



## Teaching Guide

| Teaching Guide           |                                                                                                                                                                                                                                                                                                                                      |        |                          |           |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------|-----------|
| Identifying Data         |                                                                                                                                                                                                                                                                                                                                      |        |                          | 2016/17   |
| Subject (*)              | Hydrological planning and projects                                                                                                                                                                                                                                                                                                   |        | Code                     | 632844201 |
| 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  | Obligatoria              | 6         |
| Language                 | English                                                                                                                                                                                                                                                                                                                              |        |                          |           |
| Teaching method          | Face-to-face                                                                                                                                                                                                                                                                                                                         |        |                          |           |
| Prerequisites            |                                                                                                                                                                                                                                                                                                                                      |        |                          |           |
| Department               | Métodos Matemáticos e de RepresentaciónTecnoloxía da Construción                                                                                                                                                                                                                                                                     |        |                          |           |
| Coordinador              | Padilla Benitez, Francisco                                                                                                                                                                                                                                                                                                           | E-mail | francisco.padilla@udc.es |           |
| Lecturers                | Acinas Garcia, Juan Ramon                                                                                                                                                                                                                                                                                                            | E-mail | j.acinas@udc.es          |           |
|                          | Naves García-Rendueles, Acacia                                                                                                                                                                                                                                                                                                       |        | acacia.naves@udc.es      |           |
|                          | Padilla Benitez, Francisco                                                                                                                                                                                                                                                                                                           |        | francisco.padilla@udc.es |           |
| Web                      | <a href="http://caminos.udc.es/info/asignaturas/201/masterindex.html">http://caminos.udc.es/info/asignaturas/201/masterindex.html</a>                                                                                                                                                                                                |        |                          |           |
| General description      | Assessment and analysis of water resource systems. Groundwater management. Surface-water management. Water withdrawals and uses. Methods of analysis: identification, optimization, uncertainties, objectives and control of water management plans. Data management systems by GIS. Design of water resources systems and planning. |        |                          |           |

## Study programme competences / results

| Code | Study programme competences / results                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A1   | Knowledge, understanding and capacity to apply legislation related with water engineering during professional development. Capacity to analyse the working mechanism of the economy and public and private management of water                                                                                                                                                                                                                                                        |
| A6   | Capacity to analyse the mechanism of the economy working and the public and private management of water                                                                                                                                                                                                                                                                                                                                                                               |
| A7   | Knowledge of the fundamentals about the evaluation of water resources and the principal tools for the hydrological planning, starting from theoretical justification and practical applications that lead to the specific problem resolution and the use of updated methodologic (programs and models) for the evaluation of the exploitation, uses, defence, and the management the combined planning of surface and underground water. Knowledge of national and hydrological plans |
| A9   | Knowledge of geographical information systems (SIG) applied to the management of water resources. Knowledge of the basic working of the system for the analysis of the geographical data, making use of SIG tools and support management and the analysis of data regarding water resources. Knowledge of the geospatial data and his characteristics and the processes for its acquisition, storage treatment analysis, modelling and presentation                                   |
| A18  | Capacity to realize an integral use and efficient use of water resource. Knowledge of the working of the basin organisms and general analysis of water engineering projects in the area of cooperation and development and humanitarian aid.                                                                                                                                                                                                                                          |
| 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 possess and understand knowledge that gives a base or opportunity 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 surroundings 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 |
| C8 | The students must be able to communicate their conclusions, knowledge and the last reasons that support them, to specialized publics and not specialized in a clear and unambiguous way.                                                                                        |
| C9 | The student must possess the learning ability with permits them to continue to study in a manner which will be in a great measure self directed and individual                                                                                                                  |

| Learning outcomes |  |                                       |         |
|-------------------|--|---------------------------------------|---------|
| Learning outcomes |  | Study programme competences / results |         |
|                   |  | AC1                                   | BC1 CC1 |
|                   |  | AC6                                   | BC2 CC2 |
|                   |  | AC7                                   | BC3 CC3 |
|                   |  | AC9                                   | BC4 CC4 |
|                   |  | AC18                                  | BC5 CC5 |
|                   |  |                                       | BC6 CC6 |
|                   |  |                                       | BC7 CC7 |
|                   |  |                                       | BC8 CC8 |
|                   |  |                                       | BC9 CC9 |

