Teaching Guide				
Identifying Data				2017/18
Subject (*)	Environmental management and floor and air technology		Code	610475403
Study programme	Mestrado Universitario en Biotecnoloxía Avanzada			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optativa	3
Language	SpanishGalicianEnglish			
Teaching method	Face-to-face			
Prerequisites				
Department	Química			
Coordinador	Kennes , Christian	E-mail	c.kennes@udc.es	
Lecturers	Kennes , Christian Veiga Barbazan, Maria del Carmen	E-mail	c.kennes@udc.es m.carmen.veiga@udc.es	
Web	masterbiotecnologiaavanzada.com/			
General description	Profesors of the UVIGO do also participate in the teaching of this subject: Marta Maria Pazos Currás (email: mcurras@uvigo.es) Maria Angeles Sanromán Braga (email: sanroman@uvigo.es) The course consists of three parts: air pollution (8h, theory), soil contamination (5h, theory), and waste management (4h, theory). It teaches the students the fundamentals of air and soil pollution, with an emphasis on describing the major sources and types of pollutants as well as techniques for pollution abatement. It also addresses problems realted to the management and treatment of waste.			

Study programme competences	
Code	Study programme competences
A27	Coñecer a problemática da contaminación ambiental e saber facer avaliacións do impacto ambiental.
A28	Coñecer e saber aplicar as técnicas de detección e tratamento da contaminación ambiental.
A29	Coñecer e saber aplicar as técnicas de biorremedación e biorecuperación de ambientes contaminados.
B1	Capacidade de análise e síntese (localización de problemas e identificación das causas e a súa tipoloxía).
B2	Capacidade de organización e planificación de todos os recursos (humanos, materiais, información e infraestruturas).
B3	Capacidade de xestión da información (con apoio de tecnoloxías da información e as comunicacións).
B4	Capacidade de planificación e elaboración de estudos técnicos en biotecnoloxía microbiana, vexetal e animal.
B5	Capacidade de identificar problemas, buscar solucións e aplicalas nun contexto biotecnolóxico profesional ou de investigación.
B6	Capacidade de comunicación oral e escrita dos plans e decisións tomadas.
B7	Capacidade para formular xuízos sobre a problemática ética e social, actual e futura, que propón a Biotecnoloxía.
B8	Capacidade de comunicación eficazmente coa comunidade científica, profesional e académica, así como con outros sectores e medios de comunicación.
B9	Capacidade de Traballo en equipo multidepartamental dentro da empresa.
B10	Capacidade de Traballo nun contexto de sostibilidade, caracterizado por: sensibilidade polo medio ambiente e polos diferentes organismos que o integran así como concienciación polo desenvolvemento sostible.
B11	Racionamento crítico e respecto profundo pola ética e a integridade intelectual.
B12	Adaptación a novas situacións legais, ou novidades tecnolóxicas así como a excepcionalidades asociadas a situacións de urxencia.
B13	Aprendizaxe autónoma.
B14	Liderazgo e capacidade de coordinación.
B15	Sensibilización cara á calidade, o respecto medioambiental e o consumo responsable de recursos e a recuperación de residuos.

Learning outcomes	
Learning outcomes	Study programme competences

Knowledge of fundamentals of design and operation of a bioreactor	AC27	BC1 BC2 BC3 BC4 BC5 BC6 BC7 BC8 BC9 BC10 BC11 BC12 BC13 BC14 BC15	
Designing and managing biotechnology-based projects	AC28	BC1 BC2 BC3 BC4 BC5 BC6 BC7 BC8 BC9 BC10 BC11 BC12 BC13 BC14 BC15	
Knowing and applying techniques of bioremediation of contaminated environments	AC29	BC1 BC2 BC3 BC4 BC5 BC6 BC7 BC8 BC9 BC10 BC11 BC12 BC13 BC14 BC15	

Contents	
Topic	**Sub-topic**
1. Introduction to atmospheric pollution.	Introduction. Selection of the best treatment technologies based on the type and source of pollutants.

