



| Teaching Guide           |  |        |  |         |
|--------------------------|--|--------|--|---------|
| Identifying Data         |  |        |  | 2018/19 |
| 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               | BiologíaEnxeñaría CivilEnxeñaría Naval e Industrial  |        |  |         |
| Coordinador              | Servia García, María José  | E-mail | maria.servia@udc.es  |         |
| Lecturers                | Martínez Díaz, Margarita<br>Servia García, María José<br>Vázquez González, Ana María   | E-mail | margarita.martinez@udc.es<br>maria.servia@udc.es<br>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 / results |   |
|---------------------------------------|---|
| Code                                  | Study programme competences / results   |
| 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 responsibilities and ethics related to the application of the knowledge and judgments     |



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| C8 | The students must be able to communicate 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 / results |     |     |
| The learning outcomes address water treatment and how it influences the normal functioning of freshwater ecosystems. | AC19                                  | BC1 | CC1 |
|  | AC23                                  | BC2 | CC2 |
|  | AC25                                  | BC3 | CC3 |
|  |                                       | BC4 | CC4 |
|  |                                       | BC5 | CC5 |
|  |                                       | BC6 | CC6 |
|  |                                       | BC7 | CC7 |
|  |                                       | BC8 | CC8 |
|  |                                       | BC9 | CC9 |

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



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

| Planning                       |  |                                      |                               |             |
|--------------------------------|--|--------------------------------------|-------------------------------|-------------|
| Methodologies / tests          | Competencies / Results                                   | Teaching hours (in-person & virtual) | Student's personal work hours | Total hours |
| Guest lecture / keynote speech | A19 A23 A25 B6   | 30                                   | 30                            | 60          |
| Seminar                        | B1 B2 B3 B4 B5 B7<br>B8 B9 C1 C2 C3 C4<br>C5 C6 C7 C8 C9 | 30                                   | 30                            | 60          |
| 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         |
| Seminar                        | Practical lectures related to the theoretical aspects regarded at the magistral lectures |

| Personalized attention |  |
|------------------------|--|
| Methodologies          | Description  |
| Seminar                | Personalized attention to be provided for the seminars |

| Assessment                     |  |  |               |
|--------------------------------|--|--|---------------|
| Methodologies                  | Competencies / Results                                   | Description  | Qualification |
| Seminar                        | B1 B2 B3 B4 B5 B7<br>B8 B9 C1 C2 C3 C4<br>C5 C6 C7 C8 C9 | The attendance to the seminars and the work being developed at the seminars will be considered for the final mark    | 50            |
| Guest lecture / keynote speech | A19 A23 A25 B6   | The knowledge of the concepts developed at the magistral lectures will be assessed and considered for the final mark | 50            |

| Assessment comments |
|---------------------|
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| Sources of information |
|------------------------|
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|----------------------|--|
| <b>Basic</b>         | <ul style="list-style-type: none"><li>- U.S. Environmental Protection Agency (2006). Wastewater Management Fact Sheet - Energy conservation. U.S. Environmental Protection Agency, Office of Water (<a href="http://www.epa.gov/own/mtb/energycon_fasht_fi">http://www.epa.gov/own/mtb/energycon_fasht_fi</a>)</li><li>- Karassik, I.; Messina, J.; Cooper, P.; Head, C. (2008). Pump handbook. New York: McGraw-Hill (4th ed.)</li><li>- Malcolm Pirnie (2006). Municipal wastewater treatment plant energy evaluation summary report. Albany, New York: New York State Energy Research and Development Authority</li><li>- 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</li><li>- US Environmental Protection Agency (2009). Energy Star for Wastewater Plants and Drinking Water Systems . <a href="http://www.energystar.gov/index.cfm?c=water.wastewater_drinking_water">http://www.energystar.gov/index.cfm?c=water.wastewater_drinking_water</a></li><li>- Dodds, W. &amp; Whiles, M. (2010). Freshwater Ecology. Academic Press</li></ul> |
| <b>Complementary</b> |  |

### 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.