Co-funded by the
Erasmus+ Programme
of the European Union

SWARM UNIQUE SET OF COURSES

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

University of Nis

PROJECT INFO

Project title	Strengthening of master curricula in water resources management for the Western Balkans HEIs and stakeholders
Project acronym	SWARM
Project reference number	597888-EPP-1-2018-1-RS-EPPKA2-CBHE-JP
Funding scheme	Erasmus+ Capacity building in the field of higher education
Web address	www.swarm.ni.ac.rs
Coordination institution	University of Nis
Project duration	15 November 2018 – 14 November 2021

DOCUMENT CONTROL SHEET

Work package	WP2 Development of competence-based curricula aligned with EU trends
Ref. no and title of activity	A2.2 Development of courses content and syllabi
Title of deliverable	SWARM unique set of courses
Lead institution	Aristotle University of Thessaloniki
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Document status	Draft
Document version and date	v05, 08/10/2020
Dissemination level	International

VERSIONING AND CONTRIBUTION HISTORY

Version	Date	Revision description	Partner responsible
v.01	01/11/2019	Document created	AUTh, UNI, UNSA, UNS, UNMO, TCASU, UoM, UPKM
v.02	21/11/2019	Updated version	AUTh, UNI, UNSA, UNS, UNMO, TCASU, UoM, UPKM

v.03	01/12/2019	Updated version	AUTh, UNI, UNSA, UNS, UNMO, TCASU, UoM, UPKM
v.04	12/01/2020	Final version	AUTh, UNI, UNSA, UNS, UNMO, TCASU, UoM, UPKM
v.05	8/10/2020	Final version after inclusion of the external evaluator comments	AUTh, UNI, UNSA, UNS, UNMO, TCASU, UoM, UPKM

Contents

List of abbreviations

AUTh	Aristotle University of Thessaloniki
BOKU	University of Natural Resources and Life Sciences, Vienna
CBHE	Capacity Building in Higher Education
EACEA	Education, Audiovisual and Culture Executive Agency
EHEA	European Higher Education Area
EQF	European Qualification Framework
HE	Higher Education
HEI	Higher Education Institution
NEO	National Erasmus Office
NMBU	Norwegian University of Life Sciences, Norway
PWMC VV	Public Water Management Company ''Vode Vojvodine''
SWARM	Strengthening of master curricula in water resources management for the Western Balkans HEIs and stakeholders
UACEG	University of Architecture, Civil Engineering and Geodesy, Bulgaria
UNI	University of Nis, Serbia
UL	University of Lisbon, Portugal
UoM	University of Montenegro
UNIRIFCE	University of Rijeka, Croatia
UNMO	Dzemal Bijedic University of Mostar
UNS	University of Novi Sad
UNSA	University of Sarajevo
UPKM	University of Pristina in Kosovska Mitrovica
TCASU	Technical College of Applied Sciences Urosevac with temporary seat in Leposavic
WB	Western Balkan
WRM	Water Resources Management

1. Introduction

This document is a part of activity WP2.2 Development of courses content and syllabi created under the project SWARM "Strengthening of master curricula in water resources management for the Western Balkans HEIs and stakeholders" (Project number 597888-EPP-1-2018-1-RS-EPPKA2-CBHE-JP).

It summarizes and offers set of new and updated courses developed or modernized under the activity WP2.2 Development of courses content and syllabi.

In Table 1.1 the number of new and updated courses per curricula is presented.

Table 1.1 Number of new and updated courses per curricula

WB HEI	Undergraduate		Master	
	New courses	Upgrade/improve of existing courses	New courses	Upgrade/improve of existing courses
University of Pristina in Kosovska Mitrovica/ Faculty of Technical Sciences	3	1	2	
Technical College of Applied Sciences Urosevac-Leposavic			3	
University of Montenegro/ Faculty of Civil Engineering				4
University of Novi Sad/ Faculty of Technical Sciences			5	1
Dzemal Bijedic University of Mostar/ Faculty of Civil Engineering			1	2
University of Nis/ Faculty of Civil Engineering and Architecture	4		2	
University of Sarajevo/ Faculty of Civil Engineering				4
TOTAL	7	1	13	11

1.1 Methodology for the SWARM competence-based curricula development

The heterogeneous team consisting of stakeholders such as curriculum developers, teachers, educational managers, and WRM field experts analysed and collected information about the competences within the WRM domain, and identified the competencies that students should acquire.

The competencies presented in the Catalogue of competencies (result of activity A2.1) were obtained as a result of researching the existing water sector competence models and job profiles. A competence profile has important implications, since it constitutes the basis of a competence-based curriculum.

The methodology for competence-based curriculum development consisting of six phases was applied: 1) Conceptualisation; 2) Planning; 3) Data collection; 4) Data analysis and Creation of the catalogue of competences; 5) Development of competence-based curriculum, and 6) Development of applications. The methodology needs continuous improvement through the consideration of the university strategic plans. It is based on the intensive research and needs analysis of the university's competence-based curriculum development.

Conceptualisation included analyses of current state in the water sector in the WB countries (WP1.1 Report on WB regional issues related to WRM) and analyses of existing curricula in both EU and WB partner countries (WP1.2 Report on master curricula related to WRM in EU and WB partner countries) as well as adequate analyses of water sector needs (WP3.2 Report on analyse of water sector needs for LLL courses in WB).

Planning included working meetings with the key staff at the WB HEIs in order to develop plan and timeline as well se identification of needed people for the team per each WB HEI that should develop new or modernized existing curricula. Also, roles and responsibilities were defined in order to develop curricula and receive the final decisions made by different HE bodies.

Data collection included definition of questionnaire in activity A3.2 to receive information related to the current state in the water sector as well as water sector models analysis.

Data analysis and Creation of the catalogue of competences included analyses of obtained information and creation of catalogue of competences (WP2.1 Catalogue of competences) tailored to a certain WB university study programme. It should be noted that delivering competences to learning objectives/outcomes starts with a catalogue of competences.

Development of competence-based curriculum included matching competences and learning objectives/outcomes, conducting course design, developing of learning activities, assessment and knowledge resources. This phase involved all partners during joint coordination meetings in order to discuss and review draft versions of developed curricula.

Development of applications included establishment of teaching and learning technological infrastructure realised through the activities A1.4 and A2.6 (WP1.4 Report on needed resources for harmonization of WB laboratory and WP2.6 Report on purchased laboratory equipment and software).

After development of the SWARM unique set of courses and their selection and insertion in each WB HEI university study programme, they will be accepted by WB HEI bodies and accredited by

adequate national agencies for performing accreditation (if it is needed) – activity A2.4 Accreditation of master curricula. The next steps will be implementation of developed curricula through activity A4.2 Implementation of developed master curricula and their evaluation and improvement through activity A4.3 Self-evaluation of master curricula.

In order to get unified views, it is important to give some widely accepted definitions of terms that will be more likely than others to appear during continuation of work on the courses and curricula development, which is part of a general European Qualification Framework (EQF):

Qualification means the formal name for the result of a process of assessment and validation, which is obtained when a competent body determines that an individual has achieved learning outcomes to the standards laid down.

Learning outcomes are statements of what learning pupil / student / person knows, understands and can perform, based on the completion of the learning process, defined by knowledge, skill and competence.

Knowledge means the result of the adoption of information through the learning process. Knowledge is a set of facts, principles, theories and practices related to area of work or study. In the context of the EQF for lifelong learning knowledge is described as theoretical and / or factual.

Skills are the ability to apply knowledge and use the principle of "know how" to perform a specific task and to solve the problem. In the context of the EQF, skills are defined as cognitive (involving the use of logical, intuitive and creative thinking), practical (including physical skill and use of methods, materials, devices and instruments) and social skills (communication and cooperation skills, emotional intelligence and other).

Competence means the ability to apply knowledge, skills and personal, social and methodological skills in the workplace or during learning, as well as in personal and professional development. In the context of the EQF competences are described as responsibility and independence.

1.2 Matching matrix

In order to perform a gap analysis, a matching matrix (Table 1.2) for curricula is developed. In the columns all courses (subjects) of the degree program are listed, while in the rows the desired competences are shown. All courses taught in a program are matched with those competences graduates should have when they finish their studies. In the process of inventarisation of the current curriculum is necessary to translate the traditional learning objectives to the competences (see section 2 of the Catalogue of competences for more details).

Table 1.2 Matching matrix between competences and courses

Courses/Competences	**$Course_1$**	**$Course_2$**	**…**	**$Course_N$**
$Competence_1$				
$Competence_2$				
…				
$Competence_M$				

The filled matrix is a basis for defining recommendations for curriculum redesigning.

2. University of Nis

2.1 Undergraduate academic study programme

2.1.1 Hydrotechnical Facilities

UNIVERSITY OF NIŠ		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering and Architecture

GENERAL INFORMATION	
Study program	Project management
Study Module (if applicable)	
Course title	Hydrotechnical Facilities
Level of study	Bachelor
Type of course	Mandatory
Semester	Autumn
Year of study	3rd
Number of ECTS allocated	5
Name of lecturer/lecturers	Milica Marković, Jelena Marković-Branković
Teaching mode	Classes are conducted interactively in the form of lectures, classroom, laboratory and computer exercises. The lectures present the theoretical part of the material, accompanied by characteristic examples for easier understanding of the material. In the auditory exercises, characteristic tasks are done and the presented material is deepened. In addition to lectures and exercises, consultations are regularly held. Part of the material, which forms a logical whole, can be taken during the teaching process through a colloquium. Colloquia are taken in writing and in the form of a test.

PURPOSE AND OVERVIEW (max. 5 sentences)
Introducing students with the preparatory work for planning, design and construction management for hydrotechnical facilities.

Students' ability to participate in the design and construction management of hydrotechnical facilities.
SYLLABUS (brief outline and summary of topics, max. 10 sentences)
Hydrotechnical facilities, division and specificity, action of water on hydrotechnical facilities. Building materials, static and dynamic water pressure and the influence of seismicity, waves, ice action, and safety of sliding, overturning, and floating. Instability of the facility due to disturbance of the soil structure under the facility, buoyancy, measures to reduce buoyancy. Impacts on objects in the zone of action of surface and groundwater. Hydrotechnical systems, their specificity and management. Independent work of students; homework, processing and presentation of a given topic in the field of design.
LANGUAGE OF INSTRUCTION
Serbian (complete course)
ASSESSMENT METHODS AND CRITERIA

Pre exam duties	Points	Final exam	Points
Activity during lectures		Written examination	40
Practical teaching	10	Oral examination	30
Teaching colloquia	20	OVERALL SUM	100
*Final examination mark is formed in accordance with the Institutional documents			

2.1.2 Water energy management

UNIVERSITY OF NIŠ		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering and Architecture

GENERAL INFORMATION	
Study program	Project management
Study Module (if applicable)	
Course title	Water energy management
Level of study	Bachelor

Type of course	Elective
Semester	Autumn
Year of study	3rd
Number of ECTS allocated	5
Name of lecturer/lecturers	Jelena Marković-Branković
Teaching mode	Classroom lectures with the help of presentation technology. Methodological units are accompanied by appropriate descriptive or computational examples or real-life examples from practice. Exercise classes begin with short explanations, and then students do the tasks individually. Consultations.

