Universidad Zaragoza

Academic Year/course: 2021/22

26425 - Geotechnics and Geophysical Prospecting

Syllabus Information

Academic Year: 2021/22
Subject: 26425 - Geotechnics and Geophysical Prospecting
Faculty / School: 100 - Facultad de Ciencias
Degree: 296 - Degree in Geology
ECTS: 7.0
Year: 4
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:
Acquire work techniques in geological engineering. Appreciate the importance of geology, in general terms, in civil engineering. Accept the ethical commitment that every geologist must have in their professional performance. Know the different variables that influence the geotechnical behavior of the terrain (both soils and rocks) and understand their importance for its evaluation. Know the methods of data collection in geotechnics. Know the physical properties of soils and their impact on public works. Manage the main parameters used in soil mechanics. Know the mechanical properties of soils, resistance, etc. and the main tests used for its determination. Know the theory of consolidation of soils and the tests used to determine settlements. Know and manage the properties and parameters that describe the behavior of rocks. Manage the parameters used in the study and classification of rocky massifs and their application for the excavation of slopes, construction of foundations, design of dams, tunnels, etc. Apply the usual numerical methods to solve specific questions in the design of foundations, studies of slopes, dams, tunnels, earthworks, etc. Know the main prospecting methods used in geotechnics. Assess geophysical prospecting methods based on their physical foundation. Distinguish the applications and limitations of common geophysical prospecting methods. Know the theory and applications of electrical prospecting. Interpret electrical profiles by applying algorithms. Know the main electromagnetic prospecting methods, and their applications. Know the physical fundamentals of refraction seismic and know how to apply the method to solving geotechnical problems. Master the basic vocabulary of the profession.

1.2. Context and importance of this course in the degree

This subject is taken in the 4th year of the degree. Students, therefore, have a correct level of geology and handle the necessary tools from the field of geology. They will not be insisted upon, although in professional performance they are essential. Let's say that the rest of the degree provides the necessary foundations. In subjects from previous plans, very similar to this one, it has been found that students, a priori, find the subject interesting from a training point of view for their professional future, although at the same time they manifest a certain lack of knowledge about their concrete contents and their relationships with other subjects of the degree.

1.3. Recommendations to take this course

The subject is part of a line of learning on applied aspects of geology, it requires having the habit of solving numerical problems, as well as being able to integrate what has been studied in other disciplines detecting its relevance in this field of geology. In this sense, it is advisable to have successfully studied physics and structural geology subjects from previous years of the degree. Learning this subject will require more effort in the field of understanding and reasoning than in the purely rote. It is recommended: (1) attend all the activities of the subject, (2) follow the subject with a continuous work plan, studying the theoretical contents as they are taught and keep up-to-date the tasks and questionnaires proposed and (3) make use of of the material made available to the student in the Digital Teaching Ring and of the academic tutorials.

2. Learning goals

2.1. Competences

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

- Master the basic concepts of the subject.

- Demonstrates ability to solve common problems in geotechnics or geological engineering at a basic level.
- Learn about the main geophysical prospecting methods and assess their usefulness based on the objectives set for prospecting.
- He/she is fluent in the concepts and physical foundations of geophysical prospecting methods.
- Evidence of your ability to work in a team.

2.3. Importance of learning goals

The student, to pass this subject, must demonstrate that He/she ...
Knows the concepts and basic terminology of the discipline.
Knows and manages the unified classification of soils and the parameters and tests necessary for it.
Knows how to calculate the vertical load induced by the weight of geological materials in terms of total and effective stresses.
Knows how to calculate the increase in vertical stress induced by loads distributed on transmitting surfaces.
Knows and manages the concepts of normally consolidated and overconsolidated soils.
Knows the Mohr-Coulomb failure criterion and handles the Mohr circle.
Understands the foundation, operation and objectives of the different failure tests.
Appreciates the importance of detecting problem soils and how this information integrates with other geological disciplines.
Understands the distinction between rocky matrix and rocky massif and its practical implications.
Knows the main failure criteria for matrix and rock mass.
Knows the main parameters necessary to characterize a rocky massif.
Knows about the different types of foundations and associated structures.
Knows how to calculate the bearing capacity of a soil depending on the type of foundation.
Knows how to estimate settlements and settlement times.
Knows the criteria for planning a geotechnical survey.
Knows the types of slope breakage in soils and rocks and know how to estimate their degree of stability.
Knowsabout the main slope stabilization methods.
Knows the physical fundamentals of the main methods.
Knows their applications and limitations.

3. Assessment (1st and 2nd call)

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

Continuous evaluation

1. *Questionaries* (running test): at the end of each lecture the student must answer one or more questions related to the topic at hand.

