Teaching Guide					
Identifying Data					2021/22
Subject (*)	Air Quality			Code	610500010
Study programme	Mestrado Universitario en Ciencias, Tecnoloxías e Xestión Ambiental (plan 2012)				
Descriptors					
Cycle	Period	Year		Type	Credits
Official Master's Degree	1st four-month period	First		Optional	3
Language	SpanishEnglish				
Teaching method	Face-to-face				
Prerequisites					
Department	Física e Ciencias da TerraQuímica				
Coordinador	Lopez Mahia, Purificacion		E-mail	purificacion.lopez.mahia@udc.es	
Lecturers	Kennes , Christian Lopez Mahia, Purificacion Montero Rodríguez, María Belén		E-mail	c.kennes@udc.es purificacion.lopez.mahia@udc.es belen.montero@udc.es	
Web	http://http://campusvirtual.udc.es				
General description	It is a subject that introduces students to the knowledge of air quality, with emphasis on the analytical approach to the assessment of air quality, major pollutants, their dispersion in the atmosphere and technologies to treat contaminated air				

Contingency plan	1. Modifications to the contents No modifications 2. Methodologies *Teaching methodologies that are maintained Guest lecture/keynote lecture Problem solving Case studies Objective test Personalized attention *Teaching methodologies that are modified Field trip will not be a face-to-face visit but rather that the student will make the visit virtually. 3. Mechanisms for personalized attention to students - email: Daily, used for virtual consultations, to request a virtual meeting to solve doubts and for the follow-up of case studies or to solve problems. ? Moodle: Daily, according to the need of the student. Making use of the ?thematic forum? for any specific consultation. ? Teams: One weekly session for large groups to progress in the theoretical part of the subject and for solving problems during the periods scheduled for this subject. One or two weekly sessions (according to the needs of the student) in small groups (< 6 persons), for the follow-up and support in the case study and for solving raised problems 4. Modifications in the evaluation *Evaluation observations: The same evaluation methodology will be maintained as in the Guía docente. There are no modifications in the evaluation methodology. Only the objective test will be performed virtually (via Moodle and/or Teams), for both the first as well as the second opportunity. This situation is the same for full-time students as well as for part-time students and for those not attending the classes, as explained in the "NORMA QUE REGULA O RÉXIME DE DEDICACIÓN AL ESTUDIO DE LOS ESTUDIANTES DE GRADO EN LA UDC (Arts. 2.3; 3.b e 4.5) (29/5/212). 5. Modifications to the bibliography or webgraphy No modifications. All the working material is already available in digital form in Moodle. 6. In the event of capacity problems in the spaces designated for face-to-face activities, additional spaces will be reserved for students to follow the activities through the TEAMS platform. In the case of practical activities, the groups will be divided to adapt to the capacity of the laboratory.

Study programme competences	
Code	Study programme competences
A1	Coñecemento das realidades interdisciplinares da Química e do Medio Ambiente, dos temas punteiros nestas disciplinas e das perspectivas de futuro.
A3	Capacitar ao alumno para o desenvolvemento dun traballo de investigación nun campo da Química ou do Medio Ambiente, incluíndo os procesos de caracterización de materiais, o estudo das súas propiedades fisicoquímicas e biolóxicas e dos procesos que poden sufrir no medio natural.
A6	Coñecemento do comportamento de diferentes especies químicas e dos procesos aos que poden estar sometidas unha vez liberadas no medio ambiente, incluíndo as súas relacións entre distintos compartimentos ambientais.
A15	Coñecer os indicadores de calidade do chan e do aire, os procesos de distribución de contaminantes e as tecnoloxías de recuperación e aplicación en cada caso.
A19	Coñecemento e interpretación da lexislación, normativa e procedementos administrativos básicos sobre medios acuosos, chans e atmosferas. Comprensión das bases científicas e económicas da sustentabilidade.