PURPOSE AND OVERVIEW (max. 5 sentences)

Mastering the basic principles on which water energy management is based.
Acquired knowledge in the field of water energy management principles.

SYLLABUS (brief outline and summary of topics, max. 10 sentences)

Introduction. Origin and characteristics of water energy. History of water energy use. Research in the field of renewable energy sources. Converting water energy into electricity. Formation of water energy drops in the cross section of the river flow. Accumulation lakes. Hydropower plants. The role of water energy in the energy system. Energy system control. Water energy and the environment. Forms and units of measure for strength and energy. Hydropower potential of river flow. Calculation of linear hydropower potential. Hydropower solutions for the use of water power. Energy parameters of hydropower plants. Types of turbines. Criteria for selecting the type of turbine. Mini hydropower plants.

Computational and design exercises in the areas listed in the theoretical classes.

LANGUAGE OF INSTRUCTION

Serbian (complete course)

ASSESSMENT METHODS AND CRITERIA

Pre exam duties	Points	Final exam	points
Activity during lectures		Written examination	40
Practical teaching	10	Oral examination	30
Teaching colloquia	20	OVERALL SUM	100

*Final examination mark is formed in accordance with the Institutional documents

2.1.3 Water Supply and Sewerage of Buildings

UNIVERSITY OF NIŠ		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering and Architecture

GENERAL INFORMATION	
Study program	**Project management**
Study Module (if applicable)	
Course title	Water Supply and Sewerage of Buildings
Level of study	Bachelor
Type of course	Elective
Semester	Autumn
Year of study	4th
Number of ECTS allocated	5
Name of lecturer/lecturers	Dragan Milićević, Milica Marković
Teaching mode	Lectures, practical computer work, seminar papers, consultations.

PURPOSE AND OVERVIEW (max. 5 sentences)

Expected acquisition of necessary knowledge for independent solving of professional problems in the field of water supply and sewerage of buildings.
Acquired necessary knowledge for independent solving of professional problems in the field of water supply and sewerage of buildings.

SYLLABUS (brief outline and summary of topics, max. 10 sentences)

Theoretical classes:
1. Introduction
Water needs and consumers. Basic concepts of water supply and sewerage systems of settlements. Relevant flows. Water supply sources and water receivers from the facility. Drinking water quality. Physical, chemical and bacteriological properties of drinking water. Disinfection of water and water supply facilities. Wastewater quality.
2. Materials for the construction of the water supply and sewerage network of buildings
Pipes, fittings and fittings. Plumbing fixtures and accessories.
3. Plumbing of buildings
Elements of the water supply network of the building. Design and calculation of building water supply network. Execution of building water supply network. Control of the constructed water

supply network and commissioning. Special cases and issues. 4. Sewerage of buildings Elements of the sewerage network of the facility. Design and calculation of building sewerage network. Construction of the sewer network of buildings. Control of the constructed sewerage network and commissioning. Special cases and issues. 5. Regulations, norms and standards in the field of water supply and sewerage of buildings Practical classes: Exercises, Other forms of teaching 1. Water needs and consumers. Basic concepts of water supply and sewerage systems of settlements. Relevant flows - Calculation exercises. Sources for water supply and water receivers from the facility - Calculation exercises. 2. Drinking water quality - Laboratory exercises. Physical and chemical properties of drinking water - Laboratory exercises. Bacteriological properties of drinking water - Laboratory exercises. Physical, chemical and bacteriological properties of drinking water - Calculation exercises. 3. Water supply of buildings - Development of partial tasks. Sewerage of buildings - Development of partial tasks. Design of water supply and sewerage network for a small residential building.
LANGUAGE OF INSTRUCTION
Serbian (complete course)
ASSESSMENT METHODS AND CRITERIA

Pre exam duties	Points	Final exam	Points
Activity during lectures	10	Written examination	25
Practical teaching	20	Oral examination	25
Teaching colloquia	20	OVERALL SUM	100
*Final examination mark is formed in accordance with the Institutional documents			

2.1.4 Municipal Hydrotechnics

UNIVERSITY OF NIŠ		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering and Architecture

GENERAL INFORMATION	
Study program	Project management
Study Module (if applicable)	

Course title	Municipal Hydrotechnics
Level of study	Bachelor
Type of course	Elective
Semester	Autumn
Year of study	4th
Number of ECTS allocated	5
Name of lecturer/lecturers	Dragan Milićević, Milica Marković
Teaching mode	Lectures, practical computer work, seminar papers, consultations.

PURPOSE AND OVERVIEW (max. 5 sentences)

Enabling students to independently solve professional problems in the field of water supply and sewerage of smaller settlements.
Ability of the student to use the acquired knowledge in solving engineering problems in the field of communal hydraulic engineering.

SYLLABUS (brief outline and summary of topics, max. 10 sentences)

Theoretical classes
1. Water supply of settlements
Sources for supplying settlements with water. Water intake facilities. Health care of springs. Water pumping and pushing. Pump stations and aggregates. Budget and choice. Water distribution in the settlement. Water supply network systems. Network design, calculation and execution. Buildings on the distribution network. Tanks.
2. Sewerage of settlements
Systems for acceptance and evacuation of waste and other waters from settlements. Quantities and quality of water. Water disposition. Canal network of settlements and facilities on it. Network design, calculation and execution. Channel network maintenance.
3. Water purification
Water purification needs. Basic operations in water purification. Schemes of compact plants for the preparation of drinking water and wastewater treatment of settlements.
Practical classes: Exercises
1. Relevant settlement water flows - Calculation exercises.
2. Development of a water supply project for a small settlement.
3. Development of a sewerage project for a small settlement.
4. Analysis of the influence of channel content on the receiver.

LANGUAGE OF INSTRUCTION

Serbian (complete course)

ASSESSMENT METHODS AND CRITERIA

Pre exam duties	Points	Final exam	Points

Activity during lectures	10	Written examination	30
Practical teaching	10	Oral examination	30
Teaching colloquia	20	OVERALL SUM	100
*Final examination mark is formed in accordance with the Institutional documents			

2.2 Master academic study programme

2.2.1 Water Resources Management

UNIVERSITY OF NIŠ		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering and Architecture

GENERAL INFORMATION	
Study program	**Project management**
Study Module (if applicable)	
Course title	Water Resources Management
Level of study	Master
Type of course	Elective
Semester	Autumn
Year of study	1st
Number of ECTS allocated	5
Name of lecturer/lecturers	Slaviša Trajković
Teaching mode	Lectures: Theoretical teaching, audiovisual means. Exercises: Making a seminar paper for students in the field of water management planning. Selection of the optimal alternative solution, for certain areas of water management, with the help of explanations and consultations with the associate and the teacher. Application of optimization methods

PURPOSE AND OVERVIEW (max. 5 sentences)
Mastering basic knowledge in the field of water management and water management planning. Introduction to water legislation in our country and in Europe. By implementing the program, students can gain basic knowledge about water management planning and water use, water protection and water protection, in the present and future, as well as to be able to implement legislation in the field of water.
SYLLABUS (brief outline and summary of topics, max. 10 sentences)
Theoretical classes 1. Global indicators of available water, water consumption and water demand. Water regimes,

indicators of spatial and temporal unevenness of available and required water resources in the basin.
2. Importance of planning in the field of water management
3. European Water Framework Directive.
4. Water management areas and branches. Water management postulates.
5. Water management systems, description and stages of their development. Single-purpose and multi-purpose water management systems. Features of water management systems.
6. Defining tasks of planning and management of water management systems. Water management objectives, criteria and constraints.
7. Mathematical modeling in water management system tasks
8. Basic principles and tasks of application of simulation models in the field of water management planning.
9. Simulation models for water management systems
10. Systematization of optimization methods for solving tasks of planning and management of water management systems.
11. Water management basis, structure and content, information systems within water management systems.
12. Socio-economic relations and legal regulations in Water Management.
Practical classes
During the semester, students work independently on two seminar papers. One from the field of water management planning, which is based on the selection of optimal solutions in the field of available water resources, water needs, and protection from water in the basin. The second refers to the implementation of legal regulations in our country and in Europe within the framework of planning.

LANGUAGE OF INSTRUCTION
Serbian (complete course)

ASSESSMENT METHODS AND CRITERIA			
Pre exam duties	Points	Final exam	Points
Activity during lectures	10	Written examination	
Practical teaching	60	Oral examination	30
Teaching colloquia		OVERALL SUM	100
*Final examination mark is formed in accordance with the Institutional documents			

2.2.2 Hydrological Risks Management

UNIVERSITY OF NIŠ		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering and Architecture

GENERAL INFORMATION	
Study program	Project management
Study Module (if applicable)	
Course title	Hydrological Risks Management
Level of study	Master
Type of course	Elective
Semester	Autumn
Year of study	1st
Number of ECTS allocated	4
Name of lecturer/lecturers	Borislava Blagojević, Milan Gocić
Teaching mode	Lectures; Exercises; Semester work

PURPOSE AND OVERVIEW (max. 5 sentences)

Introducing students to the main hydrological hazards (floods with external and internal waters and droughts) and the consequent risks. The aim of the course is to provide students with an overview of the main approaches to hydrological risk assessment and the main modeling techniques for its quantification.
The student is able to develop and lead projects of less complexity in the field of hydraulic engineering or water management using GIS software.

SYLLABUS (brief outline and summary of topics, max. 10 sentences)

Theoretical classes
Introduction to hydrology and flood risk; Main processes of the hydrological cycle; River runoff modeling; Definition of large waters and floods; Statistical methods for describing extreme events; Intensity-duration-return period curves; Flood risk models; Vulnerability assessment models; 1D and 2D hydraulic models; Simplified geo-morphological models; Structural and non-structural flood defense measures; Sensitivity assessment models; Exposure models; Flood generation; Flood risk analysis; Definition of drought; General principles of models and modeling for drought risk assessment.

