MASTER´S DEGREE IN INTEGRAL WATER CYCLE ENGINEERING

60 ECTS Credits

12 months

Online

UCAM
UNIVERSIDAD
CATÓLICA DE MURCIA

Structuralia

SUMMARY

STRUCTURALIA

Structuralia is an online school specialized in graduate engineering, infrastructure, construction, energy, building, new technologies, and digital transformation programs and courses. We are dedicated to providing high-quality education for engineers, architects, and STEM (science, technology, engineering, and mathematics) professionals.

Since our creation in 2001, over 200,000 students from more than 90 countries have participated in our virtual classrooms as we disseminate knowledge and guide professionals toward success.

To this effect, we collaborate with leading international experts in each field, which enables our students to specialize under the guidance of active professionals. Our constant interaction with major companies in each sector, as their specialized training provider, enables us to tailor high-quality academic material to meet the current job requirements of our students.

Our master's programs are certified by our partner universities, such as the Universidad Católica San Antonio de Murcia, UDAVINCI, or Universidad Isabel I.

Every day we strive to provide the best training for engineers, architects, and STEM professionals with a clear goal: your professional success.

BRIEF SUMMARY

A simple action like opening a water tap is the result of the work of thousands of people.

According to the World Health Organization, approximately 2.2 billion people in the world do not have access to safe drinking water, and 4.2 billion lack sanitation services. Furthermore, climate change is expected to cause increasingly frequent and disastrous droughts and floods. These facts and projections have motivated water companies around the world to initiate infrastructure adaptation plans.

This master's program seeks to study each process within the water cycle in depth, as well as the design and operations of all the necessary infrastructures to guarantee safe water supply and the protection of river ecosystems.

GROUPS OF INTEREST

Recently graduated engineers interested in the water sector.

Civil, industrial, agricultural and forestry engineering students interested in water treatment processes and preparing for job interviews in the water engineering sector.

Engineering professionals who wish to specialize in the water and sanitation sector.

CAREER OPPORTUNITIES

- WTP manager
- WWTP manager
- Water infrastructure design engineer
- Water infrastructure maintenance manager
- Water infrastructure design project manage
- Water consultant engineer
- Executive at water and environmental engineering companies

OBJECTIVES

At the end of the program, the students will be able to:

- Understand the entire urban water cycle, as well as each of its processes.
- Design the infrastructures that guarantee the integral water cycle.
- Exploit and maintain the infrastructures that guarantee the integral water cycle.
- Manage projects for the design, expansion, operations, and maintenance of water cycle infrastructures.
- Select the best management and operation strategies for companies in the water sector.

PROGRAM

MODULE I: CLIMATE VARIABILITY AND CLIMATE CHANGE

UNIT 1. The climate system

- Introduction to the climate system.
- Structure and components of the climate system.
- The atmosphere and life on Earth.
- The importance of the hydrological cycle in climate regulation.
- Natural drivers of climate change.

UNIT 2. Weather, climate, and climate system

- Energy balance in the climate system
- Changes in the climate system
- Oceans and atmosphere: Essential interactions for climate
- Climate variability
- Weather, climate, and climate change in global systems

UNIT 3. Climate change

- Anthropogenic climate change drivers
- History of climate change
- Observed climate change trends: Major effects
- Climate change global scenarios
- The importance of the 1,5 ºC

UNIT 4. Vulnerability assessment and climate change risks

- Expected climate change trends: second-order effects
- Vulnerability and climate change
- Vulnerability dimensions and climate change risks
- Main climate risks
- Examples

MODULE II: WATER RESOURCE CATCHMENT AND MANAGEMENT

UNIT 1: Water as a resource

- Integral Water Cycle. Hydrology I
- Integral Water Cycle. Hydrology II
- Catchment infrastructures. General concepts
- Dam auscultation
- Dam flood control
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UNIT 2: Catchment infrastructure I

- Shallow water catchment. Infrastructures
- Concrete dams. Gravity dam
- Non-rigid dams
- Underground water catchment. Wells and aquifers
- Water supply to risk-vulnerable population

