26418 - Geophysics and Global Tectonics

Información del Plan Docente

Academic Year	2016/17
Academic center	100 - Facultad de Ciencias
Degree	296 - Degree in Geology
ECTS	6.0
Course	3
Period	First semester
Subject Type	Compulsory
Module	---

1.Basic info

1.1.Recommendations to take this course

This module requires comprehension of tectonic structures and Geology and basic Physics and Mathematics knowledge to understand the fundamentals of Geophysics. Abilities to work with contour maps, cross-sections and a minimum background of informatics are not compulsory but can help.

1.2.Activities and key dates for the course

The 6 ECTS of this module corresponds to 60 hours of presential education which will be distributed in the following way:

- 28 hours of lectures (3 h/week), Monday, Tuesday, Wednesday, 9:00 to 10:00.
- 24 hours of teacher-assisted laboratory sessions (2 h/week), Mondays 16:00 to 18:00 or 18:00-20:00.
- 8 hours of evaluation sessions (3 sessions along the academic period).
- Beggining and end of the module: see the academic calendar approved by the Facultad de Ciencias.

2.Initiation

2.1.Learning outcomes that define the subject

During this module the student will develop:

- Knowledge of the main methods in geological surveying and their use for the understanding of the internal structure of the Earth and for solving geological problems.
- Ability to work with gravimetric and magnetic anomaly maps and interpret them according to the geological background.

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- Ability to derive and solve problems related to seismic surveying (refraction and reflection).
- Ability to analyse plate kinematics and to interpret associated geological structures in plate boundaries.
- Understanding of the main processing methods in geophysics.
- Basic understanding of rheological models of the oceanic and continental lithospheres, and mechanisms of deformation at different levels within the crust.
- Intellectual skills to integrate her/his geological knowledge within the frame of Global Tectonics.

2.2.Introduction

Brief presentation of the course

The aim of this module is to introduce the main concepts of the structure, properties and composition of the Earth and the lithosphere, in order to define the frame where the geological knowledge and concepts acquired in other modules can be placed. To understand the Earth as a whole using different geophysical techniques (gravimetric, magnetic and seismic) is the other main goal of this module. In the end, these techniques can be applied to different types of geological problems, including shallow surface and deep features, and a basic knowledge of their application is a necessary step for geologists whatever their field of expertise.

3.Context and competences

3.1.Goals

The expected results of the course respond to the following general aims:

1. To provide knowledge about the methods to explore the Earth.
2. To understand the structure of the Earth and the Lithosphere.
3. To interpret geophysical data coming from potential fields (gravimetry and magnetometry).
4. To understand processing of seismic reflection profiles.
5. To relate physical properties of rocks to their behaviour at depth.
6. To apply geophysical data to the interpretation of geological bodies.
7. To understand the rheology of the lithosphere and mechanisms of deformation at different depths.

3.2.Context and meaning of the subject in the degree

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This course is part of a group of subjects in the Degree in Geology that constitute the basin background for geologists to understand the Earth as a whole and to apply geophysical techniques to geological problems.

3.3.Competences

After completing the course, the student will be competent in the following skills:

- Ability to transfer geophysical information to geological features.
- Capacity to understand the Earth as a whole and the implications that its structure has for the different disciplines in Earth Sciences.
- Skills to work with contour maps of potential fields.
- Ability to solve elementary problems in geophysics.
- Capacity to interpret seismic reflection profiles in terms of geological cross-sections.
- Skills to obtain information from earthquake parameters.
- Capacity to solve questions of plate kinematics by means of vectorial calculations, paleomagnetism and magnetic anomalies of the ocean floor.
- Ability to understand mechanisms of heat transfer within the Earth and their implication in plate tectonics.

3.4.Importance of learning outcomes

The understanding of the structure of the Earth as a whole, the meaning of geophysical data, the kinematics of tectonic plates, and the application of geophysical methods to Geology is a basic part of the background in Earth Sciences for all geologists, whatever their field of specialization.

4.Evaluation

The student will prove that she/he has achieved the expected learning results by means of the following assessment tasks:

Continuous assessment:

1. Resolution of 3 tests during the semester, using skills and basic knowledge acquired in the lectures and lab sessions. Minimum score 5 out of 10. Slightly lower scores can be balanced between different assessments.

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Categorising performance levels:

- Excellent performance (9-10 points): knowledge and problem resolution based on the taught programme
- Typical performance (7-8 points)
- Threshold performance (5-6 points)
- Compensable (4-4.9 points)
- Failure (0-4 points)

Final assessment:

1. In case of failure of one or more of the continuous assessment tests (minimum score 5 out of 10), the final assessment is a second-chance examination, also for students that cannot attend the normal development of the module.

5.Activities and resources

5.1.General methodological presentation

The learning process that has been designed for this course is based on the following activities:

The students will have class notes given by the professor as the basis for their learning, that must be completed with important remarks during the lectures and the laboratory sessions. Study of basic handbooks is strongly recommended.

The 6 ECTS of this subject correspond to 28 hours of lectures, 24 hours of lab sessions and 8 hours of assessments and comments about the assessments, that are here used as a powerful learning tool.

The tutorials will be considered as another academic activity where the students will be free to ask about any topic concerning the module.

5.2.Learning activities

The programme offered to the students to help them achieve the learning results includes the following activities:

- 28 hours of lectures (3 hours/week).
- 24 hours of lab sessions (2 hours/week).
- 8 hours of assessments and comments about them (3 assessments in the modality of continuous evaluation).

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5.3.Program

I. Program of Contents/Lectures

1. Introduction to Global Geophysics.
2. Elastic properties. Seismic waves.
3. Fundamentals of seismic refraction.
4. Structure of the Earth from seismic data.
5. The lithosphere.
6. Earthquake seismology.
7. Focal mechanisms. Palaeoseismology.
8. Plate tectonics. Dynamics of plate margins.
9. Divergent, transform and convergent margins.
10. Fundamentals of seismic reflection surveying.
11. Seismic data processing.
12. Structures associated with plate margins. Divergent margins.
13. Structures in convergent and transform plate margins.
14. The Earth's magnetic field.
15. Magnetic properties of rocks and minerals.
16. Magnetic surveying. Paleomagnetism.
17. Magnetic anomalies of the ocean floor. Plate kinematics.
18. Gravimetry. Gravity field. Geoid.
19. Processing of gravimetric data.
20.

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Isostasy.

21. Thermal properties of rocks.
22. Thermal flow. Distribution and causes.
23. Mechanisms for plate movement.
24. Plate tectonics in Earth's history.
25. Planetary tectonics.

II. Program of Practical/Problems

1. Seismic refraction interpretation.
2. Modelling of seismic rays within the Earth.
3. Focal mechanisms. Interpretation.
4. Plate boundaries. Vulcanism and seismicity.
5. Topography of plate boundaries and interiors.
6. Interpretation of seismic reflection profiles.
7. Kinematics of plates.
8. Interpretation of magnetic anomalies in the ocean floor.
9. Exercises on plate boundaries, seismicity, paleomagnetism and plate kinematics.
10. Computer-based modelling of gravimetric and magnetic anomalies.
11. Isostasy.
12. Interpretation of tectonic structures in Mars and Venus.

III. Program of Assessments and comment sessions

Written exams (100%): 3 tests during the semester, and/or two final resit tests (February and September) in case of

failure. Tests include laboratory and theoretical questions, typically 13.

5.4.Planning and scheduling

Timetable according to the Faculty of Science webpage indications.

5.5.Bibliography and recomended resources

BB	Burger, Henry Robert. Introduction to applied geophysics : exploring the shallow subsurface / H. Robert Burger , Anne F. Sheehan , Craig H. Jones. New York : W.W. Norton , 2006
BB	Jones, E. J. W.. Marine geophysics / E.J.W. Jones. Chichester [etc.] : John Wiley & Sons, cop. 1999.
BB	Kearey, Philip. An introduction to geophysical exploration / Philip Kearey, Michael Brooks, Ian Hill . - 3rd ed. Oxford : Blackwell Science, 2002
BB	Kearey, Philip. Global tectonics / Philip Kearey, Frederick J. Vine . - 3rd ed. Oxford [etc.] : Blackwell Science, 2008
BB	Lillie, Robert J.. Whole earth geophysics : an introductory textbook for geologists and geophysicists / Robert J. Lillie Upper Saddle River (New Jersey) : Prentice Hall, cop. 1999
BB	Milsom, John.. Field geophysics / John Milsom. . - 3rd ed. Chichester [etc.] : John Wiley & Sons, 2003
BB	Mussett, Alan E.. Looking into the Earth : an introduction to geological geophysics / Alan E. Mussett, M. Aftab Khan ; illustrations by Sue Button. . - [1st publ.] Cambridge : Cambridge University Press, 2000.
BB	Stüwe, Kurt. Geodynamics of the lithosphere : [an introduction] / Kurt Stüwe Berlin : Springer, 2002

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BC	Lowrie, William. Fundamentals of geophysics / William Lowrie . - 1st ed., 4th reprint. Cambridge : Cambridge University Press, 2011
BC	Watts, A. B.. Isostasy and flexure of the lithosphere / A. B. Watts. Cambridge : Cambridge University Press, 2001.

LISTADO DE URLs:

Atlas de perfiles sísmicos - [http://seismicatlas.org/]

Geomagnetismo - [http://geomag.usgs.gov/]

Geophysical data center - [http://www.ngdc.noaa.gov/]

Instituto Geográfico Nacional - [http://www.ign.es/ign/es/IGN/home.jsp]

Instituto Geológico y Minero - [http://www.igme.es]

Plate motion calculator - [http://www.unavco.org/community_science/science-support/crustal_motion/dxdt/r

Recursos de geofísca en la red - [http://serc.carleton.edu/NAGTWorkshops/geophysics/resources.html]