Practical classes: Exercises Case study in the field of flood or drought risk management. Analysis of all aspects of hydrological risk. Presentations on specific applications: assessment of the consequences of failure in defense, reduction of exposure models, calculation of damage to buildings due to floods, models of assessment of drought on large areas, simple tools for assessing the distribution of extreme events.
LANGUAGE OF INSTRUCTION
Serbian (complete course)
ASSESSMENT METHODS AND CRITERIA

Pre exam duties	Points	Final exam	Points
Activity during lectures	10	Written examination	
Practical teaching	10	Oral examination	30
Teaching colloquia	50	OVERALL SUM	100
*Final examination mark is formed in accordance with the Institutional documents			

2.3 Link between competencies and courses

		Undergraduate Studies				Master Studies	
		Mandatory Courses	Elective Courses			Elective Courses	
		Hydrotechnical Facilities	Water energy management	Water Supply and Sewerage of Buildings	Municipal Hydrotechnics	Water Resources Management	Hydrological Risks Management
Generic Competencies	communicating, verbally and in writing, clearly and effectively	☒	☒	☒	☒	☒	☒
	critical thinking			☒		☒	☒
	scenario modeling	☒		☒	☒	☒	
	creativity		☒		☒	☒	☒
	initiative					☒	
	prediction of solutions and consequences	☒	☒	☒	☒	☒	☒
	collaboration	☒	☒	☒	☒	☒	☒
	working in multidisciplinary team	☒		☒	☒	☒	☒
	working autonomously	☒		☒			☒
	working in an international context						☒
	generating new research ideas	☒			☒	☒	
	intensive use of ICT in acquiring knowledge and solving problems	☒		☒	☒		☒
	solving complex multidisciplinary problems in theory and practice applying acquired knowledge	☒		☒	☒		
	social and civil responsibility	☒	☒			☒	☒
	development of professional ethics and responsibility	☒	☒	☒	☒	☒	☒
	effective leadership					☒	
	strategic thinking		☒			☒	
	experience-based critical decision making			☒	☒		
	staying up-to-date with technological development	☒		☒	☒	☒	
	knowledge transfer to the professional and wider public clearly and unambiguously					☒	
	applying knowledge in practice			☒		☒	☒
	retrieving, analyzing and		☒	☒			☒

	synthesizing data and information, with the use of necessary technologies						
	designing and managing projects			☒	☒		
	demonstrating social, professional and ethical commitment and sensitivity to gender issues						☒
	being critical and self-critical					☒	☒
	responding to written material critically, effectively and efficiently					☒	
Engineering Competencies	understanding the wider context of the engineering discipline, its practical applications, societal impact and limitations			☒	☒	☒	
	acceptance of the general principles and practices of engineering professional codes of conduct			☒			
	following general laboratory, workshop and/or fieldwork safety guidance and precautions			☒	☒		☒
	mastering of methods, procedures and processes of risk identification					☒	☒
	statistical data processing to define and derive adequate conclusions						☒
	understanding and using appropriate methods for research design regarding data collection and analysis, particularly focused on contemporary qualitative and quantitative methods, cognizant of the needs of special populations					☒	☒
	using appropriate engineering software packages as an aid to research, analysis, problem solving and presentation of results	☒	☒	☒	☒	☒	☒
	using computer systems to access learning resources, receive communications regarding the degree programme, undertake assessments and submit assignments	☒	☒	☒	☒	☒	☒

	preparing technical drawings by hand (following appropriate training)			☒	☒		
	producing sketches to communicate ideas and concepts			☒		☒	
	using appropriate equipment competently and safely (following appropriate training)	☒		☒	☒		
	forming logical, reasonable conclusions and make sound recommendations based on available data and/or observations			☒		☒	☒
	obtaining necessary data from scientific and technical documents, reports, and other reference materials	☒				☒	☒
	undertaking work with a high level of initiative and commitment to the task in hand					☒	
	preparing, processing, and interpreting data and/or observations using appropriate techniques						☒
	defining objectives for simple projects in a variety of engineering disciplines and developing and implementing basic work plans			☒	☒		
	drafting proposals, funding requests, and requests for proposals						
	defining information needs, including research needs , inventory, baseline studies, and follow-up monitoring						☒
	developing innovative solutions to complex or intractable issues			☒			
	using acquired theoretical and practical knowledge to solve new engineering problems			☒	☒	☒	
	presenting written technical reports to others and to make oral presentations that are reasoned, logical and time-limited, to a variety of audiences						
	presenting ideas, key facts, problem solutions			☒	☒	☒	☒

	and results effectively, both orally and in writing, in a variety of settings including group/team work						
WRM Competencies	understanding of climate changes, hydrological hazards and their effects on WRM		☒			☒	☒
	devising strategies and developing methodology and methods of emergency as part of WRM					☒	☒
	optimizing and managing available resources in WRM systems	☒	☒	☒	☒	☒	☒
	applying ICT in WRM	☒	☒	☒	☒	☒	☒
	development of human resources in WRM					☒	
	applying specialized civil engineering fields in WRM			☒			
	writing documents dealing with natural resource issues and technical information, drawn from a variety of sources					☒	
	understanding of the Water Framework Directive and its implementation processes					☒	
	using of mathematical models for the simulation of water related processes				☒	☒	☒
	understanding the environmental pricing concept with emphasis to the value of the water		☒	☒			
	understanding the hydrologic cycle, the various natural processes and the simulation methods.		☒			☒	☒
	defining the interaction of water with other sections, the water-energy-food-environment (WEFE) nexus approach		☒				
	obtaining knowledge on the EU legislation for the water resources		☒			☒	
	applying modern tools that facilitate the spatiotemporal management of the water resources. Geographic Information Systems (GIS) and WRM					☒	☒

	identification and analysis of problems in WRM					☒	
	holistic and proactive approach to WRM issues					☒	
	respecting natural environment		☒				☒
	identifying needs and priorities, including facilitation of group efforts to define and prioritize broad water resource program needs					☒	
	implementing water supply and water efficiency plans and programs			☒	☒		

3. University of Novi Sad

3.1 Master academic study programme

3.1.1 Environmental Practicum

Course:		**Environmental Practicum**		
ECTS credits:	7			
Course status:		Elective		
Number of classes (per week)				
Lectures:	Practice:	Other forms of classes:	Academic research:	Other:
3	0	3	0	0
Prerequisite courses:	None			

1. Educational objectives:

To introduce the basic parameters of waste streams (wastewater), to the students;

-To develop knowledge about technologies used in the treatment of wastewater, sludge and waste gasses;

-To train students in using software packages for simulation and optimization of waste streams treatment processes.

2. Educational outcomes (acquired knowledge):

After completing the course and passing the exam, the student will be able to:

-Define and interpret the basic parameters of waste streams (wastewater);

-Select and apply technologies in the treatment of wastewater, sludge and waste gasses;

-Use software packages for simulation and optimization of waste streams treatment processes.

3. Course content/structure:

The parameters of wastewater. Wastewater. Deposition. Coagulation. Flotation. Filtration. Aeration. Degassing. Disinfection. Membrane processes. Mechanisms of adsorption and application of adsorption in the wastewater treatment. Fixed bed adsorption processes. Biological wastewater treatment. Sludge. Methods for sludge thickening. Sludge conditioning. Sludge dehydration. Exhaust fumes. Gas-gas separation. Gas-solid separation. Software SuperPro Designer application in selected examples from practice.

4. Teaching methods:

Lectures, computer practice, field practice, study tours and individual consultations.

Knowledge evaluation (maximum number of points 100)					
Prerequisites	Mandatory	Points	Final examination	Mandatory	Points
Computer exercise attendance	Yes	5.00	Written part of the exam - tasks and theory	Yes	30.00
Project	Yes	50.00			
Lecture attendance	Yes	5.00			
Test	Yes	10.00			

Literature				
No.	Author	Title	Publisher	Year
1.	Šećerov-Sokolović, R., Sokolović, S.	Environmental Engineering	University of Novi Sad Faculty Technology	2002.
2.	Petrides, D.	Software SuperPro Designer, User"s Guide,	INTELLIGEN, INC.	2007.
3.	Radonić J., Turk Sekulić M., Vojinović Miloradov, M.	SuperPro Designer, Script	McGraw Hill, New York	2017.
4.	Davis, M.L., Masten, S.J.	Principles of Environmental Engineering and Science	McGraw-Hill, New York	2004.
5.	E. Worch	Adsorption Technology in Water Treatment,	Walter de Gryter GmbH & Co. KG	2012.
6.	Hendricks D.W.	Water treatment unit processes: physical and chemical	CRC press	2006.
7.	Metcalf & Eddy / Aecom	Wastewater engineering : Treatment and Resource Recovery	McGraw Hill, New York	2014.

3.1.2 Groundwater Flow

Course:	Groundwater Flow
ECTS credits: 7	
Course status:	Elective

Number of classes (per week)				
Lectures:	Practice:	Other forms of classes:	Academic research:	Other:
3	2	1	0	0

Prerequisite courses:	None

1. Educational objectives:

Training students in fundamental areas for the acquisition of professional knowledge and practical application.

2. Educational outcomes (acquired knowledge):

The knowledge acquired is used as the basis for further development in specialized subjects.

3. Course content/structure:

Seepage underneath objects, flow net (system of flow and equipotential lines). Hydraulic instability of porous media. Unsteady flow towards a single well. Specific yield of aquifers. Operating range of the well. The impact of boundaries and boundary conditions on the effects of water extraction. Data processing for test and exploitation pumping. Problems of designing and exploitation of wells. Phenomena and processes that reduce the abundance of the wells. The choice of filter characteristics and the filling openings of the filter. Lowering of groundwater for the purpose of construction of buildings (construction pit). Problems with the construction of facilities in groundwater.

4. Teaching methods:

Classes are held in the form of interactive lectures, auditory, and computer exercises. Lectures present the theoretical part of the material accompanied by characteristic examples for easy understanding of the material. For auditory exercises are done characteristic tasks and deepens the exposed material. In addition to lectures and exercises, consultations are held regularly. Part of the material, which makes logical units, may be taken by tests during the teaching process. Exam score is based on: the presence of the lectures and exercises (auditory and computer), the success of colloquiums and written exam (combined tasks and theory).

Knowledge evaluation (maximum number of points 100)

Prerequisites	Mandatory	Points	Final examination	Mandatory	Points
Exercise attendance	Yes	5.00	Written part of the exam - tasks and theory	Yes	70.00
Graphic paper	Yes	20.00			
Lecture attendance	Yes	5.00			

Literature

No.	Author	Title	Publisher	Year
1.	Vuković,M., Soro,A.	Groundwater dynamics	Institute for Water Management "Jaroslav Černi" Belgrade	1984.
2.	Hajdin Georgije	Selected Groundwater Hydraulic Chapters	University of Belgrade, Civil Engineering	2008.
3.	Fabian, Đ., Budinski, Lj.	Groundwater	University of Novi Sad, Faculty of Technical Sciences	2017.

3.1.3 Alternative separation processes in water treatment

Course:	Alternative Separation Processes in Water Treatment
ECTS credits: 6	
Course status:	Mandatory

Number of classes (per week)

Lectures:	Practice:	Other forms of classes:	Academic research:	Other:
3	0	3	0	0

Prerequisite courses: None

1. Educational objectives:

Acquiring the necessary knowledge in the field of existing alternative and advanced separation processes in water treatment – Acquiring the necessary knowledge in the field of designing water treatment plants with alternative and advanced separation processes.