2. *Practicals*: Each practical session includes additional problems that must be solved and presented before the next session.

3. *Field report:* The student will produce a properly structured report from data and observations collected in a geophysical survey in the field.

Global Evaluation test

The GET consists on two components:

- **Written test**. In turn, this test has two different parts. The first one consists on problems and practical questions to evaluate the understanding of the course. The student may consult books, course notes, etc. The second one covers the theoretical contents, without books, course notes, etc.

- **Instrumental test** where the student will show his/her skills with geophysical instruments.

In the first and second call, the students that rated above the stablished minimum requirements on the continuous evaluation (see below) will only be tested on the first part of the written test (problems). Students that failed or did not rate on the continuous evaluation will be tested on the full GET.

Assessment criteria or Course Grade Distribution

1st case. Those students graded above minimum in the continuous evaluation.

Final grade=(GET x 0.6)+(continuous ev. x 0.4), where ?continuous ev.? refers to (classroom questions + additional problems + field report) / 3

2nd case, Those students that failed the continuos evaluation:

Final grade= (written test x 0.7)+(Instrumental test x 0.3)

Minimum requirements:

Classroom questions: 7/10

Additional problems: 5/10

Geophysical report: 5/10

Written test (either problems or theory): 5/10

Instrumental test: 5/10

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

This subject combines the theoretical classes with the handling of devices and the resolution of exercises (which may include case studies) that, depending on their typology, are carried out in practice in the classroom, laboratory, or seminars, as well as field work.

4.2. Learning tasks

The program comprises the following activities.

- Activity 1: Learning of conceptual and descriptive aspects and calculation bases
    - Participatory master classes (2.8 ECTS)
    - Works on questionnaire (0.4 ECTS)
    - Seminars (1 ECTS)
- Activity 2: Learning instrumental procedures
    - Field practices (0.3 ECTS, 2 half days)
    - Office practices: numerical problem solving (2 ECTS)

Throughout the course, both in practical and theoretical classes, some bibliography and internet resources will be used in English.

Note: the teaching and evaluation activities will be carried out on-site unless, due to the Covid-19 health situation, the provisions issued by the competent authorities and by the University of Zaragoza require them to be carried out online or mixed on-site-online with reduced-capacity rotating groups. Online teaching will not be applied to field practices.

4.3. Syllabus

I. Theory Program

- Module I. Geotechnics
    - UNIT I. Fundamentals of application of soil mechanics
        - 1. Basic aspects of soils.
        - 2. Efforts in the subsoil.
        - 3. Consolidation.
        - 4. Shear strenght of soils.
    - Unit II. Some aspects of rock mechanics
        - 5. Basic aspects of rock mechanics.
        - 6. Characterization and classification of rock masses.
    - Unit III. Applications
        - 7. Foundations in soils I. Shallow foundations

        - 8. Foundation in soils II. Deep foundations
        - 9. Soil foundations III. Geotechnical study
        - 10. Slopes in soils
        - 11. Slopes in rocks
        - 12. Lateral pressures
- Module II. Geophysical prospecting
    - Unit IV. Methods and applications
        - 13. Electrical methods
        - 14. Seismic methods: refraction seismic.
        - 15. Georadar.

II. Field and Instrumental Practices Program
Seismic prospecting (refraction) in simple cases
Georadar prospecting (multi-frequency antennas), magnetic and magnetometric prospecting

III. Numerical problems
Session 1: Elemental properties of soils and classification.
Session 2. Stresses in the subsoil: p.
Session 3: Shear strenght, determination of cutting parameters.
Session 4: Shallow foundations: calculation of bearing capacity.
Session 5: Shallow foundations: settlement estimation.
Session 6: Deep foundations: piles.
Session 7: Slopes in soils. Calculation of the safety factor.
Session 8: Slopes in rock: kinematic analysis with stereographic projection.
Session 9: Vertical Electrical Sounding, two-layer, three-layer cases ...
Session 10: Refraction seismics, horizontal interfaces, inclined interfaces.

4.4. Course planning and calendar

Schedule

This course is taught in the first semester. Classes will begin the first academic week.
Students can go to the websites of the Faculty of Sciences and the Department of Earth Sciences (https://ciencias.unizar.es; https://cienciastierra.unizar.es/) for schedules, classes and dates of subject examination.
On the first day of class, more information will be provided (exams and tests, group assignment, tutoring hours ...). The date of the field day will be published on the website of the Department of Earth Sciences.

Milestones:
- First week of the course: start of theoretical classes.
- Second week of the course: start of practical classes.
- Exams on the dates proposed by the Dean of the Faculty of Sciences

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=26425