

**MSc EuroAqueae HydroInformatics and Water Management  
EuroAqueae**

**Year 1 Semester 1 (Basic Skills Aquisition)**

**Location: UNSA / BTUC / UPC**

**UNSA/BTUC.UPC**

**Study Period: Mid-Sep to End-Jan**

Year 1 Sem 1	Module Title	Brief Description	ECTS
Module 1.1	Mathematics & Physics &	The participants receive a refresher course on mathematics and physics used in water engineering and Hydroinformatics (numerical and computer methods). Mathematics covers statistics applied in hydrology (Cf. extreme values). Physics is focused on fluid mechanics.	6
Module 1.2	Hydrology & Hydraulics &	The module gives to the participants the basic principles of hydrology and free-surface hydraulics. The presentation covers concepts, methods and tools used in engineering activities. Subjects are hydrological cycle, precipitations measurement and analysis, evaporation analysis, rainfall-runoff analysis, physical properties of water, hydrostatics, basic hydrodynamics, uniform flow in channels and pipes, steady-state, non-uniform and unsteady flow concept.	6
Module 1.3	Introduction to water and aquatic environment management	The module presents the water issues in the world, such as floods, draughts, sanitation, water supply, irrigation. Lectures are focused on the operational management of the aquatic environments and the key role of Hydroinformatics. The module covers ecological, physical, chemical and biological aspects of aquatic environments and the related artificial infrastructure/constructions.	6
Module 1.4	Computer skills, databases & GIS - ICT &	The module provides basic skills in operating computer resources in networks, in one programming language, in databases management and in Geographical Information Systems (GIS) Technology. The participants receive an introduction into modern ICT and the position of ICT in engineering activities related to the water field. Exercises are mainly focusing on simple programming examples and GIS application for water related problems.	6
Module 1.5	Web-based collaborative engineering	The course introduces the use and practice of Web-services and software for collaborating engineering and communicating over the Internet. Participants from all places have to collaborate over the Net on a given engineering exercise within small mixed groups. The intention is to familiarise with the medium Internet and establish virtual contacts between the participants who will later meet in the 2nd semester face to face. Students are supposed to acquire skills of working in an heterogeneous multi-cultural environment. The module is technically coordinated by our partner the Technical University of Cottbus (Germany).	4
Module 1.6	European Language I skills (French)	Basic/Intermediate French language training (depending on student level). The validation is obtained through oral and written assessment.	2

**MSc EuroAqueae HydroInformatics and Water Management  
EuroAqueae**

Year 1 Semester 2 (Hydroinformatics )

Location: NU

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Study Period: Beginning Feb to End-May

Year 1 Sem 2	Module Title	Brief Description	ECTS
Module 2.1	Hydroinformatics & Integrated River Basin Management &	The module presents the context of different environments such as urban areas, catchments, coastal zones. According to these specific situations, the course gives a methodology to identify the type of Hydroinformatics methods and tools. The course provides a global vision of computer based decision support systems that are widely used into offices of engineers, water authorities, national bodies and international agencies. The module underlines the major issues on sustainable water management, the water policies and strategies of management.	5
Module 2.2	Numerical methods & computational hydraulics &	The module provides introduction, through theory and practice, to numerical methods applied generally to the water field and especially to computational hydraulics. The course is based on introduction to differential equations in fluid mechanics for free-surface flow and transport system used for unsteady flows simulation. The module presents in details and through exercises the most widely used approaches such as method of characteristics, finite differences and finite elements.	5
Module 2.3	Introduction to software packages / Modelling of Floods /	The module offers to the participants to use and to apply through case studies the major modelling packages for hydrological catchments modelling, 1D and 2D free surface flows in continental and marine environments. The proposed tools are issued and developed by the most advanced professional and scientific producers such as Danish Hydraulic Institute (DK), Electricité de France EDF (F), Deltares (NL), Wallingford Software (UK), Halcrow (UK) DHI-WASY (DE). The purpose for the participants is to have an extensive knowledge and practice of the modelling procedures with the different packages for the modelling of floods.  Danish Hydraulic Institute (DK), Electricité de France EDF (F), Deltares (NL), Wallingford Software (UK), Halcrow (UK) DHI-WASY (DE)	5
Module 2.4	Software engineering / Hydroinformatics Systems Development /	The module presents the main concepts of software engineering based on modern ICT. Knowledge on programming and Web-technologies are complemented. Introduction is given to computational environments such as Internet, clusters, parallel computing etc. as well as the design, implementation and set-up of water related Web services.	5
Module 2.5	Climate Change: vulnerability, impacts and adaptation	This module addresses the risks and likely impacts of climate change in the human, natural and built environments, covering key aspects such as water resources, flooding, sea level rise and coasts, health, transport, infrastructure and cities. Engineering strategies for adaptation are described in detail, so the participant can learn not just how climate change will impact society, but also how society can respond. Participants are well equipped to assess, propose and apply sustainable strategies in a range of key infrastructures and environmental settings.	5
Module 2.6	European Language skills (English) - Thesis writing -	The module is focused on thesis writing (MSc thesis) in English and includes also a communication part (oral and written activities with multimedia devices and tools) focused on thesis defence. On completion of this module, the participant acquires essential skills which are compulsory into future professional activities and positions in multi-cultural environment.	5

