11- Design of a campaign for basin analysis (5h)

Session 12- Design of a research campaign in structural geology and a geophysical survey (5h)

Session 13- Design of a geomorphological and hydrogeological survey (5h)

Session 14- Fieldwork (8h)

4.4.Course planning and calendar

The course is taught is 2.5-hour sessions that combine lecture time and practice sessions.

At the beginning of the course, during the first sessions, a calendar with all planned activities will be handed out. This calendar will include the deadlines for submission of each piece of assessment.

The field work sessions will be scheduled and anounced in due time.

Beginning of the subject: beginning of the first semester according to the academic calendar published on the website of the Faculty of Sciences.

Practical field trips: according to the field calendar that is approved for the degree and can be found on the web of the

Department of Earth Sciences.

Examination dates: according to the calendar published on the website of the Faculty of Sciences.

4.5.Bibliography and recommended resources

http://biblos.unizar.es/br/br_citas.php?codigo=60430&year=2019