2. Educational outcomes (acquired knowledge):

After completing the course and passing the exam, the student will be able to: - Specify and understand advanced and alternative technological processes and operations that are nowadays applied in water treatment technology. - Implement alternative separation processes into a water treatment design solution.

3. Course content/structure:

Specific pollutants of water environments. Review of conventional and alternative separation processes. Removal of organic and inorganic pollutants by various alternative sorption processes. Alternative adsorbents. Operating modes of adsorbers. Reactor types. Improved membrane processes. Reverse osmosis. Electroflotation. Electrocoagulation. Electro-oxidation. Advanced oxidation processes. Phytoremediation. Photocatalytic degradation of organic pollutants. Advanced biological processes in water treatment. Phosphorus recycling from wastewater. Application of algae in water treatment. Floating wetland ecosystems. Different future perspectives of water treatment, remediation and recycling.

4. Teaching methods:

Lectures. Computing exercises that are based on specific practical problems solving and designing of the equipment for the separation of pollutants from wastewater. Students with supervision collaborate in the groups to design technical solutions for wastewater treatment plants with alternative treatment technologies; Individual and group consultations. During the semester, students are required to attend lectures and computing classes. After successfully realised examination prerequisites, students take the final exam in written (computing part) and oral form (theoretical part). Written part of the exam can be quarterly taken through the two colloquiums.

Knowledge evaluation (maximum number of points 100)

Prerequisites	Mandatory	Points	Final examination	Mandatory	Points
Exercise attendance	Yes	5.00	Written part of the exam - tasks and theory	Yes	40.00

Lecture attendance	Yes	5.00	Oral part of the exam	Yes	30.00
Project	Yes	20.00			
Test 1	No	20.00			
Test 2	No	20.00			

Literature

No.	Author	Title	Publisher	Year
1.	V.K. Gupta Imran Ali	Environmental Water - Advances in Treatment, Remediation and Recycling	Elsevier	2012.
2.	D. G. Rao, R. Senthilkumar, J. Anthony Byrne, S. Feroz	Wastewater Treatment: Advanced Processes and Technologies	IWA Publishing and CRC Press	2013.
3.	Metcalf & Eddy / Aecom	Wastewater Engineering : Treatment and Resource Recovery	McGraw-Hill, New York	2014.
4.	Degremont, Gilbert, ed.	Water Treatment Handbook. 6th Edition Vol. I and II.	John Wiley & Sons Inc.	2007.

3.1.4 Water Quality Management and Methods for Sediment Remediation

Course:	**Water Quality Management and Methods for Sediment Remediation**
ECTS credits: 6	
Course status:	Mandatory

Number of classes (per week)

Lectures:	Practice:	Other forms of classes:	Academic research:	Other:
3	**3**	0	0	0

Prerequisite courses: None

1. Educational objectives:

-Acquiring the necessary knowledge about the basic elements of natural, socio - economic and legal environment of water management;

-Acquiring knowledge and theoretical foundations of methods and techniques for monitoring the quality and status of surface and groundwater and remediation of sediment.

-Preparation of data and monitoring of water quality for the purpose of planning documents in the field of water management;

-Preparation for sediment remediation studies.

2. Educational outcomes (acquired knowledge):

After completing and mastering the material the student should:

-Develop ability to solve scientific research and professional tasks and problems in the field of water quality analysis and sediment remediation.

-Define the types of analytical methods and methods for data processing which are used for the assessment of water quality and sediment remediation;

-Define the methods used in order to develop plans and project documentation

3. Course content/structure:

Pressures on water quality and the impact on the composition of sediments in the aquatic environment. Legislation in the field of water quality and aquatic sediment quality. Theoretical basis and methods for water quality analysis and immobilization of organic and inorganic components in aquatic sediments. The application of techniques and methods for monitoring of water and sediment quality. Status of surface water, groundwater and sediment. Monitoring of water quality and aquatic sediment. Methods for sediment remediation. Measures and actions for improvement of water quality and aquatic sediment. Analysis of the main activities and objectives of water quality management plans and studies of sediment remediation.

4. Teaching methods:

Classes will be realized in the form of lectures, exercises and seminar work. In addition to lectures and exercises consultation are held regularly. Term papers are made by groups designated by the subject teacher, while research papers are auditory in terms of exercise. Each term paper consists of a theoretical and computational work that can be put down in writing during the semester. Students who did not pass both term papers must take the tests over the entire final exam. The oral exam is taken after passing the written exam and all examination prerequisites realized.

Knowledge evaluation (maximum number of points 100)

Prerequisites	Mandatory	Points	Final examination	Mandatory	Points
Exercise attendance	Yes	5.00	Written part of the exam - tasks and theory	Yes	40.00
Lecture attendance	Yes	5.00	Coloquium exam	No	20.00
Term paper	Yes	20.00	Coloquium exam	No	20.00
			Oral part of the exam	Yes	30.00

Literature

No.	Author	Title	Publisher	Year
1.	Dimkić Milan, Kovačević Srđan	Basic Principles of Water Management	University of Novi Sad, Faculty of Technical Sciences	2012.
2.	Dimkic A.Milan., Brauch Heinz-Jürgen, Kavanaugh Michael	Groundwater Management in Large River Basins	IWA Publishing London	2008.
3.	Daniel P. Loucks, Eelco van Beek	Water Resources Systems Planning and Management - an introduction to methods, models and applications	UNESCO Publishing	2005.
4.	Reible D. Danny.	Processes, Assessment and Remediation of Contaminated Sediments	Springer	2014.
5.	Edson Reis, Andrea Lodolo, Stanislav Miertus	Survey of sediment remediation technologies	International Centre for Science and High Technology	2007.

3.1.5 Open channel hydraulics

Course:	Open Channel Hydraulics
ECTS credits: 6	
Course status:	Mandatory

Number of classes (per week)

Lectures:	Practice:	Other forms of classes:	Academic research:	Other:
2	2	0	0	0

Prerequisite courses: None

1. Educational objectives:

Getting to know the basics of river hydraulics, sediment transport and river morphology. Application base on the practical aspects such as regulation works and measures.

2. Educational outcomes (acquired knowledge):

Acquired knowledge is used as a basis for further upgrading in professional courses.

3. Course content/structure:

Flow characteristics in open channels. Geomorphological characteristics of natural streams. Flow in open canals and streams of prismatic and non-prismatic cross sections. Uniform flow. Manning's equation. Velocity distribution, friction losses. Transition regimes flows and calculations on non-uniform flow in open channels and natural streams.

Origin and physical properties of sediments. Sediment transport. Bed load, suspended load and total load.

4. Teaching methods:

Teaching is performed interactively in the form of lectures, auditory and computer practice. Certain problems are solved through lectures, discussions and computer simulations. Lectures are accompanied with numerous real-life cases.

Knowledge evaluation (maximum number of points 100)

Prerequisites	Mandatory	Points	Final examination	Mandatory	Points
Graphic paper	Yes	25.00	Written part of the exam - tasks and theory	Yes	70.00
Lecture attendance	Yes	5.00			

Literature

No.	Author	Title	Publisher	Year
1.	Georgije Hajdin	Fluid Hydraulics - Basics	University of Belgrade, Faculty for Civil Engineering	2002.
2.	Miodrag Jovanović	River Regulation – River Hydraulics and Morphology	University of Belgrade, Faculty for Civil Engineering	2002.

3.	Muškatirović, D.	River Regulation	University of Belgrade, Faculty for Civil Engineering	1979.

3.1.6 Fundamentals in hydrotechnics, hydromechanics and geotechnics

Course:	Fundamentals in hydrotechnics, hydromechanics and geotechnics			
ECTS credits: 6				
Course status:	Elective			
Number of classes (per week)				
Lectures:	Practice:	Other forms of classes:	Academic research:	Other:
2	3	0	0	0
Prerequisite courses:	None			

1. Educational objectives:

Training students in fundamental areas in the field of hydrotechnics, hydromechanics and geotechnics basic principles and practical application.

2. Educational outcomes (acquired knowledge):

The acquired knowledge is used as the basis for further development in specialized subjects.

3. Course content/structure:

Fundamentals of hydrology and hydrometry.

Physical and chemical properties of liquids. Hydrostatics, piezometer, manometer, gauge, absolute, atmospheric and static pressure. Hydrostatic forces on plane and curved surfaces. Hydro-kinematics, flow velocity, acceleration, continuity equation, Steady flow, energy equation for ideal and real fluids. Application of Bernoulli's equation. Flow in pipes, friction and minor losses.

Steady flow in open channels. . Uniform free surface flow. Chezy - Manning equation. Non-uniform flow. Flow Profiles. Calculation of non-uniform flow.

Fundamentals of groundwater Flow, Darcy's Equation. Composition of the Earth and its crust. Petrogenic minerals and rocks. Physical, mechanical and technological properties of rocks. Tectonic activity, faults, folds and cracked rock masses. Applied Hydrogeology. Geological aspects of seismicity areas. Endogenous and exogenous geological processes, the conditions for their development and engineering activities to prevent their harmful effects. Principles and methods of geotechnical testing ground for various construction projects. Measures to improve the properties of the field. Testing of the field.

4. Teaching methods:

Classes are held in form of interactive lectures. Lectures present the theoretical part of the material accompanied by characteristic examples to facilitate understanding of the material. In addition to lectures regularly held of consultations. Presentations of the lectures are available in electronic form.

Part of the material, which seems logical units, may be taken in the course of the teaching process through tests. Colloquium shall be written in the form of the test.

Knowledge evaluation (maximum number of points 100)

Prerequisites	Mandatory	Points	Final examination	Mandatory	Points
Computer exercise defence	Yes	5.00	Final exam - part one	Yes	40.00
Homework	Yes	5.00			
Homework	Yes	5.00			
Lecture attendance	Yes	5.00	Final exam - part two	Yes	30.00
Test	Yes	10.00			
Test	Yes	10.00			

Literature

No.	Author	Title	Publisher	Year
1.	Hajdin, G.	Uvođenje u hidrauliku	Građevinski fakultet, Beograd	2002.
2.	Batinić R., Radojković M.	Stacionarno strujanje u otvorenim tokovima prizmatičnog preseka	Građevinski fakultet, Beograd	1973.
3.	Vasić Milinko	Inženjerska geologija	Fakultet tehničkih nauka, Novi Sad	2002.
4.	Maksimović Milan	Mehanika tla		2008.