UNIT 3: Catchment infrastructure II

- Dam security. Water inlet, scour outlet and spillways
- Dam security. Spillway types
- Dam construction. Construction and maintenance aspects
- Heightening and reinforcements
- Hydroelectric utilization

UNIT 4: Adduction and regulation infrastructures

- Adduction and regulation infrastructures
- Pressure conduits
- Canals I
- Canals II
- Water lifting system

MODULE III: DRINKING WATER TREATMENT: PURIFICATION AND DESALINATION

Unit 1. Design of the treatment process

- The origin of water
- Water chemistry
- Water pollution
- Design of the treatment process
- Treatment of specific pollutants

Unit 2. Solid – Liquid separation systems

- Water intake works and pretreatment
- Coagulation and flocculation
- Sedimentation
- Granular medium filtration
- Advanced filtration

Unit 3. Disinfection

- Water disinfection technologies
- Chlorine and sodium hypochlorite
- Chlorine dioxice and chloramines
- Ozone and potassium permanganate
- Case study: design of DWTP

Unit 4. Seawater desalination

- Desalination systems
- Water quality and intake works
- Pretreatment
- Filtration with reverse osmosis membranes
- Post-treatment and auxiliary systems

MODULE IV: PIPES AND WATER DISTRIBUTION NETWORKS

Unit 1. Introduction to networks and service connections

- General conditions
- Components of the water main connection (I)
- Components of the water main connection (II)
- Components of the water main connection (III)
- Dimensioning and installation of the wáter main connection

Unit 2. Components of the supply system

- General considerations. Pipes (I)
- General considerations. Pipes (II)
- General considerations. Pipes (III)
- Joints and fittings
- Operation and control elements

Unit 3. Design and protection of the supply system

- Design and layout criteria
- Hydraulic dimensioning of pipelines
- Calculation of cathodic protection
- Pipe protection and cleaning
- Practical exercises on pipe networks

Unit 4. Structural considerations and quality management

- Structural considerations
- Underground trench installations (I)
- Underground trench installations (II)
- Quality management (I)
- Quality management (II)

MODULE V: SEWAGE SYSTEMS

Unit 1. Gravity sewer systems

- Structure and type of systems
- Pipelines
- Materials and sections. Joints and special parts
- Manholes: catch basins, chambers, and connections
- Urban drainage

Unit 2. Construction, maintenance, and operation of sewage systems

- Underground pipeline systems
- Trechless pipeline installation
- Maintenance of the sewage system
- Rehabilitation of the sewage system
- Advanced system operation

Unit 3. Wastewater Pumping Station (WWPS)

- General design of WWPS
- Discharge and complementary elements
- Centrifugal pumps
- Operation of a centrifugal pump
- Additional facilities

Unit 4. Spillways and storm tanks

- Spillways and retention basins
- Elements of a storm tank
- Elements of the retention chamber
- Design of storm tanks
- Design of elements in storm tanks

MODULE VI: DESIGN AND OPERATION OF A WASTEWATER TREATMENT PLANT

Unit 1. Wastewater. Introduction to wastewater treatment

- Wastewater
- Design of a WWTP
- Pretreatment
- Primary treatment
- Secondary treatment

Unit 2. Water line. Secondary treatment

- Conventional activated sludge
- Equipment and types of activated sludge processes
- Advanced treatments
- Biofilm processes
- Purification in small towns

Unit 3. Water line. Tertiary treatment

- Sizing of a WWTP biorreactor for nitrogen elimination according to standard ATV A-131
- Qualities and uses of reclaimed water
- Regeneration technologies
- Filtration
- Disinfection

Unit 4. Sludge and gas lines

- Sludge
- Thickening
- Stabilization
- Dehydration
- Gas line

MODULE VII: ELECTROMECHANICAL EQUIPMENT AT WATER TREATMENT PLANTS

Unit 1. Pumping and isolation systems

- Types of pumps used in water treatment plants
- Submersible pumps
- Surface or dry-pit centrifugal pumps
- Surface or dry-pit screw pumps
- Isolation systems (valves)

