Teaching Guide				
Identifying Data				2017/18
Subject (*)	Geology		Code	610G01006
Study programme	Grao en Química			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	First	FB	6
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Naval e IndustrialFísica e Ciencias da Terra			
Coordinador	Lado Liñares, Marcos	E-mail	marcos.lado@udc.es	
Lecturers	Lado Liñares, Marcos Paz Gonzalez, Antonio Vidal Vázquez, Eva	E-mail	marcos.lado@udc.es antonio.paz.gonzalez@udc.es eva.vidal.vazquez@udc.es	
Web				
General description	The aim of this course is to provide the students with basic knowledge on crystalline solid-state-matter, its structure and symmetry. Also, an important part of this course is focused on the natural processes that lead to the formation of minerals and on the recognition of common minerals based on some of their properties.			

Study programme competences / results	
Code	Study programme competences / results
A1	Ability to use chemistry terminology, nomenclature, conventions and units
A3	Knowledge of characteristics of the different states of matter and theories used to describe them
A6	Knowledge of chemical elements and their compounds, synthesis, structure, properties and reactivity
A9	Knowledge of structural characteristics of chemical and stereochemical compounds, and basic methods of structural analysis and research
A12	Ability to relate macroscopic properties of matter to its microscopic structure
A15	Ability to recognise and analyse new problems and develop solution strategies
A16	Ability to source, assess and apply technical bibliographical information and data relating to chemistry
A20	Ability to interpret data resulting from laboratory observation and measurement
A23	Critical standards of excellence in experimental technique and analysis
A24	Ability to explain chemical processes and phenomena clearly and simply
A25	Ability to recognise and analyse link between chemistry and other disciplines, and presence of chemical processes in everyday life
A27	Ability to teach chemistry and related subjects at different academic levels
B1	Learning to learn
B3	Application of logical, critical, creative thinking
B4	Working independently on own initiative
B5	Teamwork and collaboration
B6	Ethical, responsible, civic-minded professionalism
B7	Effective workplace communication
C1	Ability to express oneself accurately in the official languages of Galicia (oral and in written)
C2	Oral and written proficiency in a foreign language
C3	Ability to use basic information and communications technology (ICT) tools for professional purposes and learning throughout life
C6	Ability to assess critically the knowledge, technology and information available for problem solving
C7	Acceptance as a professional and as a citizen of importance of lifelong learning

Learning outcomes

Learning outcomes	Study programme competences / results		
The study of minerals, as natural inorganic chemical compounds, and mineral formation processes, provides knowledge on the reactivity of chemical elements that result in natural compounds	A1 A3 A6 A12	B1 B3	C1 C2
Laboratory work includes the analysis of crystal forms and the identification of common minerals through a critical analysis of its symmetry, the development and training of spatial perception and the students? abstraction capabilities.	A1 A12 A15 A16 A23 A25 A27	B1 B4 B5 B7	C6
The student will face practical and theoretical aspects of minerals and crystalline matter, and the relationship between atomic arrangement and macroscopic properties	A9 A12 A16 A20 A25		C1 C2
The internal structure of each mineral class, crystal system and the most representative unit cells are analyzed	A1 A3 A6 A16	B3 B7	C1 C2 C3
The student will be able to relate mineral properties (density, cleavage, hardness, piezoelectricity) and mineral chemical composition, bonds and internal structure	A6 A12	B1	C6 C7
Small group assignments are focused on solving problems related, in general, to practical aspects of mineralogy. The student should be able to present it in a synthetic manner, and to establish the interactions between the problem and other disciplines	A15 A16 A20 A24	B1 B5 B6 B7	C1 C2 C7
The student will learn to recognize crystalline matter, to analyze its structure, and to describe its internal symmetry	A1 A3 A6	B1 B3 B4	C1 C2
The student will become familiar with the international standard terminology both in crystallography and mineralogy studies	A1 A3 A16	B1 B4 B7	C1 C2

Contents	
Topic	Sub-topic

Crystallography and symmetry of crystalline matter	1. Introduction to crystallography and mineralogy. Definition of crystal and mineral. Main properties of crystalline matter. Fundamentals of crystal chemistry: coordination. 2. Crystal systems: Orthorhombic, tetragonal, hexagonal, monoclinic, triclinic and isometric. 3. Point symmetry: symmetry elements, symmetry class. 4. Morphology of crystal forms: crystallographic axis, axis relations, faces, Miller indices. 5. Crystallographic projections (spheric and stereographic). 6. Planar symmetry: 2-dimensional order and planar lattices. Planar symmetry and groups. 7. Space symmetry: 3-dimensional order. Bravais lattices. Space symmetry (glide planes and screw axes). Space groups. Relations between point groups and space groups. 8. Molecular symmetry and Schoenflies notation.
Geological processes, mineral formation, and types of rocks	9. Formation of chemical elements. 10. Formation of minerals. 11. Types of rocks: igneous, sedimentary and metamorphic. 12. The most aboundant minerals in Earth crust: silicates.
Chemical and physical properties of crystalline matter	13. Physical properties of minerals: cleavage and fracture, hardness, piezoelectricity, pyroelectricity, magnetic properties. 14. Optical properties: X-ray diffraction, color, luster and streak, refraction, luminescence and phosphorescence).