3.2 Link between competencies and courses

		Master Studies					
		Mandatory Courses			Elective Courses		
		Alternative separation processes in water treatment	Water Quality Management and Methods for Sediment Remediation	Open channel hydraulics	Fundamentals in hydrotechnics, hydromechanics and geotechnics	Environmental Practicum	Ground water flow
Generic Competencies	communicating, verbally and in writing, clearly and effectively	☒	☒	☒	☒	☒	☒
	critical thinking	☒	☒			☒	☒
	scenario modeling			☒		☒	☒
	creativity	☒				☒	
	initiative	☒	☒			☒	
	prediction of solutions and consequences		☒				☒
	collaboration	☒	☒	☒	☒	☒	☒
	working in multidisciplinary team	☒	☒	☒	☒	☒	☒
	working autonomously		☒		☒		☒
	working in an international context		☒			☒	
	generating new research ideas	☒	☒			☒	☒
	intensive use of ICT in acquiring knowledge and solving problems			☒		☒	☒
	solving complex multidisciplinary problems in theory and practice applying acquired knowledge	☒	☒	☒		☒	
	social and civil responsibility					☒	☒
	development of professional ethics and responsibility				☒		☒
	effective leadership						
	strategic thinking		☒			☒	
	experience-based critical decision making	☒				☒	
	staying up-to-date with technological development	☒	☒	☒		☒	
	knowledge transfer to the professional and wider public clearly and unambiguously	☒	☒		☒	☒	☒
	applying knowledge in practice	☒	☒	☒		☒	☒
	retrieving, analyzing and synthesizing data and	☒	☒			☒	

	information, with the use of necessary technologies						
	designing and managing projects	☒	☒			☒	
	demonstrating social, professional and ethical commitment and sensitivity to gender issues						
	being critical and self-critical	☒	☒			☒	☒
	responding to written material critically, effectively and efficiently	☒	☒			☒	
Engineering Competencies	understanding the wider context of the engineering discipline, its practical applications, societal impact and limitations	☒	☒	☒		☒	☒
	acceptance of the general principles and practices of engineering professional codes of conduct		☒	☒			☒
	following general laboratory, workshop and/or fieldwork safety guidance and precautions	☒	☒	☒		☒	☒
	mastering of methods, procedures and processes of risk identification		☒			☒☒	
	statistical data processing to define and derive adequate conclusions		☒			☒	☒
	understanding and using appropriate methods for research design regarding data collection and analysis, particularly focused on contemporary qualitative and quantitative methods, cognizant of the needs of special populations	☒	☒			☒	☒
	using appropriate engineering software packages as an aid to research, analysis, problem solving and presentation of results		☒	☒		☒	☒
	using computer systems to access learning resources, receive communications regarding the degree programme, undertake assessments and submit assignments	☒	☒			☒	☒
	preparing technical						

	drawings by hand (following appropriate training)						
	producing sketches to communicate ideas and concepts						
	using appropriate equipment competently and safely (following appropriate training)	☒	☒				☒
	forming logical, reasonable conclusions and make sound recommendations based on available data and/or observations	☒	☒	☒		☒	☒
	obtaining necessary data from scientific and technical documents, reports, and other reference materials	☒	☒	☒		☒	☒
	undertaking work with a high level of initiative and commitment to the task in hand	☒				☒	
	preparing, processing, and interpreting data and/or observations using appropriate techniques		☒			☒	
	defining objectives for simple projects in a variety of engineering disciplines and developing and implementing basic work plans	☒	☒			☒	☒
	drafting proposals, funding requests, and requests for proposals						
	defining information needs, including research needs , inventory, baseline studies, and follow-up monitoring	☒	☒			☒	
	developing innovative solutions to complex or intractable issues	☒	☒			☒	
	using acquired theoretical and practical knowledge to solve new engineering problems	☒	☒	☒		☒	☒
	presenting written technical reports to others and to make oral presentations that are reasoned, logical and time-limited, to a variety of audiences						☒
	presenting ideas, key facts, problem solutions and results effectively,	☒					

	both orally and in writing, in a variety of settings including group/team work						
WRM Competencies	understanding of climate changes, hydrological hazards and their effects on WRM	☒	☒	☒	☒	☒	☒
	devising strategies and developing methodology and methods of emergency as part of WRM	☒					
	optimizing and managing available resources in WRM systems	☒	☒				☒
	applying ICT in WRM			☒		☒	☒
	development of human resources in WRM	☒	☒	☒	☒		☒
	applying specialized civil engineering fields in WRM		☒	☒	☒		
	writing documents dealing with natural resource issues and technical information, drawn from a variety of sources					☒	
	understanding of the Water Framework Directive and its implementation processes	☒				☒	☒
	using of mathematical models for the simulation of water related processes			☒	☒	☒	☒
	understanding the environmental pricing concept with emphasis to the value of the water		☒				☒
	understanding the hydrologic cycle, the various natural processes and the simulation methods.		☒	☒	☒	☒	☒
	defining the interaction of water with other sections, the water-energy-food-environment (WEFE) nexus approach					☒	
	obtaining knowledge on the EU legislation for the water resources		☒			☒	☒
	applying modern tools that facilitate the spatiotemporal management of the water resources. Geographic Information Systems (GIS) and WRM		☒				☒
	identification and analysis		☒			☒	☒

	of problems in WRM						
	holistic and proactive approach to WRM issues						
	respecting natural environment	☒	☒			☒	☒
	identifying needs and priorities, including facilitation of group efforts to define and prioritize broad water resource program needs		☒				
	implementing water supply and water efficiency plans and programs						☒

4. University of Sarajevo

4.1 Master academic study programme

4.1.1 Sewage Systems

Code:	Course name: Sewage Systems		
Cycle: II (M – H)	Year: 1	Semester: 2	ECTS: 5
Status: Obligatory		Total number of hours: 3+2	

Name of lecturer/lecturers	Suvada Šuvalija
Prerequisite for enrollment:	No
Course objective (s):	Acquisition of advanced knowledge on the principles of wastewater disposal of settlements and industry, and their importance in providing hygienic living conditions and protection of water from pollution. To acquaint students with the theoretical settings and rules of the profession, related to the planning, design and construction of various wastewater drainage systems from urban areas.
Thematic units:	Wastewater and its drainage systems - characteristics, types and selection of drainage methods. Relevant quantities of wastewater, hydraulic network calculation and application of mathematical model. Sewer network design - design criteria and tracing. Sewer collectors - type, installation, testing and selection. Equipping the sewer network. Wastewater drainage system facilities and their hydraulic calculation and dimensioning. Basics of wastewater discharge sizing. Guidelines for wastewater treatment. Presentation of sewage systems in project documentation. Internal and external road drainage. Measurement, operation, maintenance and management of sewage systems. Wastewater disposal as a part of water management and urban water system (UVS) - basics of integrated and sustainable wastewater management. New approaches in urban stormwater management.
Learning outcomes:	Knowledge: Enabling students to independently apply the acquired theoretical knowledge, ie writing technical reports, sizing and preparation of project drawings in all phases of development of various levels of project documentation. Skills: Enabling students for engineering activities of planning, design, construction and maintenance of drainage systems. Competences: Independent solving of engineering problems in the field of wastewater disposal
Teaching methods:	Lectures, exercises, research work, consultations, project or seminar paper
Knowledge assessment methods with assessment structure:	The exam is taken in writing during classes in two parts - the first and second partial exam. The final exam is conducted orally. In addition to the exam, students are required to do a seminar program. Scoring is done as follows: Partial written exams = 70 points; (written exam (35) consists of theoretical part (20) and task (15) - minimum 40% must be won for each part) Program = 20 points;

	Seminar = 10 points; If a student passes one part of a partial exam during classes, he / she takes a partial exam at the next exam that he / she did not pass. Students who do not pass any part during the classes take the exam in writing integrally, and their grade is formed: 50% of the points achieved during the classes + 50% of the points achieved at the final exam. For each of the above obligations, the student should achieve at least 55%, and then the sum of points is added and the final grade is formed according to the scale prescribed by the Law on Higher Education.
Literature:	Obligatory: Margeta J. Kanalizacija naselja, Građ. fak. Sveučilišta u Splitu, Split, 2009. Margeta J. Oborinske i otpadne vode: teret onečišćenja, mjere zaštite, Građ. fak. Sveučilišta u Splitu, Split, 2007. Additional: Despotović J. Kanalisanje kišnih voda. Građevinski fakultet Univ. u Beogradu, 2009. Ljubisavljević D., Đukić A., Babić B., Jovanović B. Komunalna hidrotehnika – Primeri iz teorije i prakse, Građ. fak. Univerziteta u Beogradu, 2001.

4.1.2 Water Protection I

Code:	Course name: Water protection I		
Cycle: II (M – H)	Year: 2	Semester: 3	ECTS: 5
Status: Obligatory		Total number of hours: 3+2	
Name of lecturer/lecturers	Emina Hadžić		
Prerequisite for enrollment:	No		
Course objective (s):	Acquiring basic knowledge about the characteristics of natural waters, changes in water quality, causes of changes, and activities, measures and plans for water protection. After completing the course, students will gain the ability to assess the impact of pollutants on the environment, forecasting the transport of pollutants, planning measures and activities in the protection of water resources.		
Thematic units:	Basic characteristics of water resources: Origin of water and development of scientific thought about water. Distribution and global amounts of water on the planet. Hydrological cycle. Water balance. Basic characteristics of water. Composition of natural waters. Water quality. Water quality change. Water regime. Basic characteristics of BiH water resources. Pressures on water resources: Water pollution and pollution-changes in water quality. Sources of water pollution. Division of pollution sources according to spatial coverage and method of discharge. Active and potential sources of pollution. Dilution and self-purification. Pre-pumping of water sources. Approach to water protection: Sustainable development - Concept, Dimensions and significance, Differences and advantages in relation to unsustainable,		

	Sustainable development and water resources. Control mechanisms. Effluent quality. Receivers and protection of aquatic ecosystems. Environmentally friendly flow. Water protection measures and procedures. Ways of groundwater remediation. Water protection planning: Basic principles of planning, control of pollution sources, basics of systemic approach to water resources protection, basic elements of water protection plan development. Mathematical models and their application in monitoring and forecasting the transport of pollutants in surface and groundwater and solving water protection problems. Water erosion. Calculation of soil loss due to water erosion (river sediment production). River sediment - formation, division, physical properties. Sediment quality Sediment initiation and movement mechanism. Sediment transport calculation (using conceptually different empirical equations). Morphological changes of the river bed. Modeling of sediment transport processes and morphological changes of the river bed.
Learning outcomes:	Knowledge: To enable students to independently apply theoretical and practical knowledge in order to prevent pollution, and preserve and improve the quality and quantity of water resources. Skills: Training students for engineering work in order to prevent pollution, and preserve and improve the quality and quantity of water resources Competencies: Solving engineering problems in the field of water protection in cooperation with other engineering professions.
Teaching methods:	Lectures, exercises, research work, consultations, project or seminar paper
Knowledge assessment methods with assessment structure:	The exam is taken in writing during classes in two parts - the first and second partial exam. The final exam is conducted orally. In addition to the exam, students are required to do homework (program, seminar, etc.). Scoring is done as follows: • Partial written exams = 50 points; • Programs I and II = 30 points; • Seminar paper = 20 points. If a student passes a part of a partial exam during classes, he / she takes a partial exam at the first final exam that he / she did not pass. Students who do not pass any part during the classes take the exam in writing integrally, and their grade is formed: 50% of points achieved during classes + 50% of points achieved in the final exam. For each of the above obligations, the student should achieve a minimum of 55%, and then the sum of points is added and the final grade is formed according to the scale prescribed by the Law on Higher Education. Cancellation of the exam: Students who have passed both parts, and are not satisfied with the result achieved in one part, can cancel it and take that part in the final exam.
Literature:	Obligatory: 1. Hadžić, E., 2013, Osnovi zaštite podzemnih voda u granularnim sredinama, Građevinski fakultet Sarajevo 2. Hadžić E., Bonacci O., 2019, Okolišno prihvatljivo upravljanje

	vodotocima, Građevinski fakultet Sarajevo Additional: 1. Bonacci, O.: Ekohidrologija, Građevinski fakultet Split 2003. 2. Tedeschi, S., 1996., Zaštita vodnih sustava i pročišćavanje otpadnih voda, Građevinski institut Zagreb, 3. Margeta, J., 1992., Osnove gospodarenja vodama, Građevinski fakultet Split, Split. 4. Leo Van Rijn, 2002. Principles of sediment transport in rivers, estuaries and coastal seas, Aqua Publications

4.1.3 Treatment of drinking water

Code:	Course name: Treatment of drinking water		
Cycle: II (M – H)	Year: 1	Semester: 1	Broj ECTS kredita: 6
Status: Obligatory		Total number of hours: 3+2	
Name of lecturer/lecturers	Suvada Šuvalija		
Prerequisite for enrollment:	No		
Course objective (s):	To acquaint students with the need for preparation of drinking water, hydraulic principles and mechanisms of various technologies, ie preparation processes, depending on the quality of the affected spring water. Introduce students to conventional and modern processing technologies. Introduce students to the principles of planning, design and construction of facilities and all equipment of the station / plant for the preparation of drinking water within the water supply system.		
Thematic units:	- Basically about water resources in the water supply system. - Introduction to the relevant legislation that considers the issues of water protection, categorization of springs, quality of drinking water, methods of laboratory testing of water ... - Water quality and human health - the need to prepare drinking water in the water supply system. Conventional and modern approaches and technologies for drinking water preparation. - Water treatment station in the water supply system - tasks, capacity, location selection, disposition of facilities, hydraulic analysis, basics of planning and design, control and management. - Hydraulic facilities and operations of preliminary, basic and additional preparation of drinking water. More details on the basic operations of water preparation - coagulation and flocculation, sedimentation, filtration and disinfection - theoretical foundations, functions, construction and types of facilities, sizing and problems of operation and management. - New trends in the selection of facilities, equipment, chemicals and project criteria. Fundamentals of mathematical modeling of drinking water preparation process.		
Learning outcomes:	Knowledge: To enable students to independently apply theoretical knowledge in planning, design, construction and maintenance of facilities and equipment of drinking water treatment plants,		

	Skills: Training students for engineering activities of planning, design, construction, control and management of drinking water treatment plant within the water supply system. Competencies: Solving engineering problems in the field of drinking water preparation in cooperation with other engineering professions.
Teaching methods:	Lectures, exercises, research work, consultations, project or seminar paper
Knowledge assessment methods with assessment structure:	The exam is taken in writing during classes in two parts - the first and second partial exam. The final exam is conducted orally. In addition to the exam, students are required to do homework (program, seminar, etc.). Scoring is done as follows: • Partial written exams = 80 points; • Tasks = 20 points; If a student passes a part of a partial exam during classes, he / she takes a partial exam at the first final exam that he / she did not pass. Students who do not pass any part during the classes take the exam in writing integrally, and their grade is formed: 50% of points achieved during classes + 50% of points achieved in the final exam. For each of the above obligations, the student should achieve at least 55%, and then the sum of points is added and the final grade is formed according to the scale prescribed by the Law on Higher Education. Cancellation of the exam: Students who have passed both parts, and are not satisfied with the result achieved in one part, can cancel it and take that part in the final exam.
Literature:	Obligatory: 1. Stanojević, M. Tretman pijaće vode. Građevinska knjiga d.o.o, Beograd, 2009. 2. Margeta J.Vodoopskrba naselja, Građ. fak. Sveučilišta u Splitu, Split, 2010. Additional: 3. Gulić, I. Kondicioniranje vode, HSGI, Zagreb, 2003. 4. Jusić S. Osnove modeliranja pripreme vode za piće-konvencionalno brzo filtriranje, Građevinski fakultet u Sarajevu, 2016

4.1.3 Integral Water Resources Management

Code:	Course name: Integral Water Resources Management		
Cycle: II (M – H)	Year: 1	Semester: 2	ECTS: 5
Status: Elective		Total number of hours: 3+2	
Name of lecturer/lecturers	Emina Hadžić, Suvada Šuvalija		
Prerequisite for enrollment:	No		
Course objective (s):	Due to the escalation of conflicts of interest in the field of water, problems of protection against harmful effects of water, increasing demand to increase the efficiency of water management systems, increasing the dangers to man and his environment due to water pollution, water management is becoming more complex and complex.		

	their planning, design and management. Since in these conditions the traditional methods of water management planning have become inapplicable, the aim of studying this subject is to master the basic techniques and methods of integrated water resources management.
Thematic units:	Basic concepts of water management: historical development. Integrated Water Resources Management - IUVR: The concept of integrated water resources management, Advantages, principles and implementation of IUVR. Strategies and principles. Water Framework Directive and current EU and BH legislation in the field of water protection. Implementation of water management, Water Management Basics and Plans. Consequences of urbanization and climate change on runoff and rainwater quality. Sustainable stormwater drainage and treatment systems. New approaches in the management of stormwater in urban areas and roads (SUDS-Sustainable (Urban) Drainage Systems' (SUDS), 'Low Impact Development' (LID) or 'Best Management Practices' (BMP), "Sponge" city, etc.) . Examples of application of these approaches in neighboring countries. General tendencies in water management development. Planning of water management systems: planning tasks; goals in water management planning; decision making; optimization and expert systems in the decision-making process. Optimization of water management systems: optimization tasks; systematization of methods; goal and constraint functions; the most commonly used system optimization methods. Simulation of water management systems: concept and tasks of simulation; formation of a simulation model; model verification. Management of water management systems: basic principles and tasks of management; criteria and constraints in management tasks. Economic analysis of water management systems: the concept of investment; making investment decisions; methods for making investment decisions. Water management systems and the environment: problems of environmental pollution; more significant ecological concepts; impacts of water management systems on the environment.
Learning outcomes:	Knowledge: To enable students to independently apply theoretical and practical knowledge for the purpose of integrated water management planning. Skills: Enabling students for engineering jobs to conduct research, calculations, analysis and conclusions related to water management planning. Competencies: Solving engineering problems in the field of optimization of water management systems in accordance with other engineering professions.
Teaching methods:	Lectures, exercises, research work, consultations, project or seminar paper
Knowledge assessment methods with assessment structure:	The exam is taken in writing during classes in two parts - the first and second partial exam. The final exam is conducted orally. In addition to the exam, students are required to do homework (program, seminar, etc.). Scoring is done as follows: • Partial written exams = 70 points; • Programs I and II = 30 points;

	If a student passes a part of a partial exam during classes, he / she takes a partial exam at the first final exam that he / she did not pass. Students who do not pass any part during the classes take the exam in writing integrally, and their grade is formed: 50% of points achieved during classes + 50% of points achieved in the final exam. For each of the above obligations, the student should achieve a minimum of 55%, and then the sum of points is added and the final grade is formed according to the scale prescribed by the Law on Higher Education. Cancellation of the exam: Students who have passed both parts, and are not satisfied with the result achieved in one part, can cancel it and take that part in the final exam.
Literature:	Obligatory: 1. Margeta, J.: Osnove gospodarenja vodama. GF Split, 1992. 2. Hrelja, H., 1996., Vodoprivredni sistemi, Svjetlost Sarajevo, 3. Hrelja,H., 1997.Optimizacija vodoprivrednih sistema - Zbirka riješenih problema, Svjetlost Sarajevo, 4. L. Jotte, G. Raspati, and K. Azrague (2017) Review of storm water management practices - Raport, SINTEF Building and Infrastructure, Trondheim, Norway Additional: 5. Đorđević,B., 1990., Vodoprivredni sistemi, Građevinska knjiga Beograd, 6. Opricović, S., 1986.,Višekriterijumska optimizacija, Naučna knjiga Beograd

4.2 Link between competencies and courses

		Master Studies			
		Mandatory Courses			
		Treatment of drinking water	Water protection I	Sewage Systems	Integral Water Resources Management
Generic Competencies	communicating, verbally and in writing, clearly and effectively	☒	☒	☒	☒
	critical thinking		☒	☒	☒
	scenario modeling	☒	☒	☒	☒
	creativity	☒	☒	☒	☒
	initiative		☒	☒	☒
	prediction of solutions and consequences	☒	☒	☒	☒
	collaboration	☒	☒	☒	☒
	working in multidisciplinary team		☒	☒	☒
	working autonomously	☒			
	working in an		☒	☒	☒

	international context				
	generating new research ideas		☒	☒	☒
	intensive use of ICT in acquiring knowledge and solving problems	☒	☒	☒	☒
	solving complex multidisciplinary problems in theory and practice applying acquired knowledge		☒	☒	☒
	social and civil responsibility	☒			
	development of professional ethics and responsibility				
	effective leadership				
	strategic thinking	☒	☒	☒	☒
	experience-based critical decision making		☒		
	staying up-to-date with technological development	☒	☒		
	knowledge transfer to the professional and wider public clearly and unambiguously				
	applying knowledge in practice		☒	☒	☒
	retrieving, analyzing and synthesizing data and information, with the use of necessary technologies	☒	☒	☒	
	designing and managing projects				☒
	demonstrating social, professional and ethical commitment and sensitivity to gender issues				
	being critical and self-critical				
	responding to written material critically, effectively and efficiently				
Engineering Competencies	understanding the wider context of the engineering discipline, its practical applications, societal impact and limitations	☒	☒	☒	
	acceptance of the general principles and practices of engineering professional codes of conduct				
	following general laboratory, workshop and/or fieldwork safety		☒		

	guidance and precautions				
	mastering of methods, procedures and processes of risk identification	☒	☒		
	statistical data processing to define and derive adequate conclusions	☒	☒		
	understanding and using appropriate methods for research design regarding data collection and analysis, particularly focused on contemporary qualitative and quantitative methods, cognizant of the needs of special populations	☒	☒		
	using appropriate engineering software packages as an aid to research, analysis, problem solving and presentation of results	☒	☒	☒	☒
	using computer systems to access learning resources, receive communications regarding the degree programme, undertake assessments and submit assignments	☒	☒	☒	☒
	preparing technical drawings by hand (following appropriate training)				☒
	producing sketches to communicate ideas and concepts		☒		
	using appropriate equipment competently and safely (following appropriate training)				
	forming logical, reasonable conclusions and make sound recommendations based on available data and/or observations				
	obtaining necessary data from scientific and technical documents, reports, and other reference materials				
	undertaking work with a high level of initiative and commitment to the task in hand				
	preparing, processing, and interpreting data and/or observations using appropriate				

	techniques				
	defining objectives for simple projects in a variety of engineering disciplines and developing and implementing basic work plans	☒	☒	☒	☒
	drafting proposals, funding requests, and requests for proposals				
	defining information needs, including research needs , inventory, baseline studies, and follow-up monitoring	☒	☒	☒	☒
	developing innovative solutions to complex or intractable issues				
	using acquired theoretical and practical knowledge to solve new engineering problems	☒	☒	☒	
	presenting written technical reports to others and to make oral presentations that are reasoned, logical and time-limited, to a variety of audiences		☒		
	presenting ideas, key facts, problem solutions and results effectively, both orally and in writing, in a variety of settings including group/team work				
WRM Competencies	understanding of climate changes, hydrological hazards and their effects on WRM	☒	☒	☒	☒
	devising strategies and developing methodology and methods of emergency as part of WRM	☒	☒		
	optimizing and managing available resources in WRM systems		☒		☒
	applying ICT in WRM	☒	☒	☒	☒
	development of human resources in WRM		☒		☒
	applying specialized civil engineering fields in WRM	☒	☒		☒
	writing documents dealing with natural resource issues and technical information, drawn from a variety of sources		☒	☒	☒

	understanding of the Water Framework Directive and its implementation processes				
	using of mathematical models for the simulation of water related processes				
	understanding the environmental pricing concept with emphasis to the value of the water				
	understanding the hydrologic cycle, the various natural processes and the simulation methods.				
	defining the interaction of water with other sections, the water-energy-food-environment (WEFE) nexus approach				
	obtaining knowledge on the EU legislation for the water resources				
	applying modern tools that facilitate the spatiotemporal management of the water resources. Geographic Information Systems (GIS) and WRM				
	identification and analysis of problems in WRM	☒	☒	☒	☒
	holistic and proactive approach to WRM issues		☒	☒	☒
	respecting natural environment	☒	☒	☒	☒
	identifying needs and priorities, including facilitation of group efforts to define and prioritize broad water resource program needs	☒	☒		
	implementing water supply and water efficiency plans and programs	☒	☒	☒	

5. Dzemal Bijedic University of Mostar

5.1 Master academic study programme

5.1.1 Sustainable management of municipal water supply enterprises

Džemal Bijedić University of Mostar **Faculty of Civil Engineering** **STUDY PROGRAMME: ENVIRONMENTAL INFRASTRUCTURE MANAGEMENT**			
Course title:	Sustainable Management of Communal Water Supply Enterprises		Course code: 0000
Study programme cycle, Study year, Semester	2nd (second) cycle		I year / 2. Semester
Names of lecturers:	Suad Špago		
Contact details:	E-mail:	Phone:	
Hours of Active Classes:	Hours per week lectures (L): 2	Hours per week exercises (E): 2	Total number of lectures (L) + exercises (E): 30L+30E
ECTS:	**6 ECTS**		
Mainstream qualification	Qualification for which the subject is primarily made		
Typology :	Mandatory course		
Prerequisite for taking the exam:			
Aim of Course:	▪ Introducing a student with basic concepts related to the management of communal water supply enterprises		
Learning outcomes	Training students for significant design, execution (implementation / construction) and other engineering activities (studies, planning, research) in the field of management of communal water supply enterprises		
Syllabus:	▪ Introduction ▪ Areas of operational management ▪ Areas of financial management ▪ Reliability of water supply network system ▪ Water balance and leak detection ▪ Institutional framework and financial sustainability		

	▪ Guidelines for accountancy procedures ▪ Fuzzy model of decision making when managing the process of reconstruction and development of water supply network ▪ Multi-criteria decision making in water supply systems ▪ Water balance and determination of leaks – advanced techniques ▪ Tariff methodology Water pricing ▪ International network of performance comparison ("Benchmarking") for water management companies.
The course consists of:	Lectures, exercises and seminars
Other Student obligation (if they are predicted):	
Evaluation methods (exam):	Final written test; Mid-term written test; Seminars
Recommended literature and web reference:	1. Špago S.: Osnove upravljanja sistemom vodosnabdijevanja u komunalnim preduzećima, Univerzitet „Džemal Bijedić" Mostar, 2014 2. Špago S.: Napredne tehnike upravljanja komunalnim vodovodnim poduzećima, Univerzitet „Džemal Bijedić" Mostar, 2016
Quality assurance methods:	

5.1.2 Water protection

Džemal Bijedić University of Mostar **Faculty of Civil Engineering** STUDY PROGRAMME: ENVIRONMENTAL INFRASTRUCTURE MANAGEMENT			
Course title:	Water Protection		Course code: 0000
Study programme cycle, Study year, Semester	2nd (second) cycle		I year/ 1. Semester
Names of lecturers:	Suad Špago		
Contact details:	E-mail:	Phone:	
Hours of Active Classes:	Hours per week lectures (L): 2	Hours per week exercises (E): 2	Total number of lectures (L) + exercises (E):

			30L+30E
ECTS:	5 ECTS		
Mainstream qualification	Qualification for which the subject is primarily made		
Typology :	Elective course		
Prerequisite for taking the exam:			
Aim of Course:	▪ Introducing a student with the basics of pollution of water and environment, water and environmental protection, pollution control procedures.		
Learning outcomes	After studying the subject, the student is expected to be able to describe and explain the problems of water pollution and environmental protection; the basic ecological characteristics of water and environment, sources and types of pollution, the impact of pollution on water and environmental conditions, measures and activities in the protection of water and the environment, and participate in planning and solving problems in water pollution and environmental protection.		
Syllabus:	▪ Pollution of water and environment: problem of wastewater and pollution of environment. Circulation of water and environment pollution. Basic principles of water quality management. Criteria and standards. Basic ecological principles. Quality of water. Determining the quality of water. The pollutants, point and nonpoint and their characteristics. Pressure and change in water quality. Dilution and self-purification. The impact of waste matter. ▪ Protection of water and environment: integral concept of protection of water and environment. Basic management framework. Goals and methods. Strategies and principles. Control mechanisms. Quality of effluent. Examples and protection of water eco systems. Stakeholders and their role. ▪ Procedure of pollution control: minimization of waste. The best environment practice. The best available technology. Clean technologies. Managing the sewage system and devices for purification of water. Re-use of wastewater and waste matter. Emission into the ground, clear water and sea. Water purification. Treatment of sludge. ▪ Planning of protection: basic principles of planning. Control of point and nonpoint polluters. Solid waste and its disposal. Planning of protection. Basics of systematic approach to protection of water resources. Basic elements of production of water and environment protection plan. Studies of impact on environment.		
The course consists of:	Lectures, exercises and seminars		

Other Student obligation (if they are predicted):	
Evaluation methods (exam):	Final written test; Mid-term written test
Recommended literature and web reference:	1. S. Tedeschi: Zaštita vodnih sustava i pročišćavanje otpadnih voda, Građevinski institut, Zagreb, 1996. 2. J. Margeta: Osnove gospodarenja vodama, Građevinski fakultet Split, 1992.
Quality assurance methods:	

5.1.3 Urban hydrology

Džemal Bijedić University of Mostar **Faculty of Civil Engineering** STUDY PROGRAMME: ENVIRONMENTAL INFRASTRUCTURE MANAGEMENT	
Level:	2nd (Master) cycle
The name of the course:	Urban hydrology
Lecturer (Name, middle name, last name):	Suad Špago
Course status:	Elective
Number of ECTS:	5 (30+30)
Prerequisites:	
Course objective:	Introducing the students with the urban hydrological cycle and the rainwater effects on the urban environment. Understanding the importance of protection against rainfall and runoff in settlements. Basic principles of developing the concept of protection and management of urban water. Mastering the methods of runoff calculation and sizing of elements of the system for receiving, draining and controlling rainwater quality and quantity.
Learning outcomes:	Training of students for collecting data, independent processing and analysis of meteorological and hydrological data, calculation of rainwater runoff from urbanized areas and designing elements of rainwater drainage systems and quality control.
Content:	Areas of study and its significance to contemporary living conditions in the urban environment. Analysis of the components of the hydrological cycle in urban environments (urban water systems); the impact of urbanization on the water balance. Guidelines for the design of urban drainage systems and roads. Interaction of urban municipal infrastructure and urban watercourses with stormwater drainage system. Hydrological Measurement and

	Data Processing on Urban Watercourses. Statistical analysis of extreme (high and low water). Analysis of short-term heavy rainfall. Precipitation and runoff correlation. Hydrological models of runoff in urban (and suburban) areas. Hydrological models of harvested catchments. Estimation of runoff from individual buildings, residential districts and city roads. Urban drainage hydrogram (LA Hydrogram, Chicago, SCS). Modern concepts of urban drainage. Hydraulic sizing of elements in the system for collecting, receiving and draining storm water. Relevant rain counts and flows for the design of facilities and systems. Urban retention as a function of defense against blue waves. Groundwater balance of urban space and their protection. Purification of runoff from roads, buildings and urban areas. Hydrological characteristics of urban space and their influence on urban planning. (Studies, panels, projects and measures in the function of managing water resources in an urban area. Rain and surface water protection projects in urban areas, practical examples.			
Literature:	1. Hajdin, G. (2002) Osnove hidrotehnike, Građevinski fakultet, Beograd. 2. Hajdin, G., Vukmirović, V., Batinić, B. (1998) Zadaci iz hidrotehnike, Građevinski fakultet, Beograd. 3. Hrelja, H. (2007) Inženjerska hidrologija, 2007. 3. Vukmirović, V. i Pavlović D. (2005) Primijenjena hidrologija – zbirka zadataka, Građevinski fakultet Beograd. 4. Despotović, J. (2009) Kanalisanje kišnih voda, Građevinski fakultet Beograd. 5. *Hormoz Pazwash,* Urban Storm Water Management, Edition2nd Edition, First Published 2016			
Number of classes of active teaching:	Lectures: 30	Exercises: 30		Other

