Teaching Guide				
Identifying Data				2021/22
Subject (*)	Groundwater engineering		Code	632844207
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	Enxeñaría Civil			
Coordinador	Juncosa Rivera, Ricardo	E-mail	ricardo.juncosa@udc.es	
Lecturers	Juncosa Rivera, Ricardo Padilla Benitez, Francisco Soriano Hoyuelos, Gemma	E-mail	ricardo.juncosa@udc.es francisco.padilla@udc.es gemma.soriano@udc.es	
Web	caminos.udc.es/hosting/masteragua/			
General description	Basis of flow in porous and fractured media (physical hydrogeology) in both saturated and unsaturated conditions. Interactions of surface water and groundwater. Hydrogeochemical principles and rockwater interaction (chemical hydrogeology, transport in porous media), hydrodynamics test of aquifers (slug tests, pumping tests,?), constructive aspects of wells, development and exploitation of aquifers			
Contingency plan	1. Modifications to the contents Not change 2. Methodologies *Teaching methodologies that are maintained Not change *Teaching methodologies that are modified Some classes will be taught through TEAMS 3. Mechanisms for personalized attention to students By TEAMS or email 4. Modifications in the evaluation Not change *Evaluation observations: Not change 5. Modifications to the bibliography or webgraphy Not change			

Study programme competences	
Code	Study programme competences
A15	General vision and balanced of the basic aspects and application of underground hydrologic from the needs of civil engineering. Capacity to Project or interpret the different hydraulic trials of hydrodynamic characterization, interpret hydrogeological maps and know the constructive aspects of the water uptake
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		
Overview of basic and applied aspects of hydrogeology from needs of civil engineering. Ability to design and interpret the hydraulics tests and hydrodynamic characterization of medium, interpreting hydrogeological maps and constructive ways of sources	AC15	BC1	CC1
		BC2	CC2
		BC3	CC3
		BC4	CC4
		BC5	CC5
		BC6	CC6
		BC7	CC7
		BC8	CC8
		BC9	CC9

Contents	
Topic	Sub-topic
Introduction to the Hydrologic Cycle	Components Evapotranspiration and potencial Evapotranspiration Infiltration and recharge Baseflow
Geologic materials	Continental environments:erosion, transportation and deposition Kind of depositis: fluvial, eolian, lacustrine and galcial Uplift, diagenesis and erosion Tectonism and the formation of fractures
Ground water movement	Basic concepts Darcy´s experimental law and field extensions Propierties: porosity and hydraulic conductivity Filed Mapping Flow in fractured rocks
Main equations of flow	Conservation of fluid mass The storage properties of porous media Boundary conditions and flow nets
Flow in the unsaturated zone	Richards ´s equation Unsaturated flow in fractured rocks

Solute and particle transport	Advection Basic concepts of dispersion: diffusion and mechanical dispersion
Principles of aqueous geochemistry	Aqueous systems Equilibrium versus kinetic descriptions Equilibrium models of reaction Kinetcis reactions Ground water composition
Chemical reactions	Homogeneous reactions: Acid-base reactions, complextion reactions, oxidation-reductions reactions Heterogeneous reactions: dissolution/precipitation, reactions on surfaces
Saline water/ Sweet Water interface	Saline intrusion Methods
Hydraulic testing	Conventional hydraulic testing Single borehole test hydraulic testing in fractured or low permeability rocks Others methods of testing
Ground water as a resource	Land subsidence Coastal aquifers drainage on slopes road drainge dams

Planning				
Methodologies / tests	Competencies	Ordinary class hours	Student?s personal work hours	Total hours
Seminar	A15 B1 B2 B3 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 C7 C8 C9	30	30	60
Guest lecture / keynote speech	A15 B1 B2 B3 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 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
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
Guest lecture / keynote speech Seminar	Pernonalized attention to be provided for the semminars

Assessment			
Methodologies	Competencies	Description	Qualification

Guest lecture / keynote speech	A15 B1 B2 B3 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 C7 C8 C9	The knowledge of the concepts developed at the magistral lectures will be assesed and considered for the final mark	50
Seminar	A15 B1 B2 B3 B4 B5 B6 B7 B8 B9 C1 C2 C3 C4 C5 C6 C7 C8 C9	The attendance to the semminars and the work being developed at the semminars will be considered for the final mark	50

Assessment comments

Sources of information	
Basic	- Domenico, P.A. and Schwartz, F.W. (1990). Physycal and chemical hydrogeology. Wiley - Bear, J. (1972). Dynamics of fluids in porous media. American Elsevier - Bear, J. (1979). Hydraulics of groundwater. Mc Graw Series in water resources and environmental engineering - Feiter, C.W. (1999). Contaminant Hydrogeology. Prenice hall - Fieter, C.W. (2001). Applied hydrogeology. Prenice hall - Weight, Willis D. (2009). Hydrogeology field manual. Mc Graw Hill
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.