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A3 A6 A9 A12 A20 A25 B1 B3 B6 C1 C2 C7	26	60	86
Laboratory practice	A12 A15 A16 A23 B1 B3 B4 B5 B7 C1 C2 C6	15	22.5	37.5
Collaborative learning	A1 A9 A12 A15 A24 A25 A27 B1 B5 B7 C1 C2 C3	4	6	10
Problem solving	A15 A20 A23 B7 C1 C2 C7	5	7.5	12.5
Mixed objective/subjective test	A1 A3 A6 A9 A12 A15 A16 A20 A23 A25 B7 B3 B1 C1 C2	2	0	2
Introductory activities	B1 B3 C7	1	0	1
Personalized attention		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	
Methodologies	Description
Guest lecture / keynote speech	50-min sessions that will cover the theoretical aspects of the course using audiovisual contents

Laboratory practice	Hands-on activities where the students will learn to identify crystal groups, symmetry operations, and point groups based on model structures. These activities will include also the recognition of the most representative minerals in the rocks of the area.
Collaborative learning	These sessions will be conducted in small groups, where students will solve problems and discuss the theoretical aspects that were developed in the keynote speeches.
Problem solving	These sessions will be focused on the individual work of students solving problems related to crystal lattices and the identification of combinations of symmetry elements in point groups.
Mixed objective/subjective test	A written test that will be conducted in order to verify the knowledge and competences that the student developed during the course.
Introductory activities	An introductory session during the first day of the course, where the methodology, contents, assessment criteria and time schedule of the different activities will be discussed.

Personalized attention	
Methodologies	**Description**
Problem solving Collaborative learning	Personalized attention will be provided through individual meetings between the professor and the students, in dates previously selected. Moreover, non-presential tools, mainly e-mail, will be used to solve questions and doubts related to the course. Special attention will be provided to those students that can experience more difficulties during the learning process and to part-time students.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Mixed objective/subjective test	A1 A3 A6 A9 A12 A15 A16 A20 A23 A25 B7 B3 B1 C1 C2	A test designed to assess the theoretical background of the adquired during the course. The minimum grade to pass the test will be 5 points out of 10	70
Problem solving	A15 A20 A23 B7 C1 C2 C7	The assessment will consist on a booklet with problems that the student needs to solve	3
Laboratory practice	A12 A15 A16 A23 B1 B3 B4 B5 B7 C1 C2 C6	The assessment will include questions to be aswered during the laboratory work and a test about crystalline structures	20
Collaborative learning	A1 A9 A12 A15 A24 A25 A27 B1 B5 B7 C1 C2 C3	The assessment will include activities related to information analysis, brief oral presentations, discussions and problem solving. The effort, participation and presentation will be assessed	7

Assessment comments

The requisite to pass each of the activities included in the assessment is to obtain a minimum grade of 5 out of 10 points in each of those activities. Otherwise, the student will not pass the course. In those cases when the average of all grades of the different activities is higher than 5, but the student did not obtain a minimum of 5 in all the activities, the grade that will be assigned in the official records will be 4.

Once all the activities have been passed, the final grade of the course will be the sum of the different grades obtained in the tests and activities. The mixed test will yield 70% of the final grade. Laboratory work and small-group activities will result in the other 30% of the final grade. Nevertheless, it will be strictly necessary to obtain 5 points out of 10 in each of the activities: the mixed test, the laboratory work, and the small group activities. The attendance to lectures, laboratory work, and the completion of the individual and group exercises are compulsory in order to be evaluated.

The student will be assessed as NOT PRESENTED only if he/she did not participate in more than 25% of the course activities.

The tests of May-June (first opportunity) and July (second opportunity) will be evaluated similarly in terms of percentages and requirements to pass the course. The qualification obtained in the laboratory work and group activities will be preserved until the second opportunity, while the mixed test qualification in the second opportunity will replace the one obtained in the first one.
Honors will be given only to students whose evaluation is conducted during the course and will pass the tests in any of the two opportunities, until the maximum number of Honors dictated by the institution regulations is reached.

The students who haven?t pass the course in previous years will have to participate in all the activities and pass a new assessment of all the activities, since the learning-teaching process, which includes the assessment, is only valid for one academic year.

Part-time students are not obligated to attend to lectures and small-group activities, although they must attend to laboratory work. The percentage of the final grade corresponding to small-group activities will be replaced by the corresponding increase in the percentage of the mixed objective/subjective test, both in the first and second opportunities.

Sources of information	
Basic	- Borchardt-Ott, W. (2012). Crystallography: An Introduction. Springer - KLEIN, C. y HURLBUT, C.S. Jr (1996). Manual de mineralogía basado en la obra de J. Dana. Reverté - Phillips, F.C. (1972). Introduccion a la Cristalografía. Paraninfo - Gay P. (1977). Introduccion al estado cristalino. EUNIBAR Recursos na web: http://www.uned.es/cristamine/ (curso de Cristalografía y Mineralogía de la UNED) http://www.ucm.es/info/crismine/TEXTOS_MONOGRÁFICOS.htm (Facultad de Ciencias Geológicas de la UCM) http://161.116.85.21/crista/castella/index_es.htm (Cristalografía de Màrius Vendrell, UB) http://webmineral.com/(Sitio con abundantes recursos relacionados con la cristalografía y mineralogía) http://www.iucr.org/ (Sitio da Unión Internacional de cristalografía)
Complementary	- Amorós, J.L. (1990). El cristal. Morfología, estructura y propiedades físicas. Atlas - Galán, E. y Mirete, S. (1979). Introducción a los minerales de España. IGME Recursos na web: Jiménez, J. y Velilla, N. Óptica mineral. Universidad de Granada (consultado en xulio de 2017). http://www.ugr.es/~minpet/pages/docencia/opticamineral/paginas/default.htm Tindle, A. 2010.Andy Tindle?s Pages. The Open University(consultado en xulio de 2017). http://www.open.ac.uk/earth-research/tindle/ http://www.uned.es/cristamine/mineral/metodos/prop_micr.htm http://www.nature.com/news/specials/crystallography-1.14540

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus

Other comments

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.