Geological Engineering II: Mechanics and Geotecnics

Code: 101053
ECTS Credits: 6

2024/2025

Degree	Type	Year
2500254 Geology	OT	3
2500254 Geology	OT	4

Contact

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Teaching groups languages

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

Prerequisites

Though there are not official requirements to take this class is highly convenient that the student has in mind the classical mechanics from Physics, stress and deformation concepts from Structural Geology, and water flow from Hidrogeology, classes.

Objectives and Contextualisation

The general objective is to give students the theoretical-practical knowledge of soil mechanics and geological engineering. Special emphasis will be given on applied geological research to solve various geotechnical problems.

Specific objectives aim for students to acquire skills on:

The use of geotechnical characterization techniques, both "in-situ" and in the laboratory.

The integration of various geological disciplines for a multidisciplinary and synthesis work, focused on solving geotechnical problems.

The organization and planning of tasks as well as the development of interpersonal skills that allow team-working.

Expose their team-work activities in class.

Present oral and written exams.

Competences

Geology

- Display knowledge of the applications and limitations of geophysical methods for learning about the Earth.
- Draw up and interpret geological maps and other means of depicting geological information (columns, correlation frames, geological cross-sections, etc.)
- Identify and characterise minerals and rocks through instrumental techniques, determine their formation environments and know their industrial applications.
- Learn and apply the knowledge acquired, and use it to solve problems.
- Plan the exploration and sustainable development of geological resources.
- Process, interpret and present field data using qualitative and quantitative techniques, and suitable computer programmes.
- Recognise theories, paradigms, concepts and principles in the field of geology and use them in different areas of application, whether scientific or technical.
- Recognise, depict and reconstruct tectonic structures and the processes that generate them and relate types of rocks and structures to geodynamic environments.
- Show an interest in quality and incorporate it into practice.
- Show initiative and adapt to problems and new situations.
- Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
- Work in different environments and localisations, with respect for diversity and multiculturalism.

Learning Outcomes

1. Assess methods for restoring and remediating land.
2. Correctly sample industrial mineral and rock deposits.
3. Draw up geological cross-sections or other types of presentation for geological data in order to characterise hydrocarbon reserves and mineral deposits.
4. Enumerate the industrial applications of minerals and rocks.
5. Identify types of deposits with geodynamic environments.
6. Interpret simple geophysical profiles to know subsoil structure.
7. Learn and apply the knowledge acquired, and use it to solve problems.
8. Resolve and present paragenetic mineral sequences of deposits.
9. Show an interest in quality and incorporate it into practice.
10. Show initiative and adapt to problems and new situations.
11. Solve problems in reserves, mineral deposits and geological engineering based on field and laboratory observations and the concepts studied.
12. Suitably transmit information, verbally, graphically and in writing, using modern information and communication technologies.
13. Work in different environments and localisations, with respect for diversity and multiculturalism.

Content

1. Basic concepts.

1.1 What is soil mechanics and Geological and Geotechnical engineering.

1.2 Concept of soil in geotechnics

1.3 Soil phases

1.4 Soil phase relationships

2. Index Parameters of soils

2.1 Granulometry

2.2 Atterberg limits

2.3 Soil classification systems

3. Soil Compaction

3.1 Concept.

3.2 Laboratory and in-situ tests for quality control

4. Soil exploration

4.1 Geotechnical investigations: methods and levels

4.2 SPT, DPSH, CPT tests

4.3 Records and interpretations

5. Water flow.

5.1 Hydraulic properties of the soil. permeability

5.2 Darcy's Law. Bernoulli's law 1D flow.

5.3 Flow network. 2D flow.

6. Distribution of stresses

6.1 Total stress and effective stress

6.2 Main stresses in soil mechanics. Mohr's circle

6.3 Modifications of the vertical stress due to the application of loads to the ground

7. Consolidation

7.1 Consolidation test and consolidation parameters.

7.2 Calculation of settlements

7.3 Settlement time.

8. Soil resistance parameters

8.1 Direct shear test

8.2 Uniaxial compression

8.3 Triaxial: CD, CU, UU

8.4 Correlation with field tests

8.5 Concept of safety factor, FS.

9. Foundations

9.1 Shallow foundations: footings.

9.2 Deep foundations: piles.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Field trip	7	0.28	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13
Lab work	22	0.88	1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13
Master classes	22	0.88	1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12
Type: Supervised			
Tutoring	11	0.44	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Type: Autonomous			
Study, problem solving, practical report writting and final project	82	3.28	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