B2	Que os estudantes saiban aplicar os coñecementos adquiridos e a súa capacidade de resolución de problemas en contornas novas ou pouco coñecidos dentro de contextos máis amplos (ou multidisciplinares) relacionados coa súa área de estudo.
B3	Que os estudantes sexan capaces de integrar coñecementos e enfrontarse á complexidade de formular xuízos a partir dunha información que, sendo incompleta ou limitada, inclúa reflexións sobre as responsabilidades sociais e éticas vinculadas á aplicación dos seus coñecementos e suizos.
B4	Que os estudantes saiban comunicar as súas conclusións e os coñecementos e razóns últimas que as sustentan a públicos especializados e non especializados dun modo claro e sen ambigüedades.
B5	Que os estudantes posúan as habilidades de aprendizaxe que lles permitan continuar estudando dun modo que haberá de ser en gran medida autodirixido ou autónomo.
B6	Ser capaz de analizar datos e situacións, xestionar a información dispoñible e sintetizala, todo iso a un nivel especializado.
C2	Ser capaz de manter un pensamento crítico dentro dun compromiso ético e no marco da cultura da calidade.
C4	Expresarse correctamente, tanto de forma oral coma escrita, nas linguas oficiais da comunidade autónoma.
C5	Dominar a expresión e a comprensión de forma oral e escrita dun idioma estranxeiro.
C7	Desenvolverse para o exercicio dunha cidadanía aberta, culta, crítica, comprometida, democrática e solidaria, capaz de analizar a realidade, diagnosticar problemas, formular e implantar solucións baseadas no coñecemento e orientadas ao ben común.
C9	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C10	Asumir como profesional e cidadán a importancia da aprendizaxe ao longo da vida.

Learning outcomes			
Learning outcomes	Study programme competences		
Sampling of pollutants in the atmosphere, approach to the assessment procedure air quality and interpretation of the results based on the applicable regulations.	AC1 AC3 AC6 AC15 AC19	BC2 BC3 BC5 BC6	CC2 CC7 CC9 CC10
Calculations of diffusion of atmospheric pollutants in different situations.	AC1 AC3 AC6 AC15	BC3 BC4 BC6	CC2 CC4 CC9
Be able to propose and develop strategies for treatment of gaseous effluents and polluted air in general.	AC1 AC3 AC15	BC2 BC3	CC2 CC5 CC7 CC9

Contents	
Topic	Sub-topic
UNIT 1.- Introduction to atmospheric pollution.	The atmospheric pollution problem. Specific rules. Monitoring and control networks.
UNIT 2.- Analytical methodology for the assessment of air quality.	Reference methodology for sampling and analysis of diverse pollutants in the air. Practical cases and interpretation of results. Conclusions on some studies and current research.
UNIT 3.-Atmospheric emissions	Main polluting activities of the air. Introduction to the PRTR regulation. Methodologies of sampling and analysis of major pollutants in emissions.
UNIT 4.- Introduction to meteorology.	Atmospheric pressure and temperature: variation with the height. Adiabatic equation. Adiabatic gradient. Potential temperature. Stability of air stratification: criteria and classes. Thermal inversion: types.
UNIT 5.- Diffusion of pollutants in the atmosphere.	General equation of Gaussian dispersion. Resolution of particular cases. Soil concentration.

UNIT 6.- Plumes: types.	Atmospheric conditions. Distribution of the concentration along the axis of the plume. Plume rise. Parameters. Briggs equations for calculations of plumes.
UNIT 7.- Technologies for the removal of particulate matter.	Fundamentals. Description of equipments. Design equations. Problems solving.
UNIT 8.- Technologies for the removal of gases/vapors.	Fundamentals. Description of equipments. Design equations. Problems solving.
UNIT 9.- Innovative technologies.	Fundamentals. Description of equipments. Design equations. Problems solving.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A6 A15 B2 B4 B6 C2	11	33	44
Problem solving	A1 A6 A15 B2 B3 C4 C5 C7 C9	4	10	14
Case study	A3 A15 A19 B2 B3 B5 B6 C4 C7 C9 C10	2	8	10
Field trip	A15 B3 B6	2	0.5	2.5
Objective test	A1 A6 A15 B2 B3 B6 C4 C9	2	0	2
Personalized attention		2.5	0	2.5
(*)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	Imparted lessons by the teachers to present basic concepts and develop ideas.
Problem solving	The esencial aspects of the themes will be carefully shown, with the practice application of the knowledge. The teacher will propose different problems and exercises some of then will be solved by him on class and orders must be resolved by the students and given to the teacher at an specific date in order to be corrected.
Case study	The students must be able to develop and propose solutions to specific cases of air pollution and treatment of industrial effluents. Hipotetic situations will be the star point and the students will have to evaluate and elaborate a report about the medioambiental situation of a specific point.
Field trip	Also a trip to air quality inmision station where the students will see the sampling systems used on the air quality evaluation.
Objective test	It will consist in a evaluation about the knowledge acquired and the capacity to put it on practice. This will be measured through a written exam with 3 parts, test, short questions and problem cases.