Remark: During Semester 2, each participant identifies and confirms a specialisation for Semester 3.

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Year 2 Sem 1	Content	Brief Description	ECTS
Module 3.1	Modelling methods for urban waters (sewage network, floods and waste waters)	The module is focused on the context and the nature of modelling in the urban environment. The participant acquires the exhaustive knowledge about hydroinformatics methods and tools (variety of modelling systems: physically based, data driven, lumped modeling) available to cover the urban problems such as sewage network, definition, optimization and management, urban flooding or waste water management.	5
Module 3.2	Methods for water supply and waste waters treatment	The module presents the main methodologies and techniques applied for the water supply and the waste waters treatments. The participants acquire theoretical knowledge about the different technical solutions. Through case studies and examples, they are trained to define and manage operational solutions in various situations. The course includes a wide use of optimization methods for technical and economic purposes as well.	3
Module 3.3	Economical and legal environments - Water industry & municipalities	The module covers legal frameworks for the development and the protection of water resources and water services, the development of policies, laws and standard (CE European Water Framework Directive), the socio-economics system components with major concepts as subsidiary principle, deregulation, free market and competition of interest. The relationships and strategies between water industry and municipality are developed and analysed according to the rules of the water market. The module could also be taught as e-learning activity for all partners.	5
Module 3.4	Project Management & Communication	The Project Management (PM) techniques as planning, task hierarchy, decision making and financial awareness are essential for the development of project in urban environment. The module is focused on the acquisition of the Project Management applied to generic projects as water supply, sewage network, waste water management and flood protection. The module includes the needs of communication related to such projects in relation with social, professional, economic and cultural urban environments.	5
Module 3.5	European Language II skills (French)		

Year 2 Sem 1	Content	Brief Description	ECTS
Module 3.1	Numerical simulation: free surface and groundwater modelling	Water resources depend on groundwater and free surface flow. Description of free surface and groundwater flow processes are given in terms of differential equations and common numerical schemes. Aspects of integration of small to large scale processes are discussed and principles for coupling of software for interacting processes presented.	6
Module 3.2	Information and process modelling in hydroengineering projects.	Information modelling for Hydroinformatics systems in water related projects based on the object oriented modelling technique (Object UML and implementation techniques) is introduced. Meta Data and information management strategies are presented. Basic mathematics of theory of sets and graphs are presented and applied for process modelling in projects. Examples are modelled taken from flood management and coastal engineering projects.	3
Module 3.3	Geometric modelling and presentation methods	Mathematical background for modelling geometry in the context of numerical grid generation and presentation of physics in Web environment are taught. Small examples are implemented and exercises with commercial software run. Attention is given to impact of discretisation to correct representation of physical processes.	3
Module 3.4	Monitoring, data acquisition and documentation	Sustainable water resources management demands for monitoring by data acquisition in the field and laboratory as well as simulation by computer models. Concepts of monitoring and data acquisition are presented and mathematical concepts (linear analysis, set theory) for handling mass data from field measurement and numerical simulation introduced. Implementation into Hydroinformatics Systems by object-oriented approaches to support information analysis, visualization, documentation and archiving are shown. Approaches are taught in the view of Web-based technology and coupling standard software tools by generalised information bases.	6

