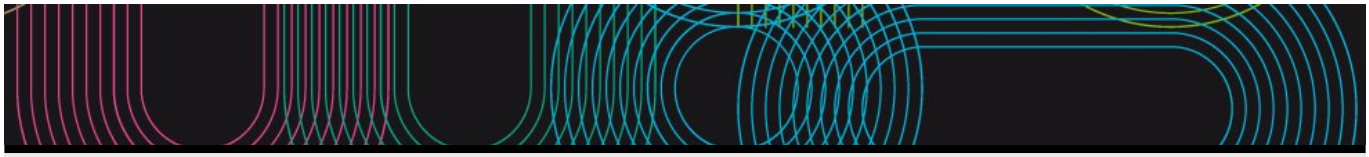

IDENTIFYING DATA				
Soil mechanics				
Subject	Soil mechanics			
Code	V09G290V01404			
Study programme	Degree in Energy Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	2nd	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Araújo Fernández, María			
Lecturers	Araújo Fernández, María Delgado Marzo, Fernando Laredo Rodríguez, Roberto Carlos			
E-mail	maraujo@uvigo.es			
Web	http://faitic.uvigo.es/			
General description	In this subject it is intended that the student knows the technological principles in the field of geotechnics (soil and rock mechanics). The knowledge about this area will focus on understanding the basic aspects of elasticity, elasto-plasticity, water flow in continuous media, consolidation and resistance behavior of soils and rocks. Another target will be to know the different experimental process for characterization, classification, resistance and consolidation in soils and rocks. To know how to design and calculate retaining walls and foundations. These theoretical and practical notions should allow the student to solve real problems and understand the singularity of the technology developed in this field. The principles of rock and soil mechanics are based on scientific knowledge, but the technical works are projected in a natural environmental where the variability of the input parameters is very relevant and has a very significant influence on the results. The knowledge of the peculiarities of this discipline will enable to solve and make good decisions into this geological context. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Competencies	
Code	
C12	Knowledge of geotechnics and mechanics of soils and rocks.
D1	Capacity to interrelate all the acquired knowledge and interpret it as components in a body of knowledge with a clear structure and strong internal coherence
D2	Capacity to develop a complete project in any field included in this type of engineering, suitably combining acquired knowledge, accessing necessary information sources, undertaking the necessary enquiries and integrating into inter-disciplinary work teams.
D3	Propose and develop practical solutions, which develop suitable strategies based on theoretical knowledge, for problem phenomena and situations that arise as everyday realities in engineering
D4	Encourage work based on cooperation, communication skills, organization, planning and recognition of responsibility in a multilingual and multidisciplinary working environment that fosters education in equality, peace and respect for fundamental rights
D5	Know what sources are available for ongoing and continual updating of all the information required to undertake their work, with access to all the current and future tools for seeking information and adapting it in the light of technological and social changes
D6	Know and handle legislation applicable to the sector, know the social and business environment and know how to work together with the Administration and use acquired knowledge to draw up engineering projects and develop any of the aspects of professional work required
D7	Capacity to organise, interpret, assimilate, create and manage all the information needed to organise their work, handling the I.T., mathematical, physical and other tools required
D8	Conceive engineering within a framework of sustainable development with an awareness of environmental issues
D9	Know the importance of the security aspects and be able to transmit this information to the stakeholders.

D10 Become aware of the need for training and continual improvement in quality, developing the values associated with scientific thinking and showing a flexible, open and ethical attitude towards diverse opinions and situations, particularly in matters of non-discrimination on the grounds of gender, race or religion, respect for fundamental rights, accessibility, etc

Learning outcomes

Expected results from this subject		Training and Learning Results
To have the capacity for consulting the technological base related with the most recent investigations within the scope of geotechnical engineering (soil and rock mechanics).	C12	D5 D6 D7
To apply for the calculation and design the basic principles of the laws of the elasticity, elasto-plasticity, water flow in continuous media, consolidation and resistance behavior of soils and rocks.	C12	D3 D7 D8
To know how characterise, classify and interpret experimental tests of resistance and consolidation in soil-rocks	C12	D2 D3 D4 D5 D6 D8 D9 D10
To know how to design and calculate retaining walls and foundations.	C12	D1 D2 D3 D5 D6 D7 D9
To make design decisions and resolve problems appllying the scientific knowledges purchased.	C12	D1 D2 D3 D4 D5 D6 D7 D8 D9 D10
To integrate the basic principle of rock and soil mechanics: the geotechnical engineer does not select the materials because it works into a natural context, and the influence of the variability of the input parameters is very relevant and has a very significant influence on the final results.	C12	D1 D2 D3 D6 D7 D8 D9
To resolve problems adjusting the design to the specificities of the project and to the natural context where it works.	C12	D1 D2 D3 D4 D5 D6 D7 D8 D9 D10

Contents

Topic	
GEOTECHNICS AND ROCK MECHANICS	Geotechnical characterization of rock masses. Behaviour and mechanical properties of rocks, discontinuities and rock masses.
DEFINITION, CLASSIFICATION AND INDEX PROPERTIES OF SOIL	Definition of soil and description of its geological origin. Granulometry. Plasticity of soils. Atterberg limits. Soil classification systems (Casagrande, H.R.B.). Index properties.
STRESS AND DEFORMATION IN A MASS OF SOIL	Effective and total stress in a soil. Tensional states in the soil mass. Elastic settlements.