Personalized attention	
Methodologies	Description
Case study	Students will be received individually in order to help to solve problems related with different practical or theorical aspect: orientation about the sources of information, concrete aspects about the study of practice cases and also the doubts that can appear in the theory of the subject and in the resolution of the problems Student with partial-time dedication or exempted from regular attendance to the lessons will be attended on a tutoring schedule (by appointment).

Assessment			
Methodologies	Competencies	Description	**Qualification**
Case study	A3 A15 A19 B2 B3 B5 B6 C4 C7 C9 C10	The student will face a real case about air quality. With the knowledge acquired during the subject they must develop a medioambiental report of the zone. Competences: A15, B2, B3, B6,C2, C7, C9	15

Objective test	A1 A6 A15 B2 B3 B6 C4 C9	The exam could have different types of questions : test, short answers, and the resolution numeric problems. Competences: A1, A6, A10, A15, B2, B3, B6, C4, C9	50
Field trip	A15 B3 B6	The student will elaborate a summary about the visit to air quality station. The teacher could ask for the sources os information or for the interpretation of different parameters that are obtained in the air quality station. Competences: A15, A22, B3	5
Problem solving	A1 A6 A15 B2 B3 C4 C5 C7 C9	There will problems presented by the teacher that will be resolved during clases. In a complimentary way, some of the problems will be given to the students it order to be solved in a individual and autonomous way and that must be given to the teacher within 20 natural days after the finish of the subject. Competences: A1, A6, A10, A15, B2, B3, C4, C6, C7, C9.	30

Assessment comments
The work of the student will be evaluated continuously through his active participation throughout the teaching of the subject. The overall rating will be obtained from the sum of the sums previously described. The grade of not presented will be granted to that student who is not presented to the objective test. STUDENTS WITH PARTIAL-TIME DEDICATION The evaluation criteria applied is the same indicated previously. STUDENTS EXEMPTED FROM REGULAR ATTENDANCE TO THE LESSONS Students exempted from regular attendance to the lessons, will be evaluated only according to their scores on the objective tests (60%), problem solving (20%) and case study (20%). This holds for both evaluation opportunities. In the evaluation of the subject, all the provisions of Article 14, regarding the Fraud Commission and disciplinary responsibilities, of the UDC's Rules for the Evaluation of Bachelor's Degrees and Master's Degrees, shall be applied.

Sources of information	
Basic	- Thad Godish (1997). Air Quality. New York, Lewis Publisher - Reeve, R.N (2002). Introduction to Environmental Analysis. Analytical Techniques in the Sciences. Chichester, UK. John Wiley & Sons - Milton, R. Beychock (2005). Fundamentals of Stack gas dispersion. Milton R. Beychock, New Port Beach, California, USA - Kennes, C and Veiga, M.C (2005). Bioreactors for Waste Gas Treatment. Dordrecht, The Netherlands, Kluwer Academic Publishers - Blackadar, A.K. (1997). Turbulence and diffusion in the atmosphere. . New York, Springer- Verlag - Baird, C (2001). Química Ambiental.. Reverté, Barcelona - Kennes,C.; Veiga, M.C (2013). Air pollution prevention and control : bioreactors and bioenergy . ohn Wiley & Sons, New York, USA - (). Atmospheric Environment.
Complementary	- McIntosh, D.H., (1983). Meteorología básica. . Madrid, Alhambra - Haltiner, G.J. and Martion, F.L. (1957). Meteorología dinámica y física. New York, McGraw-Hill - (). http://www.aemet.es/es/portada . - (). http://www.cmati.xunta.es/. - (). http://www.sogama.es/es. - (). http://www.magrama.gob.es/es/calidad-y-evaluacion-ambiental/temas/.

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 student must have clear concepts of the different topics that have been studied in the courses leading to the Degree, Bachelor or Engineer. Have knowledge of computer tools (spreadsheets, word processor, internet browsing ...) and English.It is also advisable to keep the subject up to date to assimilate the concepts and that the student's participation is fruitful. Likewise, the resolution of the problems raised is fundamental, which implies the understanding of the different topics covered in the subject.Green Campus Science Faculty Program: In order to help achieve an immediate sustainable environment and comply with point 6 of the "Environmental Declaration of the Science Faculty (2020)", the documentary work carried out in this area: a) Will be requested mainly in virtual format and computer support b) If done on paper: no plastics will be used, double-sided printing will be done, recycled paper will be used, and whenever possible, the printing of drafts will be avoided.