Syllabus

Geotechnics

Teaching Guide

1. Subject:

Geotechnics

Degree

Degree in Civil Engineering

Code

7372

2. Unit/Module:

Common to the civil part/Ground Engineering

3. Department:

Architectural Constructions and Construction and Land Engineering

4.a Professor:

Sergio Ibáñez García, Santiago Ortiz Palacio, Ana Belén Espinosa y José Ángel Porres Benito

4.b Coordinator:

Sergio Ibáñez García

5. Course and semester in which the subject is taught:

2nd Year, 3rd Semester

6. Course Type : (introductory, mandatory or elective)

Mandatory

7. Number of ECTS credits for course:

6

8. Competences that the student must acquire when taking the subject:

Specific Competences-Common module to the civil part: C05-Knowledge of geotechnical engineering and soil and rock mechanics, and its application to the development of studies, projects, constructions and operations, where earth moving, foundations and soil retaining structures are necessary. Basic competences: CB1; CB2; CB3 General competences: CGT01 Transversal competences: I01; I06; I07; I08; P06; S01; S02; S07; S08; T01; T02; A01; A03; A05

9. Course Overview:

9.1- Teaching objectives
A general introduction to soil mechanics will be offered to the students, providing them with general knowledge about it and about practical applications in civil engineering. Soil identification and classification will be explained to understand soil properties and to find out the main geotechnical parameters. This way, a student will be able to predict and calculate the soil stress-strain behavior against external mechanical solicitations and against other natural environmental factors (water, temperature, erosion, earthquakes, etc.). Thus, the student will be able to analyze and design simple compaction cases, groundwater seepage, and the main mathematical mechanical models for calculating soil stress-strain behaviour, and applications in civil engineering (retaining walls and foundations).

9.2- Teaching units (content blocks)

GEOTECHNICS

INTRODUCTION

1. What does geotechnical engineering mean?
2. Birth of modern geotechnical engineering
3. Definition of soil
4. Geotechnical uncertainties due to soil nature
5. Resolution of a geotechnical problem
6. Themes

PARTICLE SIZE DISTRIBUTION

1. Basic soil types in terms of the grain size ranges
2. Organic soils
3. Grain size
4. Interpretation of grain size

PHASE RELATIONSHIPS

1. Soil identification
2. Phase relationships

SOIL PLASTICITY AND SOIL CLASSIFICATION

1. Consistency of a soil (plasticity)
2. Sand equivalent test
3. Sand equivalent test
4. Atterberg limits
5. Soil classification

CLAY PROPERTIES

1. Clay minerals
2. Clay particles (“double layer”, “adsorbed water”)
3. Degree of sensitivity and thixotropy
4. Clay structures

SOIL WATER AND SOIL HYDRAULICS

1. Soil-water geometry
2. Hydrostatic state
3. Flow of soil water
4. Analysis of 2-dimensional flow in porous media.
5. Flow nets
6. Effects of seepage

FUNDAMENTALS OF CONTINUUM MECHANICS

1. Physical model on an interparticle contact plane
2. The principle of effective stress
3. The state of stress
4. Mohr circles
5. Principal stresses

ONE-DIMENSIONAL CONSOLIDATION

1. Introduction to the hydrodynamic origin of seats
2. The oedometer. Oedometric test
3. Normally consolidated and overconsolidated clays
4. Secondary consolidation
5. Initial consolidation
6. Oedometric and elastic moduli
7. Calculation of seats
8. Terzaghi-Fröhlich Consolidation Theory
9. Obtaining "cv" from the consolidation curve

FOUNDATION SETTLEMENTS

1. Stresses in elastic, homogeneous and isotropic space
2. Seats based on the theory of elasticity
3. Introduction to other types of charges and anisotropies
4. Seat analysis

SOIL COMPACTION

1. Introduction: definitions
2. Types of compaction effort and types of compaction equipment
3. Dry density-Water content curve
4. Compaction tests
5. Degree of compaction
6. Compaction quality assurance
7. Soil collapse
8. Soil expansivity (swelling)

SOIL STRENGTH CHARACTERISTICS

1. Introduction of concepts
2. Process types
3. Mohr-Coulomb failure criterion
4. Most common mechanical tests
5. Lambe parameters
6. Stress trajectories

LATERAL EARTH PRESSURE

1. Lateral earth thrusts according to Rankine model

SHALLOW FOUNDATIONS

1. Definition of foundation
2. Typology of foundations
3. Conditions that a foundation must meet
4. Situation-location
5. Sinking load
6. Seat analysis

DEEP FOUNDATIONS

1. Piles typology
2. Pile uses
3. Precast piles
4. Cast-in-place piles
5. Bearing capacity of an isolated pile

LABORATORY AND PRACTICES

Soil Identification. Atterberg limits. Sieving and Sedimentation Granulometry Test. Test of the equivalent of sand. Swelling Test (Lambe). Permeability and Siphoning Test. Proctor's test. Oedometric test. Direct Cut Test. Simple Compression Test. Triaxial test. Possible Technical Visits to Works or Sites of Geotechnical Interest

9.3- Bibliography

Bibliography

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State ports. Ministry of Development, ROM 0.5-94 Geotechnical recommendations for the project of maritime and port works, Ministry of Development. Publications Center,