THEORY OF GROUNDWATER FLOW IN A MASS OF SOIL	Steady state flow. Ascending flow under structures of containment. Water flow through small earth dams.
THEORY OF CONSOLIDATION AND SETTLEMENT ANALYSIS.	Theory of vertical consolidation (Terzaghi). The oedometer test. Settlement analysis. Shear strength of a soil.
LATERAL EARTH PRESSURE AND RETAINING WALLS	Rankine's lateral earth pressure. Active and passive soil states. Gravity Retaining walls. Reinforced soil wall. Anchored walls. Diaphragm walls.
FOUNDATIONS	Bearing capacity of shallow foundations. Cone and standard penetration tests (CPT and SPT). Design of shallow foundations (introduction). Bearing capacity of deep foundations.
GEOTECHNICAL SITE INVESTIGATION	Trial pits. Penetrometers. Borehole drilling. Geotechnnical reports.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	22	30	52
Problem solving	12.5	30	42.5
Laboratory practical	10	27.5	37.5
Studies excursion	3	0	3
Seminars	2.5	10	12.5
Problem and/or exercise solving	1.5	0	1.5
Objective questions exam	1	0	1

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Exhibition of the basic contents of the matter.
Problem solving	Formulation, analysis and resolution of a problem or exercise related with the subject.
Laboratory practical	Activities developed in laboratory for the application of basic skills related with the matter. A practices report will be evaluated.
Studies excursion	The realization of the formative activity "Studies excursion", will be organized by the School board, according to the porposal of the teaching staff about the type of facility or company to visit.
Seminars	Formulation, analysis and resolution of real cases related with the contents of the subject.

Personalized assistance

Methodologies	Description
Lecturing	Doubts, questions and clarifications will be addressed by email when the students can not attend the tutorials in person. The tutorial sessions will be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement, in all teaching modalities.
Problem solving	Doubts, questions and clarifications will be addressed by email when the students can not attend the tutorials in person. The tutorial sessions will be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement, in all teaching modalities.
Laboratory practical	Doubts, questions and clarifications will be addressed by email when the students can not attend the tutorials in person. The tutorial sessions will be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement, in all teaching modalities.
Seminars	Doubts, questions and clarifications will be addressed by email when the students can not attend the tutorials in person. The tutorial sessions will be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement, in all teaching modalities.

Assessment

	Description	Qualification	Training and Learning Results
Lecturing	Written exam of questions of short answer or type test. Written exam to solve problems and / or exercises. Each of the parts of the exam evaluates 35%. Learning outcomes: all the learning outcomes of the subject are worked on	65	C12 D1 D2 D3 D5 D6 D7 D8 D9

Problem solving	Written proofs formulating basic problems related to the matter. Learning outcomes: To apply for the calculation and design the basic principles of the laws of the elasticity, elasto-plasticity, water flow in continuous media, consolidation and resistance behavior of soils and rocks. To know how to design and calculate retaining walls and foundations. To make design decisions and resolve problems appllying the scientific knowledges purchased. To integrate the basic principle of rock and soil mechanics: the geotechnical engineer does not select the materials because it works into a natural context, and the influence of the variability of the input parameters is very relevant and has a very significant influence on the final results. To resolve problems adjusting the design to the specificities of the project and to the natural context where it works.	20	C12	D1 D2 D3 D5 D6 D7
Laboratory practical	Two practices reports will be evaluated. Learning outcomes: To have the capacity for consulting the technological base related with the most recent investigations within the scope of geotechnical engineering (soil and rock mechanics). To know how characterise, classify and interpret experimental tests of resistance and consolidation in soil-rocks. To make design decisions and resolve problems applying the scientific knowledges purchased. To integrate the basic principle of rock and soil mechanics: the geotechnical engineer does not select the materials because it works into a natural context, and the influence of the variability of the input parameters is very relevant and has a very significant influence on the final results. To resolve problems adjusting the design to the specificities of the project and to the natural context where it works.	15	C12	D1 D2 D4 D5 D6 D7 D8 D9 D10

Other comments on the Evaluation

In the ordinary call, the complete evaluation of the laboratory practices requires the assistance to the laboratory, the delivery of a group memory and the exhibition and public discussion of the main results obtained. At the same time, attendance and resolution of exercises / problems proposed during the course is mandatory to qualify for the total qualification associated with this section. In any case, the final grade will be the sum of the grades of the works proposed during the course (up to 35%) and the exam (up to 65%).