2. Introduction to air pollution control and waste gas treatment.	Classification of the different technologies and their range of application.
3. Technologies for particulate matter removal.	Description of technologies for particulate matter removal. Design equations.
4. Technologies for the removal of gases and vapors: Physical/chemical treatments.	Description of physical/chemical and thermal processes for the treatment of polluted gases and vapors. Design equations.
5. Bioprocesses for the treatment of polluted gases y vapors.	Description of bioreactors for the treatment of polluted gases and vapors. Design equations.
6. Innovative technologies and technologies under development.	Description of innovative treatment technologies. Design equations.
7. Introduction to soil contamination. Containment techniques.	Introduction. Containment techniques: physical barriers, chemical barriers and sealing.
8. Confinment techniques.	Physical/chemical stabilization, solidification and vitrification.
9. Soil remediation technologies: biological treatments.	Bioremediation, phytoremediation, biopiles.
10. Soil remediation technologies: Physical/chemical and thermal treatments.	Washing, flushing, soil vapor extraction, soil venting, electroremediation. Incineration, thermal desorption, pyrolisis.
11. Soil remediation technologies: combined treatments.	Combined treatments.
12. Introduction to waste management. Agricultural waste.	Valorization and management of agricultural waste for its use as fertilizer. Minimization of the environmental impact of manure.
13. Anaerobic waste treatment.	Anaerobic waste treatment.

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A27 A28 A29 B1 B3 B4 B5 B7 B8 B10 B11 B12 B13 B15	13	26	39
Problem solving	A27 A28 A29 B1 B2 B3 B13	3	6	9
Case study	A27 A28 A29 B1 B2 B3 B4 B5 B6 B9 B14	3	6	9
Laboratory practice	A27 A28 A29 B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15	4	6	10
Objective test	A27 A28 A29	2	4	6
Personalized attention		2	0	2
(*)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	Teaching of basic concepts.
Problem solving	Problem solving by the students, using equations and concepts explained in class.
Case study	Explanation of specific cases of pollution and of abatement techniques applied to real cases.
Laboratory practice	Apply the theory learned in class to practical cases of air/soil pollution abatement.
Objective test	Assessment of the acquisition of the concepts teached in this subject. The test will be a written exam consisting of theoretical questions and/or problems to be solved .

Personalized attention	
Methodologies	Description

Problem solving	The students will be supervised and will get help to solve problems and exercises, using the concepts and equations explained in class.

Assessment			
Methodologies	Competencies	Description	Qualification
Problem solving	A27 A28 A29 B1 B2 B3 B13	Solving of problems and exercises in the class, individually or in groups. Involvement and behavior of the students are evaluated during the different activities that are planned (A8, A11, A28, A29, A30, B5)	10
Laboratory practice	A27 A28 A29 B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15	Realización de las prácticas y entrega de informe/resultados (A8, A11, A28, A29, A30, B5, B8, B15, C2, C6)	40
Objective test	A27 A28 A29	El examen podra constar de preguntas de teoría y de preguntas relacionadas con la resolución de problemas. El examen podra tener relación con la materia vista en clase, los conceptos abordados en el laboratorio, o las visitas (A8, A11, A28, A29, A30, B5, B8, B15, C6)	50

Assessment comments
Similarly as for other subjects of the Master´s degree, the learning process will be evaluated in a continuous way during the period assigned to the face-to-face teaching. The final examination represents 80% of the final score; the date of the same will be on the last day of the teaching period of the subject or on any other date agreed on. The practical work in the laboratory, and the laboratory report, represent 20% of the final score. Students attending the first examination sitting will have priority to be awarded the MH ("Matricula de Honor").

Sources of information	
Basic	- WARK, K & WARNER, CF (1981). Air Pollution, its origin and control. Row & Harper Publishers - KENNES, C & VEIGA, MC (2001). Bioreactors for waste gas treatment. Kluwer Academic Publishers - US-EPA (1997). Bioremediation of hazardous waste sites: practical approaches to implementation.. EPA 625-K-96-001 - US-EPA (1995). Biorremediation of Hazardous wastes. . EPA 540-R-95-532. - LEVIN, L & GEALT, M (1997). Biotratamiento de residuos tóxicos y peligrosos. Selección, estimación, modificación de microorganismos y aplicación. McGraw-Hill - PICHTEL, J (2007). Fundamentals of site remediation : for metal and hydrocarbon-contaminated soils . 2nd ed. . Rockville, Maryland : Government Institutes - ANDERSON, WC (ed.) (1993). Innovative site remediation technology (Vol 1-8). American Academy of Environmental Engineers - KENNES, C & VEIGA, MC (2013). Air Pollution Prevention and Control. J. Wiley & Sons
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Environmental contamination/610475401 Environmental management and water technology/610475402
Subjects that are recommended to be taken simultaneously
Legal and ethical aspects in Biotechnology/610475203
Subjects that continue the syllabus
Master Thesis/610475006 External Practicals/610475007
Other comments

Dado que parte de la bibliografía recomendada para esta materia se encuentra en inglés, es aconsejable tener conocimientos de esta lengua, por lo menos, a nivel de comprensión de textos escritos.