Course guide
250335 - PRGEOGEOSI - Geophysical Prospection, Geochemistry and Seismology

Last modified: 06/10/2020

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: **Academic year:** 2020 **ECTS Credits:** 9.0
Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: JOSE ORIOL CASELLES MAGALLON, LLUÍS RIVERO MARGINEDAS

Others: JOSE ORIOL CASELLES MAGALLON, VICTOR PINTO MIGUEL, LUIS GONZAGA PUJADES BENEIT, LLUÍS RIVERO MARGINEDAS

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
4030. Geophysical and geochemical prospecting
4031. Students will acquire knowledge of seismology and earthquake engineering.
4046. Geotechnical studies applied to mining, construction and civil engineering work
4047. Students will acquire knowledge of geotechnical engineering, including modelling of public infrastructures, underground structures and geotechnical structures.

Transversal:
592. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
595. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
599. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
602. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
584. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

The course consists of 2 hours of class the first half devoted to seismology, which will be divided between theoretical and practical sessions.
During the second semester of teaching consists of weekly 2h 4h 2h theory and practice in 66% of these sessions will be devoted to teaching and Geophysical Prospecting 33% to Geochemical Prospecting. Also made two trips a day camp.

LEARNING OBJECTIVES OF THE SUBJECT

Students will acquire an understanding of geophysical and geochemical prospecting and learn how these disciplines apply to basic and applied technological problems. They will also acquire a basic understanding of earthquake engineering and learn to apply earthquake resistance standards for the protection of geotechnical structures.

Upon completion of the course, students will be able to: 1. Plan and carry out (or commission) a prospecting project using a range of techniques;
2. Interpret prospecting results in 2D and 3D according to geological parameters, and create or amend structural plans on the basis of the geophysical results obtained;
3. Solve basic problems in the field of earthquake engineering.

Gravimetric, electrical, magnetic, electromagnetic, seismic and radiometric prospecting; Geochemical prospecting; Lithogeochemistry and aquatic geochemistry; Biogeochemistry and geobotany; Soil and sediment geochemistry; Correlation of geophysical and geochemical data; Seismology; Geophysical modelling: Theory and implementation; Magnitude and mechanisms of earthquakes; Seismic attenuation and strong seismic movements; Hazard and vulnerability; Seismic risk

STUDY LOAD

Type	Hours	Percentage
Hours small group	20,0	8.89
Self study	126,0	56.00
Hours medium group	28,6	12.71
Hours large group	41,4	18.40
Guided activities	9,0	4.00

Total learning time: 225 h

CONTENTS

Geophysical Prospecting

Description:
Introduce students to the world of Geophysical Prospecting. History of Geophysics
Practice session in which students learn the main techniques of interpolation and Contouring
Show students the gravimetric prospecting the possibilities of this technique and how to perform the measurements and corrections. Introduction to modeling gravimetric
Computer sessions that will be an exercise in performance, interpretation and filtering of maps, and a modeling exercise
Explanation of the different electrical prospecting techniques, both natural and artificial field. VES, spontaneous potential, electrical tomography and calicates.
Practice modeling of BSS and electrical tomography. Case Studies
Fundamentals of Seismic Exploration
Classroom Practices seismic dordinadors
Learning the different survey techniques Electromagnetic
Practical GPR Computer
Working with various geophysical devices in the field

Specific objectives:
To present the different techniques
Introduction to the techniques of interpolation
Log into the Gravimetry as a tool for exploration
Consolidating a practical content on gravimetry theory explained
Basic knowledge of electrical prospecting techniques
Working the usefulness of this technique as a tool for geological prospecting
Learn different techniques of existing seismic prospecting
Interpretation of data on your computer s'simiques

GPR study of techniques and FDEM
Working with computer programs and GPR FDEM
Learn how different geophysical prospecting sets works in the field

Full-or-part-time: 96h
Theory classes: 18h
Practical classes: 16h
Laboratory classes: 6h
Self study : 56h

Geochemical Prospecting

Description:
History and applications of geochemical prospecting. The geochemical cycle. the distribution of crustal elements. The primary and secondary processes. Scattering halo of primary and secondary.
Methods of geochemical prospecting: the litogeoquímica prospecting and geochemistry of water.
Geochemistry Practice 1
Prospecting and exploration atmogeoquímica Phytogeography and biogeochemistry.
The geochemical survey of soils and sediment geochemistry data networks drenatge.Interpretació
Geochemistry Practice 2
Interpretation of geochemical data and complementary geophysical and geochemical data.
Output Field Geochemistry

Full-or-part-time: 48h
Theory classes: 10h
Practical classes: 4h
Laboratory classes: 6h
Self study : 28h