Lectures

The theoretical part will be taught through lectures. Along with the selected bibliography, the students will have diversified material for complementing the classes that will be available in the virtual classroom and at the library. The theoretical knowledge acquired by the students will be evaluated with written tests.

Laboratory practices / Constructive projects

We will work with a series of data acquired in the laboratory to process, visualize and analyze it at the laboratory class. There are supporting videos that explain the performing of the most significant lab tests to characterize the properties of the soils. Students will be provided with a series of exercises on a real exploration case to learn how geotechnical information is organized, processed, analyzed and synthesized it. Real laboratory and field data will be used to build a geotechnical model on which foundations will be proposed (Laboratory Practical Project)

Field trip

The field trip will take place in the Vallès, Barcelonés area to geotechnical laboratories or construction projects where the student will obtain information on conducting field or laboratory tests.

At the end of the semester, 15 minutes will be allocated for the students to answer the teacher evaluation 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
Parcial Exams and Final Exam	100 %	6	0.24	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

1.Continous Evaluation

S'avaluaren:

- Exercises (30%)
- Two partial exams: 1st partial exam (20%) i 2nd Partial exam (20%)
- Reports from practical work at lab (by teams) (15%)
- Practical Laboratory Project (15%)
- Mandatory assistance to the field trip. We might visit a geotechnical private laboratory or a construction site.

2. Re-evaluation:

- Only exams will be re-evaluated.
- Students must have delivered 2/3 of exercises and the Practical Laboratory Project to have the right to be re-evaluated.
- Re-evaluation can be partial or total, this is: present only one part to be re-evaluated, first or second part of the course, or both parts.
- The best obtained grade obtained in re-evaluation test will substitute in the exams grades to re-evaluate the final grade.

3. Unique evaluation.

- The student who choose this single evaluation option during has to communicate it to the lecturer professor during the first two weeks after the beginning of classes. He/She has to formalize it with Academic Management Area of the Faculty of Sciences infilling a form to ask for this modality.
- The single evaluation will take place the date of the second partial exam and it will consist on:

a) Theory exam(30%)

b) Practical exam (30%)

c) A geotechnical investigation project (40%) that will be defined with the professors at the beggining of the course.

- The student with single evaluation can be re-evaluated only in the exams part as in continous evaluation.

Bibliography

CLÀSSICA:

Guerra Torralbo, J.C. (2018). Mecànica de Suelos: Conceptos básicos y aplicaciones. Ed. Dextra.

Olivella PastalléS., García-Tornel Josa A., Valencia Vera F.J. (2003) Geotecnia. Problemas Resueltos. Mecánica de Suelos. Ediciones UPC.

Gonzalez de Vallejo, L.I., et. al. (2002) "Ingeniería Geológica". Prentice Hall.

NORMES i CODIS:

"EUROCÓDIGO 7 - PROYECTO GEOTÉCNICO" UNE-ENV 1997-1 Norma Experimental Europea adaptada por AENOR. (Asociación Española de

Normalización y Certificación). (Març 1999). https://www.mitma.gob.es/recursos_mfom/guia_proyecto_cimentaciones_con_eurocodigo_7_cimentacione_supe

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"*Pliego de prescripciones técnicas generales para obras de carreteras y puentes" (PG-3)*. Ministerio de Fomento. Dirección General de Carreteras. (Modificació aprovada per O.C. al 2000 - 2001).https://apps.fomento.gob.es/CVP/handlers/pdfhandler.ashx?idpub=ICW020

Software

- QGIS/ArcGIS Desktop
- Excel
- Word

Language list

Name	Group	Language	Semester	Turn
(PCAM) Field practices	1	Catalan	second semester	morning-mixed
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed