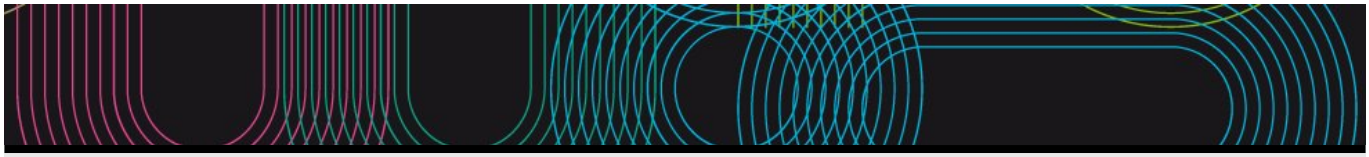

IDENTIFYING DATA				
Geology: Geology				
Subject	Geology: Geology			
Code	V11G201V01106			
Study programme	Grado en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Basic education	1st	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Gago Duport, Luís Carlos			
Lecturers	Gago Duport, Luís Carlos Gil Lozano, Carolina			
E-mail	duport@uvigo.es			
Web	http://moovi.uvigo.gal/login/index.php			
General description	The study of the structure of matter in a crystalline state -objective of Crystallography- is of great relevance for the understanding of the most diverse phenomena in the field of Chemistry, therefore, after a general view of the Earth as a geochemical system, the Approach of the subject Geology corresponding to the first year of the degree in Chemistry is mainly oriented towards the study of crystalline structures and crystallization mechanisms. These topics are approached from the point of view of Crystallography, Mineralogy and Geochemistry. Starting from the thermodynamic and kinetic mechanisms that lead to the formation of crystalline phases, structural aspects, crystallographic notation and diffraction are studied. As a corollary, the importance of these processes is introduced for the study of natural (mineral) crystals and synthetic materials, such as semiconductors, pharmaceuticals, biological macromolecules, and ceramic materials, among others. 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.			

Training and Learning Results	
Code	
A2	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
A3	Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
B1	Ability for auronomous learning
B3	Ability to manage information
B4	Ability for analysis and synthesis
C4	Use computer tools properly to obtain information, process data, perform computational calculations and calculate matter properties
C9	Know the structural aspects of chemical elements and their compounds, including stereochemistry
C10	Know the characteristics of the different states of matter and the theories used to describe them
C15	Know the main techniques of structural research, including spectroscopy
C16	Know the relationship between macroscopic properties and properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids, crystals and other materials
D3	Ability to communicate in both oral and written form in Spanish and / or Galician and / or English

Expected results from this subject	Training and Learning Results			
Describe and explain the Earth as a system.	A2 A3	B4	C10 C16	D3

Differentiate the processes that generate minerals and rocks in nature.	A3	B3	C9 C10 C15 C16	
Distinguish the stages of nucleation and crystalline growthin in the crystallization process.			C9 C10 C16	
Use concepts as periodicity, symmetry and morphology to describe crystals.	A2		C9 C10 C15 C16	
Use of the crystallographic notation and its application to the structural characterisation of crystalline solids.	A3	B3 B4	C9 C15	D3
Describe and apply the basic principles of diffraction for structural analysis.			C4 C9 C10 C16	
Use isotopic analysis techniques for measuring the geological time and following geochemical processes.	A2	B1 B3 B4	C4 C15	