Seismology

Description:
Objectives of the course. History. Seismology, Earthquake Engineering and Geological Engineering.
Introduction. Historical earthquakes and their effects. Near field and far field. Accelerograms and seismograms. Shallow earthquakes and deep earthquakes. The structure of the Earth. Structure of Seismograms: crustal phases, phases in the mantle and core phases. Parameters of an earthquake: hypocenter, epicenter, origin time, magnitude and intensity.
Hypocentral determination.
Determine the epicenter of an earthquake from the arrival times of P and S waves and the polarity of the three components of the P wave. Discuss the feasibility of determining the depth. Determine the longitude and latitude of the epicenter and the origin time.
Determine the approximate epicenter-to-station azimuth from the observation of the particle motion due to a Rayleigh wave.
Parameters of the arrival of internal waves P and S.
Practical cases.
Introduction. Intensity: historical aspects; concepts and scales. local and attenuation effects; drawing isosistes. Magnitude: definition, magnitude formulas from surface and internal waves, local magnitude and duration magnitude. Seismic Moment: concept, definition and measurement. Other parameters quantifying the size of earthquakes. Energy of an earthquake. Empirical relations.
Determination of the magnitude from surface waves.
Focal mechanism and plate tectonic. Seismic source models: direct and inverse problems. Graphical techniques. Parameters of a mechanism: strike, dip and slip, seismic moment.
Practical determination of focal mechanism from P waves
Introduction. Seismicity: databases and sampling. Deterministic and probabilistic approaches. Parameters characterizing the seismic hazard: average size, maximum intensity, probability of occurrence and of exceedence. Return periods. Probabilistic assessment of seismic hazard: radius of influence,seism ogenetic zones, laws of attenuation of the intensity and acceleration.
Case Studies.
Seismic hazard assessment. Practical cases.

Specific objectives:
Description of the historical evolution of the Seismology and the contents of the subject.
Basic concepts. Phenomenological aspects of earthquakes. Seismic phases observed and their relationship to the structure of the earth. Descriptive parameters that characterize an earthquake.
Using seismic P (three components) and S phases to estimate the azimuth and epicentral distance of an earthquake.
Observe the movement of soil to the passage of a seismic wave.
Determination of phases SV, SH, SVV, SVH, PV, PH and azimuth, and angles of incidence and of polarization of the S wave.
Determining component SV, SH, SVV, SVH, PV, PH and azimuth and angles of incidence and polarization of the S wave in practical cases.
Knowledge of the different parameters used to quantify the size of an earthquake.
Learn to calculate the magnitude of an earthquake.
Understanding the parameters that determine the mechanism of the rupture of the fault. Relationship with the local tectonic and stress regimen.
Calculating and understanding the various parameters involved in a focal mechanism.
Learn the concepts and practices related to the quantification of seismic hazard at a site.
To introduce students to the methods and techniques for seismic hazard assessment.

Full-or-part-time: 72h
Theory classes: 19h
Practical classes: 7h
Laboratory classes: 4h
Self study : 42h

GRADING SYSTEM

Delivery-mandatory practices cabinet (30%)
Labour-led (20%)
Exames made during the course (50%)
Compulsory-attendance of 70% of classes
End-Note Weighted: Geophysics (4 ECT's), geochemistry (2 ECT's) and Seismology (3 ECT's)

Assessment only
Students wishing to avail themselves of this assessment it must request in writing in the period up to 3 weeks counting from the start of classes.
Delivery-mandatory practices cabinet (5%)
Try-end (95%)
Compulsory-attendance of 70% of classes

Students of EG degree will have the opportunity of a reassessment. This new evaluation will agree to the specific rules of teaching Geological Engineering Degree, approved by Government Conseil of EG.

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

EXAMINATION RULES.

Although exercise is not completed or delivred out of time will be qualified 0 points

BIBLIOGRAPHY

Basic:
- Beus, A.A.; Grigorian, S.U. Geochemical exploration : methods for mineral deposits. Willmette: Applied Publishing Ltd., 1977. ISBN 0915834030.
- Dobrin, M.B.; Savit, C.H. Introduction to geophysical prospecting. 4th ed. New York: McGraw-Hill, 1988. ISBN 0070171963.
- Kearey, P.; Brooks, M.; Hill, I. An introduction to geophysical exploration. 3rd ed. Oxford: Blackwell, 2002. ISBN 0632049294.
- Levinson, A.A. Introduction to exploration geochemistry. 2nd ed. Wilmette (Illinois): Applied Publishing, 1980. ISBN 0915834049.
- Telford, W.M.; Geldart, L.P.; Sheriff, R.E. Applied geophysics. 2nd ed. Cambridge: Cambridge University Press, 1990. ISBN 0521339383.
- Aki, K.; Richards, P.G. Quantitative seismology. 2nd ed. Sausalito: University Science Books, 2002. ISBN 0935702962.
- Lee, W.H.K. [et al.] (ed.). International handbook of earthquake and engineering seismology. Amsterdam: Academic, 2002-2003. ISBN 0124406521.

Complementary:
- Payo, G. Introducción al análisis de sismogramas. Madrid: Ministerio de la Presidencia. Instituto Geográfico Nacional, 1986. ISBN 8450540097.
- Udías, A.; Buforn, E. Principles of seismology. 2nd ed. Cambridge: Cambridge University Press, 2018. ISBN 9781107138698.
- Shearer, P.M. Introduction to seismology. 2nd ed. Cambridge: Cambridge University Press, 2009. ISBN 9780521708425.