Year 2 Sem 1	Content	Brief Description	ECTS
Module 3.1	Artificial neural network for Decision Support Systems (DSS)	In this module the basis and the technology associated to the use of neural networks is presented. The module is oriented to the definition of Decision Support Systems (DSS) in terms of the minimum set of variables used to take the appropriated decisions in terms of risk/vulnerability derived from real conditions in hydraulic systems: floods in river basins, urban areas or others.	3
Module 3.2	Flood risk concepts and application in river basin management	This module is oriented to define the risk criteria and application to determine in real scenarios a risk map associated to a flood event predicted or estimated. The module focuses on the use of DTM information, hydraulic tools (numerical models in 1D and 2D), and the definition of risk database criteria that can be customized or adapted to any specific situation, and the use of decision support systems trained with the hydraulic tools presented before.	5
Module 3.3	DSS for flood risk in urban areas	The specificity of this small basins where the floods goes through a street networks, with a collecting system constituted by a set of street inlets and the risk associated to the pedestrians and urban components (houses, urban infrastructures, cars, shops, etc) is addressed. In this module the topics are concentrated in the runoff and flow process in urban area along the streets, the hydraulic analysis of sewer systems and the global risk problem associated to these concepts.	5
Module 3.4	Real time control and operation of irrigation canals, rivers and reservoirs	This module is oriented to the global management of the irrigation infrastructures. The key problem is to manage all the control gates along the canal, rivers and reservoirs in order to supply the water volumes demanded by the farmers at the right instant and in the desired quantities. This can be done in terms of a real time control process, first defining the trajectories of the control gates according to the initially desired discharges, and finally in real time, in case of modifications/perturbations produced during the control process. Open Channel hydraulics, system dynamics and control theory are used in this module.	5

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Module 4.1 (Option 1)	Research & development project & (Coordination by BTUC)	<p>The definition of the master work in the research area is made in dialogue between the student, a mentor from the host institution of semester 4 - and possibly with an academic tutor from a third country - and an external partner of the water field (industrial, consulting company, public services...).</p> <p>The research project is carried out in the research environment of the consortium members.</p> <p>For the participants hosted by NU for semester 1, the institution for the module must be different from NU. The work is concluded by a thesis dissertation with defence involving at least representatives from 2 European institutions. The operational organization of this module is ensured by BTUC and with the full participation of all the consortium members. The validation of the module provides 30 ECTS.</p> <p style="text-align: center;">NU BTUC 30ECTS</p>	30
Module 4.1 (Option 2)	Professional practice (Coordination by UNSA)	<p>Following the 4 thematic specialisations developed in semester 3 or oriented through fundamental topics</p> <p>The professional practice is carried out into a company or public service (external partner / associated partner), on a specific project defined in cooperation between the student, a mentor from the home institution, a supervisor from the host institution (UNSA) and a mentor from the external partner (public service or private structure). The project carried out by the student takes part of the regular activities of the company or public service. This professional internship is considered for the student as a first professional experience as executive or project engineer in Hydroinformatics. The evaluation and the validation of the module are carried out mainly through professional criteria. The work is concluded by a portfolio which presents a description of the work done in the project and an in-depth review of at least one associated topic and details of the lessons learned. The professional practice is achieved in a European company or a European public service. The operational organization of this module is made by UNS and with the full participation of all the consortium members. The validation of the module provides 30 ECTS.</p> <p style="text-align: center;">UNSA UNSA 30 ECTS</p>	30