Contents

Topic	
The Earth as a Geochemical System: Rocks forming minerals	Geochemical evolution of the Earth. Plate Tectonic. The rocks cycle. Comparison of Earth with other planets in the solar system: The case of of Mars.
The crystallization process: thermodynamic and kinetic aspects.	Differences between nucleation and crystal growth.Crystal growth kinetics. Structural aspects.
Characterization of crystalline solids: structure vs. morphology.	Microscopic and macroscopic approaches to crystalline solids
Isotopes in Geology: Measuring the geological time with radiactive isotopes. Analyzing kinetic processes by fractionation of stable isotopes.	Radioactive isotopes and stable isotopes. Isotopic dating techniques. The Isochrone method. Kinetic tracking of processes using stable isotopic techniques. Notation and units. Rayleigh fractionation.
Geometric crystallography: Periodicity and symmetry in the crystals.	Two-dimensional lattices. Point symmetry. Schoenflies and Hermann-Mauguin notations of point symmetry elements and clases. Bravais lattices. Microscopic symmetry Space groups. Miller indices and zone axes. Fractional coordinates
X-ray crystallography: Bragg's Law and the Phase problem	The physical basis of diffraction. Diffraction by crystals lattices and radiation sources. The Bragg Law The reciprocal lattice. Diffraction Patterns. Indexing of diffraction diagrams. powder diagrams and monocrystal diagrams Quantitative Analysis. The Phase problem. Methods of resolution of structures from diffraction datasets.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	26	70	96
Mentored work	1	5	6
Laboratory practical	6	0	6
Problem solving	6	34	40
Objective questions exam	1	0	1
Problem and/or exercise solving	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	First, the basic principles of crystallization are analyzed from a geological and thermodynamic point of view. Further, we introduce to the student the fundamentals of isotope geochemistry. Next themes are devoted to the structural characterization of crystals, analyzing the concepts of periodicity and symmetry in 2D and 3D crystalline lattices. Finally we introduce the principles and practical aspects of diffraction techniques applied to the estructural analysis
Mentored work	A short paper will be write by groups summarizing the laboratory work. Some guidelines concerning formats and content will be given before the realization. A seminar will be assigned to guide each working group in this task.

Laboratory practical	They will be dedicated to the study of the crystallization process, analyzing three aspects: (1) Crystallization in nature: mineral recognition (2) Optical microscopy with polarized light. (3) Crystal growth from solutions and silica gels in the laboratory.
Problem solving	Seminars will be used to solve practical exercises about nucleation and crystal process and to solve issues related to crystallographic notation and concepts

Personalized assistance

Methodologies	Description
Problem solving	The resolution of exercises will be carried out during the seminars by answering to the questions raised in class.
Mentored work	They will be developed in the computer classroom and in theoretical class as well as through the realization of tutorials or consultations using the Tema platform or the electronic mail.

Assessment

	Description	Qualification	Training and Learning Results
Mentored work	The completion of a report/work whose content will be related to the activity carried out in the laboratory and seminars will be evaluated.	10	
Laboratory practical	The activity carried out in the mineralogy laboratory and in the completion of exercises and questionnaires proposed through the Moovi platform will be evaluated.	30	
Problem solving	The exam will also include exercises and/or problems.	20	
Objective questions exam	Exam with short questions and multiple choice questions, as well as a topic about the content of the theoretical classes and/or seminars.	40	

Other comments on the Evaluation

Sources of information

Basic Bibliography

Andrew Putnis, **Introduction to Mineral Sciences**, 6ª, Cambridge University Press, 2008

Edward Tarbuck y FredericK Lutgens, **Ciencias de la Tierra. Una introducción a la Geología Física**, 10ª, Pearson, 2013

Complementary Bibliography

Christofer Hammond,, **The Basic of Crystallography and Diffraction**, 3ª, Oxford University Press, 2009

Jose Luis Amorós, **La gran aventura del cristal**, 1ª, Ediciones Complutense, 2017

Carmelo Giacovazzo et al., **Fundamentals of Crystallography**, 2ª, Oxford University Press,

Recommendations

Subjects that continue the syllabus

Chemistry: Chemistry 2/V11G201V01109

Subjects that are recommended to be taken simultaneously

Physics: Physics 2/V11G201V01107
Mathematics: Mathematics 2/V11G201V01108
Chemistry: Chemistry Lab II/V11G201V01110
Chemistry: Chemistry 2/V11G201V01109

Subjects that it is recommended to have taken before

Biology: Biology/V11G201V01101
Physics: Physics I/V11G201V01102
Mathematics: Mathematics 1/V11G201V01103
Chemistry: Chemistry Lab I/V11G201V01105