Teaching Guide				
Identifying Data				2019/20
Subject (*)	Water treatment and energy efficiency		Code	632844206
Study programme	Mestrado Universitario en Enxeñaría da Auga (plan 2012)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	First	Optional	6
Language	English			
Teaching method	Face-to-face			
Prerequisites				
Department	BioloxíaEnxeñaría CivilEnxeñaría Naval e Industrial			
Coordinador	Servia García, María José	E-mail	maria.servia@udc.es	
Lecturers	Martínez Díaz, Margarita Servia García, María José Vázquez González, Ana María	E-mail	margarita.martinez@udc.es maria.servia@udc.es ana.maria.vazquez@udc.es	
Web	caminos.udc.es/info/asignaturas/201/masterindex.html			
General description	Wastewater treatment has become a fundamental tool in water management. Indeed, the ultimate aim of the Water Framework Directive (2000/60/EC) is to achieve the elimination of hazardous substances and contribute to achieving concentrations near background values for naturally occurring substances in both freshwater and marine ecosystems. The main purpose of this subject is to help students identify and evaluate risk factors and processes involved in water pollution and water treatment.			

Study programme competences	
Code	Study programme competences
A19	Knowledge of advanced water treatment with different conclusions: depuration, re-use, purification, elimination of nutrients and regeneration treatments
A23	Fundamental knowledge of energy consumption and its environmental implications inside a development sustainable
A25	Knowledge and understanding of water in different situations: the working of ecosystems, environmental factors with the purpose of to make an inventory of medium, applying the methodology to value the impact and its use in studies and evaluations of the environmental impact.
B1	To resolve problems effectively
B2	To apply critical thinking, logic and creativity
B3	To work individually with initiative
B4	To communicate effectively in work surroundings
B5	Continuous recycling of knowledge in a general perspective in a global situation of water engineering
B6	Understanding of the need to analyse history to understand the present
B7	Facility to integrate in multidiscipline teams
B8	Capacity to organize and plan
B9	Capacity for analysis, synthesis and structure of information and ideas
C1	To understand the importance of the enterprising culture and to know the means at the reach of the enterprising people
C2	To value knowledge critically, technology and available information to resolve problems that they will face
C3	To assume as a professional and citizen the importance of learning throughout life
C4	To value the importance of the investigation, innovation and technology development in the social ?economic advance and cultural in society
C5	To posses and understand knowledge that gives a base or oportunity to be original in the development and for applications of ideas, often in the context of investigation
C6	The students must be able to apply the acquired knowledge and their capacity to resolve problems in new surrandings or not well known within wider contexts (or multidiscipline) related with the study area
C7	The students must be able to integrate knowledge and to affront the complexity to formulate judgements from information that, been incomplete or limited, include reflexions about social responsabilities and ethics related to the application of the knowledge and judments

C8	The students must be able to comunicate their conclusions, knowledge and the last reasons that support them, to spezialated publics and not spezialated in a clear and unambiguous way.
C9	The student must possess the learning ability with permits them to continues to study in a manner wich will be in a great measure self directed and individual

Learning outcomes			
Learning outcomes	Study programme competences		
The learning outcomes address water treatment and how it influences the normal functioning of freshwater ecosystems.	AC19 AC23 AC25	BC1 BC2 BC3 BC4 BC5 BC6 BC7 BC8 BC9	CC1 CC2 CC3 CC4 CC5 CC6 CC7 CC8 CC9

Contents	
Topic	Sub-topic
Water, energy and sustainable development. Life cycle analysis	Water demand Water footprint and carbon footprint Greenhouse gases emission
Water reuse as an example of sustainable initiative	Water reuse options Treatment options and their energy requirements Life cycle analysis of water reuse
Renewable energies to face water scarcity	The problem of the water and the energy Technologies based on renewable energies for freshwater production
Water and energy: two closely-related concepts	Introduction The use of energy to obtain the required water Energy obtained from water The use of water to obtain energy
The functioning of freshwater ecosystems	Lentic systems Lotic systems
Freshwater biodiversity. Types of aquatic organisms	Microbes and plants Animals
Effects of pollutants on aquatic ecosystems	Suborganismal effects Supraorganismal effects
The use of bioindicators to assess freshwater quality	Bioindicators recommended by the Water Framework Directive
Chemical contaminants of water	Types Standards Problems Health Effects and Impact on the environment
Chemical treatments	Coagulation-precipitation Oxidation reduction Ion exchange Disinfection High-service pumping Water plant residuals managment

Types of water contamination	Domestic wastewater Livestock Wastewater Industrial wastewater Municipal waste water Agricultural pollution Water from urban runoff
Analytical methods for the determination of physicochemical parameters	Analytical methods

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A19 A23 A25 B5 B6 B7 B9 C2 C3	25	25	50
Laboratory practice	A19 A25 B1 B2 B3 B4 B7 B8 B9 C2 C3 C4 C5 C6 C9	25	25	50
Workshop	A19 A23 B2 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 C7 C8	10	10	20
Personalized attention		30	0	30
(*)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	Regular lectures where the main theoretical contents of the subject are regarded
Laboratory practice	The laboratory practice will be done mainly in the chemistry laboratory. Practices will illustrate chemical concepts and the students wil learn important laboratory techniques
Workshop	During the workshop discussions will be organised and the students will be asked toproduce assays or reports in different formats

Personalized attention	
Methodologies	Description
Laboratory practice Workshop	Personalized attention to be provided mainly for laboratory practices and workshops

Assessment			
Methodologies	Competencies	Description	Qualification
Laboratory practice	A19 A25 B1 B2 B3 B4 B7 B8 B9 C2 C3 C4 C5 C6 C9	Assesment will be based mostly on claass assignments. Attendance to laboratory classes and technical visits will be taken into account for the final mark	40
Workshop	A19 A23 B2 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 C7 C8	Attendance to preparatory seminars and the work developed in the workshops will be considered for the final mark	20
Guest lecture / keynote speech	A19 A23 A25 B5 B6 B7 B9 C2 C3	The knowledge of the concepts developed at the magistral lectures will be assesed and considered for the final mark. Assessment methodologies might include oral presentations, written exams, analysis of scientific papers, etc.	40

Assessment comments

Sources of information	
Basic	- U.S. Environmental Protection Agency (2006). Wastewater Management Fact Sheet - Energy conservation. U.S. Environmental Protection Agency, Office of Water (http://www.epa.gov/own/mtb/energycon_fasht_fi - Karassik, I.; Messina, J.; Cooper, P.; Head, C. (2008). Pump handbook. New York: McGraw-Hill (4th ed.) - Malcolm Pirnie (2006). Municipal wastewater treatment plant energy evaluation summary report. Albany, New York: New York State Energy Research and Development Authority - Water Environment Federation; American Society of Civil Engineers (2009). Design of Municipal Wastewater Treatment Plants, 5th ed.; Manual of practice No.8; ASCE Manuals and Reports on Engineering Practice No.76. Alexandria, Virginia: Water Environment Federation - US Environmental Protection Agency (2009). Energy Star for Wastewater Plants and Drinking Water Systems . http://www.energystar.gov/index.cfm?c=water.wastewater_drinking_water - Dodds, W. & Whiles, M. (2010). Freshwater Ecology. Academic Press
Complementary	

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.