In subsequent calls of the same course, the exam will score 85% of the final grade and the grade obtained in the laboratory practices will be saved, considering the qualification of this non-recoverable.

Students who do not take the course for the first time will be kept, for a year, the laboratory practices qualification previously obtained.

Exam Timetable: Exam dates and rooms must be verified in the official webpage of the school:

http://minaseenerxia.uvigo.es/es/docencia/examenes

Sources of information

Basic Bibliography

Berry, P.L. y Reid, D., **Mecánica de Suelos**, McGraw-Hill, 1993

González de Vallejo, L.; Ferrer, M.; Ortuño L. y Oteo, C., **Ingeniería Geológica**, Prentice Hall, 2002

Jiménez Salas, J.; de Justo Alpañes, J.L., **Geotecnia y Cimientos**, 2ª ed., Editorial Rueda, 1981

Verruijt, A., **An Introduction to Soil Mechanics**, Springer, 2017

Complementary Bibliography

Das, Braja M., **Fundamentos de Ingeniería de Cimentaciones**, 7ª ed., Cengage Learning, 2012

Calavera, J, **Cálculo de estructuras de cimentación**, 5ª ed., INTEMAC, D.L., 2015

Craig, R. F., **Craig's soil mechanics. Solutions manual**, 7th ed., Taylor & Francis e-Library, 2004

Recommendations

Subjects that continue the syllabus

Fluid mechanics/V09G290V01305
Materials resistance/V09G290V01304

Contingency plan

Description

Considering the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University establishes an extraordinary planning that will be activated when the administrations and the institution determine it. It is based on safety,

health and responsibility, and it guarantees teaching in an online or semi-presential modalities. These already planned measures will guarantee, at the required time, the development of teaching in a more agile and effective way, because they will be known in advance by students and teachers through the standardized tool for teaching guides DOCNET.

1. Semi-presential modality
Once the semi-presential teaching is required, it would mean a reduction of the capacity of the teaching spaces used in the face-to-face modality. Therefore, as the first measure of the centre, the capacity of the teaching spaces would be reformulated and informed to the teachers, in order to proceed to reorganize the formative activities for the rest of the semester. It should be noted that the reorganization will depend on the moment throughout the semester in which this semi-presential modality is activated. For the reorganization of the teaching activities, the following guidelines would be followed:

Through the FaiTIC platform, all the students will be informed about the new conditions under which the formative activities and assessment tests will be carried out at the end of the semester.

The tutorial sessions will be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement.

Once some of the students have carried out experimental or computer laboratory practices in the face-to-face modality, if it is possible, the rest of the students will have the possibility to perform the same or equivalent activities in the same modality.

For the rest of the activities until the end of the semester, it should be done a proper identification of those formative activities which can be done under face-to-face modality and those which will be carried out remotely.

Regarding the potential tools to be applied for the formative activities during the online mode, CampusRemoto and the FaiTIC platform will be used.

2. Online modality
In the event that the non-face-to-face teaching modality is required (suspension of all face-to-face formative and assessment activities), the tools currently available at the University of Vigo, CampusRemoto and the FaiTIC platform will be used. The reorganization will depend on the moment throughout the semester in which this online modality is activated. In the reorganization of the teaching activities, the following guidelines would be followed:

2.1. Communication
Through the FaiTIC platform, all the students will be informed about the new conditions under which the formative activities and assessment tests will be carried out at the end of the semester.

2.2. Adaptation and / or modification of teaching methodologies
As the teaching methodologies have been conceived for the face-to-face teaching modality, the teaching methodologies that would be kept and those which would be modified or replaced in the online modality are indicated below.

The teaching methodologies that would be kept, since they can be used in face-to-face and online teaching mode are:
Lecturing
Problem solving
Seminars

The teaching methodologies that would be modified are the following:

Field trips to industrial facilities or companies will be replaced by interactive or explanatory videos of technological processes, or instrumental laboratory practices will be replaced by interactive videos or explanatory documents of the tests to be performed.

2.3. Adaptation of tutorial sessions and personalized attention
The tutorial sessions may be carried out by telematic means (email, videoconference, FAITIC forums, ...) with prior agreement.

2.4. Evaluation

Depending on the degree of development of the face-to-face methodologies (laboratory practical), in face-to-face modality, the suitability of increasing the weight of this methodology in the final evaluation of the subject will be assessed (detriment of the associated % to the final exam of the subject). The planning of partial exams with greater weight in the final grade will also be assessed. These changes in the evaluation will be communicated to the students through the Faitic platform or

Remote Campus.

2.5. Bibliography or additional material to facilitate self-learning
Additional interactive, documentary or audiovisual material may be provided to support student self-learning.