| Contents                                              |                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Topic                                                 | Sub-topic                                                                                                                                                                                                                                                                           |
| 1. Assessment and analysis of water resource systems. | Hydrological resources. Purposes of water resources planning. The hydrological watershed. Integrated groundwater and surface water planning. Water withdrawals, supplies and uses. Data management and appraisal. Water balances. Flow water management and historical restitution. |
| 2. Groundwater management.                            | Groundwater resources and storages. Recharges and discharges. Groundwater balances. Natural and artificial groundwater recharges. Simulation of groundwater as related to surface water systems. Calibration and validation of groundwater systems.                                 |
| 3. Surface-water management.                          | Flow data management and analysis. Deterministic river basin modelling. Synthetic streamflow generation. Stochastic river basin planning models. Water for hydroelectric generation.                                                                                                |
| 4. Methods of analysis.                               | Identification and evaluation of water management plans. Control and efficiency of water management plans. Water resources planning under uncertainty. Reservoir design and operation. Water resources planning objectives and optimization.                                        |
| 5. Hydrological planning.                             | Design of integrated water resources systems and planning. Mathematical models for the development of planning alternatives. Data management systems by GIS. Water economy and legislation. Administration of hydrological planning programs.                                       |

| Planning              |                        |                                      |                               |             |
|-----------------------|------------------------|--------------------------------------|-------------------------------|-------------|
| Methodologies / tests | Competencies / Results | Teaching hours (in-person & virtual) | Student's personal work hours | Total hours |



|                                |                                                                                |    |    |    |
|--------------------------------|--------------------------------------------------------------------------------|----|----|----|
| Seminar                        | A1 A6 A7 A9 A18 B1<br>B2 B3 B4 B5 B6 B7<br>B8 B9 C1 C2 C3 C4<br>C5 C6 C7 C8 C9 | 30 | 30 | 60 |
| Guest lecture / keynote speech | A1 A6 A7 A9 A18                                                                | 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                                                                              |
| Seminar                        | Practical lectures related to the theoretical aspects regarded at the magistral lectures |
| Guest lecture / keynote speech | Regular lectures where the main theoretical contents of the subjects are regarded        |

| Personalized attention                    |                                                        |
|-------------------------------------------|--------------------------------------------------------|
| Methodologies                             | Description                                            |
| Seminar<br>Guest lecture / keynote speech | Personalized attention to be provided for the seminars |

| Assessment                     |                                                                                |                                                                                                                      |               |
|--------------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------|
| Methodologies                  | Competencies / Results                                                         | Description                                                                                                          | Qualification |
| Seminar                        | A1 A6 A7 A9 A18 B1<br>B2 B3 B4 B5 B6 B7<br>B8 B9 C1 C2 C3 C4<br>C5 C6 C7 C8 C9 | The knowledge of the concepts developed at the magistral lectures will be assessed and considered for the final mark | 50            |
| Guest lecture / keynote speech | A1 A6 A7 A9 A18                                                                | The attendance to the seminars and the work being developed at the seminars will be considered for the final mark    | 50            |

| Assessment comments |
|---------------------|
|                     |

| Sources of information |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic                  | <ul style="list-style-type: none"> <li>- Andreu J. (1993). Conceptos y métodos para la planificación hidrológica. Ed. CIMNE</li> <li>- Balairón, L. (2000). Gestión de recursos hídricos. E.U.I.T. Obras Públicas de Ávila, Universidad de Salamanca</li> <li>- Estrada, L. (1994). Garantía en los sistemas de explotación de los recursos hidráulicos. CEDEX</li> <li>- Estrella, T. (1993). Modelos matemáticos para la evaluación de los recursos hídricos. CEDEX</li> <li>- Ferrer F.J. (1993). Recomendaciones para el cálculo hidrometeorológico de avenidas. CEDEX</li> <li>- Goodman A. (1984). Principles of Water Resources Planning. Prentice-Hall</li> <li>- Liria J. y Sáinz J.A. (1982). Recursos Hidráulicos y su Planificación. Apuntes de la ETSICCP de Santander</li> <li>- Loucks D., Stedinger J. y Haith D. (1981). Water Resource Systems Planning and Analysis. Prentice-Hall</li> <li>- Mays, L.W. (2011). Water resources engineering. John Wiley &amp; Sons</li> <li>- Sainz, J.A. y Ascorbe, A. (1984). Metodología aplicada a estudios de regulación. Univ. de Santander</li> <li>- Vallarino E. (1980). Planificación Hidráulica. Apuntes de la ETSICCP de Madrid</li> </ul> |
| 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.