



## Teaching Guide

Identifying Data					2022/23
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	Optional	3	
Language	SpanishGalicianEnglish				
Teaching method	Face-to-face				
Prerequisites					
Department	Departamento profesorado másterQuímica				
Coordinador	Kennes , Christian	E-mail	c.kennes@udc.es		
Lecturers	Kennes , Christian	E-mail	c.kennes@udc.es		
Web	masterbiotecnologiaavanzada.com/				
General description	<p>Professors of the UDC (M<sup>a</sup> del Carmen Veiga Barbazán; email: m.carmen.veiga@udc.es) and UVIGO do also participate in the teaching of this subject:</p> <p>Marta Maria Pazos Currás (email: mcurras@uvigo.es)</p> <p>Maria Angeles Sanromán Braga (email: sanroman@uvigo.es)</p> <p>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 related to the management and treatment of waste.</p>				

## 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 biorremediación 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 aplicarlas 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 excepcións 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.
C4	Acting as a respectful citizen according to democratic cultures and human rights and with a gender perspective.
C7	Developing the ability to work in interdisciplinary or transdisciplinary teams in order to offer proposals that can contribute to a sustainable environmental, economic, political and social development.



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	CC4 CC7
Designing and managing biotechnology-based projects	AC28	BC1 BC2 BC3 BC4 BC5 BC6 BC7 BC8 BC9 BC10 BC11 BC12 BC13 BC14 BC15	CC4 CC7
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	CC4 CC7



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. Confinement 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, pyrolysis.
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 C4 C7	3	6	9
Case study	A27 A28 A29 B1 B2 B3 B4 B5 B6 B9 B14 C4 C7	3	6	9
Laboratory practice	A27 A28 A29 B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 C4 C7	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 taught 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 C4 C7	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 C4 C7	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 50% 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 40% of the final score; and the participation of the student during the teaching hours and the resolution of exercises represent 10% of the final score. Students attending the first examination sitting will have priority to be awarded the MH ("Matricula de Honor").
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## Sources of information

<b>Basic</b>	<ul style="list-style-type: none"> <li>- WARK, K &amp; WARNER, CF (1981). Air Pollution, its origin and control. Row &amp; Harper Publishers</li> <li>- KENNES, C &amp; VEIGA, MC (2001). Bioreactors for waste gas treatment. Kluwer Academic Publishers</li> <li>- US-EPA (1997). Bioremediation of hazardous waste sites: practical approaches to implementation.. EPA 625-K-96-001</li> <li>- US-EPA (1995). Biorremediation of Hazardous wastes. . EPA 540-R-95-532.</li> <li>- LEVIN, L &amp; GEALT, M (1997). Biotratamiento de residuos tóxicos y peligrosos. Selección, estimación, modificación de microorganismos y aplicación. McGraw-Hill</li> <li>- PICHTEL, J (2007). Fundamentals of site remediation : for metal and hydrocarbon-contaminated soils . 2nd ed. . Rockville, Maryland : Government Institutes</li> <li>- ANDERSON, WC (ed.) (1993). Innovative site remediation technology (Vol 1-8). American Academy of Environmental Engineers</li> <li>- KENNES, C &amp; VEIGA, MC (2013). Air Pollution Prevention and Control. J. Wiley &amp; Sons</li> </ul>
<b>Complementary</b>	

## 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.

(\*)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.