Teaching Guide					
Identifying Data					2015/16
Subject (*)	Xeoloxía			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	Ciencias da Navegación e 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	
Code	Study programme competences
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

The student will become familiar with the international standard terminology both in crystallography and mineralogy studies	A1 A16	B1	C3
The student will learn to recognize crystalline matter, to analyze its structure, and to describe its internal symmetry	A3 A9 A12 A20	B1 B3	C3
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	A6 A20 A24		
The internal structure of each mineral class, crystal system and the most representative unit cells are analyzed	A1 A3 A9	B3	
The student will be able to relate mineral properties (density, cleavage, hardness, piezoelectricity) and mineral chemical composition, bonds and internal structure	A6 A12 A16 A25 A27	B5 B6 B7	C1
The student will face practical and theoretical aspects of minerals and crystalline matter, and the relationship between atomic arrangement and macroscopic properties	A15 A16	B3	
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 A20 A23	B1 B3 B4 B5	C1 C2 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 A23 A24 A25	B3 B5 B7	C1 C2 C3 C6

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	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A3 A12 A16 A20 B7 C7	26	60	86
Laboratory practice	A1 A12 A20 A23 B1 B3 B4 B5 C1 C2 C6 C7	15	22.5	37.5
Collaborative learning	A15 A23 A24 A25 A27 B3 B5 B6 B7 C1 C2 C3 C6	4	6	10
Problem solving	A1 A3 A6 A9 B4 C1 C2	5	7.5	12.5
Mixed objective/subjective test	A1 A3 A6 A9 A12 A20 A24 A25 B3 B4 C1 C2 C6	2	0	2
Introductory activities	A12	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
Collaborative learning Problem solving	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.

Assessment

Methodologies	Competencies	Description	Qualification
Collaborative learning	A15 A23 A24 A25 A27 B3 B5 B6 B7 C1 C2 C3 C6	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
Laboratory practice	A1 A12 A20 A23 B1 B3 B4 B5 C1 C2 C6 C7	The assessment will include questions to be aswered during the laboratory work and a test about crystalline structures	20
Problem solving	A1 A3 A6 A9 B4 C1 C2	The assessment will consist on a booklet with problems that the student needs to solve	3
Mixed objective/subjective test	A1 A3 A6 A9 A12 A20 A24 A25 B3 B4 C1 C2 C6	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

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. 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.

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 en la 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)
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 en la web:Jiménez, J. y Velilla, N. Óptica mineral. Universidad de Jaén (consultado enero de 2011). http://geologia.ujaen.es/opticamineralTindle, A. 2010. Andy Tindle?s Pages. The Open University(consultado en diciembre de 2010). http://www.open.ac.uk/earth-research/tindle/García del Amo et al., 2008. Microscopía óptica de polarización (consultado enero 2011). http://www.uned.es/cristamine/mineral/metodos/prop_micr.htmhttp://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.