Unit 2. Solids separation systems

- Pretreatment in water treatment plants
- Equipment in grit – Grease traps
- Equipment in clarifiers and thickeners
- Anaerobic sludge digestion equipment
- Sludge dewatering equipment (filter presses, belt presses, and centrifuges)

Unit 3. Mixing and aeration systems

- Mixing and aeration in biological reactors
- Mixing of coagulation and flocculation tanks and preparation of the chemicals used
- Air generating equipment (blowers and turbo blowers)
- Coarse and fine bubble aeration
- Types of chemicals and storage systems

Unit 4. Instrumentation and control

- Flow and level measurement
- Pressure measurement and water analysis
- Control processes (automation)
- SCADA control system (I)
- SCADA control system (II)

MODULE VIII: SUSTAINABLE URBAN DRAINAGE SYSTEMS

Unit 1. Rainfall management through SUDS

- Concept and implications of sustainable drainage
- Multidisciplinary design
- Environmental assesment
- Flood risk management
- Non-structural measures

Unit 2. Control at source: collection and transport

- Hydraulics for the design of SUDS
- Rainwater harvesting systems
- Green roofs and vertical gardens
- Filter strips and filter drains
- Vegetated swales

Unit 3. Infiltration systems

- Hydrology
- Bioretention systems
- Permeable surfaces
- Infiltration systems
- Citizen consultations

Unit 4. Storage and passive treatment systems

- Sustainable landscaping
- Detention basins
- Retention basins
- Constructed wetlands
- Integrated system design process

MODULE IX: NATURAL RISK ENGINEERING: DROUGHT AND FLOODS

UNIT 1 – Water resource assessment

- Hydrological balance
- Climatology
- Rainfall
- Evaporation and transpiration
- Geology and hydrology

UNIT 2 – Droughts

- Drought – Definition
- Ecological flow
- Underground water
- Special drought plans
- Special drought plan indicator systems

UNIT 3 – Floods

- Introduction and concepts
- Rainfall analysis
- Flood flow and flooding areas
- Flood risk management plans
- Emergency management

UNIT 4 – Engineering solutions for natural risk management

- Geomorphologic-historical analysis
- Flood exposure adaptation
- Conventional solutions
- Nature-based solutions
- Nature-based urban solutions

MASTER´S FINAL PROJECT

The program is subject to possible variations / updates of the contents to improve their quality

AUTHOR PROFILE

DIRECTOR: JORGE SÁNCHEZ DÍAZ

Raúl is a civil and territorial engineer specialized in transport and urban services. He holds a master's degree in civil engineering (Roads, canals, and ports), with a major in hydraulics by the Polytechnic University of Madrid (UPM). He has also completed training in water treatment process modeling.

Raul has worked for leading companies in the water sector. While at the I+D+i department at de Acciona Agua, he conducted wastewater treatment modeling projects to reduce nutrient discharge. Also, while working for INCLAM, he worked in fluvial hydraulics for flood risk management.

Presently, Raul works in the studies sub-directorate at Canal de Isabel II, more specifically in the strategic planning office, while collaborating with crosscutting research and projects related to the integral water cycle.

ALEJANDRO GIMÉNEZ ALVES

Raúl is a civil and territorial engineer specialized in transport and urban services. He holds a master's degree in civil engineering (Roads, canals, and ports), with a major in structures, geotechnics, construction, and materials by the Polytechnic University of Madrid (UPM).

He has worked as Head of Production at Copcisa in the building sector, where his work in fire safety and in the necessary adaptation of the sanitation network stood out.

Currently, he works at the Canal de Isabel II in the Inspection Area where he leads the network extension projects for new provisioning supplies and manages the inspection and water cutting personnel.

JUAN RAÚL RUIZ MÉNDEZ

Raúl is a civil and territorial engineer specialized in transport and urban services. He holds a master's degree in civil engineering (Roads, canals, and ports), with a major in transport by the Polytechnic

University of Madrid and the Politecnico de Torino (Italy), along with four specialization courses: in water purification, reuse and treatment.