FURTHER READING

Berry, P.L. and Reid, D., Soil Mechanics, McGraw-Hill, Calavera, J., Retaining walls and basement walls, Technical Institute of Materials and Construction, Madrid,
Cernica, J.N., Soil Mechanics, John Willey & Sons, New York,
Elton, D.J., Soils magic, ASCE, CEDEX Geotechnical Laboratory, Standard NLT-357/98: Plate load test, CEDEX, CEDEX Geotechnical Laboratory, Standard NLT-256/99: Footprint test on land, CEDEX, Lambe, T.W. and Whitman, R.V., Soil Mechanics, Limusa, Lancellota, R ,, Geotechnical Engineering, Balkema, Rotterdam, Rodríguez Ortiz, J.M .. Serra Gesta, J. and Oteo Mazo, C., Applied course of foundations, Publications Service of the Official College of Architects of Madrid, Madrid, Terzaghi, K. and Peck, R.B., Soil mechanics in practical engineering, El Ateneo,

10. Teaching and learning methodology and its relationship with the skills that the student must acquire:

Methodology	Related competency	Contact hours	Out-of-class hours	Total
Theoretical	CB1; CB2; CB3; C05; CGT01; I01; I06; T01; T02; S08; A05	22	16	38
Classroom and laboratory practical classes / Practical and laboratory classes	CB1; CB2; CB3; C05; CGT01; I01; I06; I07; I08; P01; P02; S08; A01; A02; A03; A06	22	24	46
Seminars, and individual or group tutorials to solve exercises, real practical cases, etc.	C05; I01; I06; I07; S01; S02; S04; S07; S08; P06; A01; A02; A03; A06	4	12	16
Evaluation tests and exams	C05; I01; I06; I07; I08; S01; S02; A01; A03	6	44	50
Total		54	96	150

11. Grading System:

FIRST CALL EVALUATION:
In order to pass this course, it will be necessary to obtain an overall grade equal or greater than 5 over 10 (50% of the maximum possible grade together). Likewise, it will be compulsory to get a grade equal or greater than 5 over 10 (50% of the maximum possible grade) in the evaluation procedures 1, 2, 3 and 4.

SECOND CALL EVALUATION:
The student will have to repeat any assignment 1, 2, 3 or 4 failed during the first call evaluation. If the student passed any (1, 2, 3 or 4) in the first call evaluation, he would not have to repeat it during second call evaluation.
5 will not be repeated in this second call evaluation. In this second call evaluation the student´s grade in 5 will be the same obtained in the first call evaluation.

Assessment	First Call Evaluation	Second Call Evaluation
1- Mid-course exam (units 0 to 6)	15 %	15 %
2- Mid-course exam (units 7 and 8)	15 %	15 %
3- Mid-course exam (units 9 to 11)	15 %	15 %
4- Mid-course exam (units 12 and 13)	15 %	15 %
5- Laboratory tests (quiz after everyday class)	20 %	20 %
6-Laboratory tests (mini project)	20 %	20 %
Total	**100 %**	**100 %**

Exceptional evaluation:

It must be requested as explained in the UBU evaluation regulations. There will be a final exam with four independent tests, where assesment 1, 2, 3 and 4 will be evaluated. It will be necessary to obtain a minimum grade of 5, in each of them. The student will also deliver, the same day, test 6.
Regarding the procedure number 5 of Laboratory practices, it will be necessary to take them during the course, but remember that it is not necessary to obtain any minimum grade.
In the case of students who participate in the Cantera University program, the grade will be determined based on the performance of the tasks assigned to them within the framework of the program.
Procedures Weight in the final grade
1-Identification issues and water and tensions (written test at the end of the block) 15%
2-Seating topics (written test at the end of the block) 15%
3-Topics of cutting processes, walls and partially saturated floors (written test at the end of the block) 15%
4-Foundation topics (written test at the end of the block) 15%
5-Laboratory practices (continuous evaluation) 20%
6-Laboratory practices (work performance) 20%
7-Total 100%

EXCEPTIONAL EVALUATION:
It is necessary for the student to formally request for it, if applicable.
The student has to attend laboratory tests. Then, there will be a final exam, which consists of four different exams (evaluation procedures 1, 2, 3 and 4).
Evaluation procedures (Weight)
1-Mid-course exam (units 0 to 6) (15%)
2- Mid-course exam (units 7 and 8) (15%)
3- Mid-course exam (units 9 to 11) (15%)
4- Mid-course exam (units 12 and 13) (15%)
5- Laboratory tests (quiz after everyday class) (20%)
6- Laboratory tests (little project) (20%)
Total (100%)

12. Learning resources and tutorial support:

Theoretical classes: the teacher will present the general concepts of each topic through multimedia systems, including real examples (photos, diagrams, etc.) of the teacher's professional experience that illustrate some concepts.
Classes of problems: during the development of theoretical teaching, problems will be carried out that will help the student to consolidate and put into practice the theoretical concepts studied.
Laboratory practices: the student will carry out various geotechnical tests guided by the teacher, who will also carry out a previous description of each test methodology, the physical and chemical foundations on which it is based, as well as its practical utility in civil engineering.
Seminars, resolution of practical cases, individual or group tutorials, etc .: during the development of the subject, those concepts of greater theoretical or practical complexity will be reinforced through seminars in which problems of variable difficulty will be solved in detail and the resolution process of real cases that may be illustrative. For this, large group seminars will be organized in the classroom or small tutorials (small groups or individual students) in the teacher's office. In these training actions, all those doubts that students may raise or geotechnical issues relevant to the subject that may arouse interest will be able to be resolved.
Lectures: the lecturers will explain the theoretical concepts by means of multimedia and blackboard tools. Pictures and schemes from real cases will be shown during the classes.
Practical classes: some practical cases and exercises, related to the theoretical concepts before explained, will be presented during the classes by the lecturers.
Seminars and tutorials, etc .: some of the most complicated concepts will be explained more widely during optional seminars and tutorials. All the questions the students want to ask will be also resolved here.

13. Calendars and schedules:

According to the official timetable

14. Language of instruction:

Spanish/English