Raul has also worked for the Chair of Port Operations developing economic-financial studies of seaport projects. Currently, he works at the Canal de Isabel II Sanitation and Reuse Projects Area, where he leads projects and collaborates in studies related to sanitation, purification and reuse of hydraulic infrastructures.

INÉS ERRAZURIZ

Inés is a Civil Engineer (Road, canals, and ports) with a specialty in hydraulics and energy by the Polytechnic University of Madrid and holds a master's degree in engineering and water management by the School of Industrial Organization. In addition, she has training in spatial databases (PostGIS) by the Polytechnic University of Valencia.

She has also worked as a flood risk specialist at INCLAM, conducting hydrological and hydraulic studies to assess structural measures to reduce flood risk. Currently, Ines works as a specialist in hydrology and hydraulics for climate change projects in the environment department of IDOM Consulting, Engineering and Architecture.

JANE GUERRERO

Jane Guerrero is an Ecologist from the Javeriana University of Bogotá-Colombia, with studies in Ecology, Biodiversity and Evolution from the University of Paris Sud France, and a master's degree in development and comprehensive territorial planning from the Natural History Museum of Paris, UNESCO. She has experience in disaster risk project management and Climate Change in both the public and private sector, also as a lecturer. Jane Guerrero is the co - author of "*Gestión ambiental territorial" (Territorial Environmental Planning)*. She is currently a member of the Risk Scenario Group at the Disaster Risk Management and Climate change District Institute in Bogota.

DIEGO FLORES

Diego Flores is a building specialist technician by the IFP Islas Filipinas. During the last 25 years, he has specialized in the design, construction, and commissioning of water treatment plants (wastewater treatment plants, water treatment plants and desalination plants).

He currently works as a process engineer at Acciona Agua after having spent the last 10 years in the construction and assembly phase of different water treatment plant projects around the world (Spain, Australia, Qatar, Saudi Arabia).

METHODOLOGY

At Structuralia, we apply a modern methodology adapted to the process of change we live in today. Our educational environment is based on an online learning system, that is, learning by observing, reflecting, and practicing with an organized and carefully programmed study pace, which comes along with the constant support from our team. Our learning solution is designed to facilitate learning at the student's own pace, with a uniform structure that includes continuous evaluations and practical exercises to reinforce knowledge.

Our program's calendar consists of 9 monthly modules, which are divided into 4 weekly teaching units. In addition, there are 3 months for the Master's Final Project (MFP). This structure may be adjusted depending on the innate complexities of the program.

Each of these units contain introductory videos on concepts, syllabus prepared by our experts (which can be viewed online or downloaded in PDF), and self-assessments. Some units may even have practical exercises or examples, if required by the expert. At the end of each module, there will be a compulsory exam in order to complete the module.

The Director will ask all students to complete a Master's project, in which they will apply everything they have learnt in the previous modules, to practical cases. Students will have 3 months to complete and submit the project, during which they will receive the support from the program's team.

Finally, you will receive the status reports from our team through regular follow-ups throughout the program.

EVALUATION

The assessment will be ongoing throughout the training program and will take into account not only the acquisition of knowledge, but also the development of skills and attitudes.

At the end of each monthly module, the student must answer a test-type exam on the online training platform, in addition to pose a variety of practical cases along the topics and optional unit test so as to achieve the maximum consolidation of technical concepts.

To obtain the degree it will be necessary to pass the assessable modules of the program.

DEGREE

Students who have visualized all the lessons, successfully passed the self-assessments and exams, and submitted the master's final project, will receive Structuralia's certificate and the title of Master of Professional Development by the Universidad Católica San Antonio de Murcia (UCAM), in digital format.

Likewise, the student can request a certificate of completion of his/her master's degree, or a certificate of completion from Structuralia.

The student may also request a the Hague Apostille on his/her certificate of completion from the university an additional fee.