5.2 Link between competencies and courses

		Master Studies		
		Mandatory Courses	Elective Courses	
		Sustainable management of communal water supply enterprises	Water protection	Urban hydrology
Generic Competencies	communicating, verbally and in writing, clearly and effectively	☒	☒	☒
	critical thinking		☒	☒
	scenario modeling	☒	☒	☒
	creativity	☒	☒	☒
	initiative		☒	☒
	prediction of solutions and consequences	☒	☒	☒
	collaboration	☒	☒	☒
	working in multidisciplinary team		☒	☒
	working autonomously	☒		
	working in an international context		☒	☒
	generating new research ideas		☒	☒
	intensive use of ICT in acquiring knowledge and solving problems	☒	☒	☒
	solving complex multidisciplinary problems in theory and practice applying acquired knowledge		☒	☒
	social and civil responsibility	☒		
	development of professional ethics and responsibility			
	effective leadership			
	strategic thinking	☒	☒	☒
	experience-based critical decision making		☒	☒
	staying up-to-date with technological development	☒	☒	☒
	knowledge transfer to the professional and wider public clearly and unambiguously			
	applying knowledge in practice		☒	☒
	retrieving, analyzing and synthesizing data and information, with the use	☒	☒	☒

	of necessary technologies			
	designing and managing projects			
	demonstrating social, professional and ethical commitment and sensitivity to gender issues			
	being critical and self-critical			
	responding to written material critically, effectively and efficiently			
Engineering Competencies	understanding the wider context of the engineering discipline, its practical applications, societal impact and limitations	☒	☒	☒
	acceptance of the general principles and practices of engineering professional codes of conduct			
	following general laboratory, workshop and/or fieldwork safety guidance and precautions		☒	☒
	mastering of methods, procedures and processes of risk identification	☒	☒	☒
	statistical data processing to define and derive adequate conclusions	☒	☒	☒
	understanding and using appropriate methods for research design regarding data collection and analysis, particularly focused on contemporary qualitative and quantitative methods, cognizant of the needs of special populations	☒	☒	☒
	using appropriate engineering software packages as an aid to research, analysis, problem solving and presentation of results	☒		
	using computer systems to access learning resources, receive communications regarding the degree programme, undertake assessments and submit assignments	☒	☒	☒
	preparing technical drawings by hand			

	(following appropriate training)			
	producing sketches to communicate ideas and concepts	☒	☒	☒
	using appropriate equipment competently and safely (following appropriate training)			
	forming logical, reasonable conclusions and make sound recommendations based on available data and/or observations			
	obtaining necessary data from scientific and technical documents, reports, and other reference materials			
	undertaking work with a high level of initiative and commitment to the task in hand			
	preparing, processing, and interpreting data and/or observations using appropriate techniques			
	defining objectives for simple projects in a variety of engineering disciplines and developing and implementing basic work plans	☒	☒	☒
	drafting proposals, funding requests, and requests for proposals			
	defining information needs, including research needs , inventory, baseline studies, and follow-up monitoring	☒		
	developing innovative solutions to complex or intractable issues			
	using acquired theoretical and practical knowledge to solve new engineering problems	☒	☒	☒
	presenting written technical reports to others and to make oral presentations that are reasoned, logical and time-limited, to a variety of audiences		☒	☒
	presenting ideas, key facts, problem solutions and results effectively, both orally and in writing,			

	in a variety of settings including group/team work			
WRM Competencies	understanding of climate changes, hydrological hazards and their effects on WRM	☒	☒	☒
	devising strategies and developing methodology and methods of emergency as part of WRM	☒	☒	☒
	optimizing and managing available resources in WRM systems		☒	☒
	applying ICT in WRM		☒	☒
	development of human resources in WRM		☒	☒
	applying specialized civil engineering fields in WRM	☒	☒	☒
	writing documents dealing with natural resource issues and technical information, drawn from a variety of sources		☒	☒
	understanding of the Water Framework Directive and its implementation processes			
	using of mathematical models for the simulation of water related processes			
	understanding the environmental pricing concept with emphasis to the value of the water			
	understanding the hydrologic cycle, the various natural processes and the simulation methods.			
	defining the interaction of water with other sections, the water-energy-food-environment (WEFE) nexus approach			
	obtaining knowledge on the EU legislation for the water resources			
	applying modern tools that facilitate the spatiotemporal management of the water resources. Geographic Information Systems (GIS) and WRM			
	identification and analysis	☒	☒	☒

	of problems in WRM			
	holistic and proactive approach to WRM issues	☒	☒	☒
	respecting natural environment	☒	☒	☒
	identifying needs and priorities, including facilitation of group efforts to define and prioritize broad water resource program needs	☒		
	implementing water supply and water efficiency plans and programs	☒	☒	☒

6. University of Pristina in Kosovska Mitrovica

6.1 Undergraduate academic study programme

6.1.1 Water Resources Management

Study programme: Environmental and occupational safety engineering				
Level: Undergraduate Academic Studies				
The name of the course: Water Resources Management				
Lecturer (Name, middle name, last name): Nataša M. Elezović				
Course status: Mandatory				
Number of ECTS: 5				
Prerequisites: -				
Course objective Introducing students to the problems of water use and protection, as well as water management.				
Learning outcomes Upon completion of this course, students will be able to understand the processes that take place in the aquatic environment and access to water as a natural resource whose sustainable use needs to be provided. Students will have the skills to categorize water, and students will have competencies water and to implement integrated water management as part of sustainable natural resource management.				
Content Theoretical classes Water as a natural resource. Characteristics of surface and groundwater. Water monitoring. Basic physical, chemical and biological indicators of water quality, water-sediment system sampling. Quality criteria. Categorization of watercourses. Legal framework in the field of water management in the Republic of Serbia with reference to Regulation 5/68 SWQI index (Serbian water quality index). Water Framework Directive, WFD of the European Union. Harmonization of regulations with national legislation. Pollution of water resources. Protection of water from industrial wastewater pollution. Protection against municipal wastewater pollution. Sustainable management of water resources in Serbia. Practical classes Exercises, other forms of teaching, study research work, testing of water quality (parameters), calculation of SWQI index.				
Literature 1. Н. Вељковић: Индикатори одрживог развоја и управљање водним ресурсима, Задужбина Андрејевић, Београд, 2006. 2. Б. Далмације: Основи управљања отпадним водама, ПМФ, Нови Сад, 2010. 3. М. Шћибан, М. Клашња: Технологија воде и отпадних вода, Технолошки факултет, Нови Сад, 2008. 4. Управљање водним ресурсима Србије, монографија, Институт Јарослав Черни, Београд, 2009. 5. Резултати испитивања квалитета површинских и подземних вода, Агенција за заштиту животне средине Републике Србије. B. Vučijak, A. Ćerić, I. Siladžić, S. Midžić-Kurtagić: Voda za život: Osnove integralnog upravljanja vodnim resursima, Institut za hidrotehniku Građevinskog fakulteta, Sarajevo, 2011.				
Number of classes of active teaching				Other
Lectures:	Exercises:	Other form of lectures:	Study and research work:	

2	2			

Teaching methods

Classes are conducted through lectures, laboratory and computational exercises.

Grade (maximum number of credits 100)

Pre-exam requirements	**credits**	Final exam	**credits**
activity during lectures	10	written exam	
practical teaching	10	oral exam	40
colloquia	20		
seminar paper	20		

6.1.2 Modern methods in the preparation of drinking water

Study programme: Environmental and occupational safety engineering

Level: Undergraduate Academic Studies

The name of the course: Modern methods in the preparation of drinking water

Lecturer (Name, middle name, last name): Nataša M. Elezović

Course status: Mandatory

Number of ECTS: 6

Prerequisites: -

Course objective

The aim of the course is for students to get acquainted with modern methods used in the preparation of drinking water, relying on already acquired knowledge during regular studies, and above all specific physical-chemical and biological procedures, as well as the most modern separation techniques.

Learning outcomes

After mastering and adopting teaching units and experimental exercises, the student will acquire knowledge about water preparation methods, the student will have the skills to be able to assess water quality and perform water characterization in comparison with legal regulations. The student will have competencies to apply modern methods in the preparation of drinking water.

Content

Theoretical classes

Drinking water resources, water supply safety plans, framework guidelines for drinking water quality and risk assessment (physical, chemical, biological and microbiological), ways of organizing a modern laboratory and analysis of drinking water, monitoring of water supply systems, basic technological methods of water preparation for beverages, namely: precipitation, filtration, membrane separation, improved coagulation and flocculation processes, improved oxidation processes, diffusion methods in the preparation of drinking water, disinfection of drinking water and removal of specific organic and inorganic pollutants from drinking water.

Practical classes

Analysis of drinking water quality (physical, chemical and biological parameters). Computational exercises.

Literature

1. Б. Далмација, Ј. Агбаба, М. Клашња: Савремене методе у припреми воде за пиће, ПМФ, Нови Сад, 2009.

2. Б. Далмација, J. Агбаба: Контрола квалитета воде за пиће, ПМФ, Нови Сад, 2006.
3. В. Рајаковић-Огњеновић: Квалитет воде-лабораторијски практикум са теоријским основама: Грађевински факултет, Београд, 2016.
4. М. Далмација, С. Милетић, J. Агбаба, Б. Далмација, J. Молнар, С. Угарчина-Перовић: Практикум из квалитета воде за пиће, ПМФ, Нови Сад, 2013.
5. Water Treatment: Principles and Design (Revised by: J.C. Crittenden at all). 3rd Edition. John Wiley & Sons, Inc., Hoboken, New Jersey, USA, 2012.
6. John Crittenden et al.: Water Treatment: Principles and Design, MWH, John Wiley & Sons, 2005.
Raymond Letterman: Water Quality and Treatment, McGraw-Hill, Inc., 1999.

Number of classes of active teaching				Other
Lectures: 2	Exercises: 1	Other form of lectures:	Study and research work:	

Teaching methods
Lectures and exercises (calculation exercises with the application of theoretical knowledge). Experimental exercises in the laboratory.

Grade (maximum number of credits 100)			
Pre-exam requirements	**credits**	Final exam	**Credits**
activity during lectures	10	written exam	30
practical teaching	10	oral exam	30
colloquia	10		
seminar paper	10		

6.1.3 Advances techniques in wastewater treatment

Study programme: Environmental and occupational safety engineering
Level: Undergraduate Academic Studies
The name of the course: Advanced techniques in wastewater treatment
Lecturer (Name, middle name, last name): Nataša M. Elezović
Course status: Mandatory
Number of ECTS: 6
Prerequisites: -

Course objective
Acquisition of necessary knowledge and skills in the field of wastewater treatment (treatment) and wastewater treatment plants (purifiers).

Learning outcomes
Students will acquire knowledge from the technology of preparation and treatment of wastewater, students will have skills in the application of advanced physico-chemical and biological treatment procedures. Students will have the competencies to choose the purification process that corresponds to the situation on the field and to apply the chosen methods.

Content
Theoretical classes
During the lecture, students gain knowledge about advanced oxidation techniques, ion exchange, adsorption and filtration techniques used in modern wastewater treatment and purification plants, as well as advanced biological aerobic and anaerobic wastewater treatment processes. In the first part, purification is considered, and in the second part, ways of minimizing the quantities and reusing used waters are studied. During the lectures, lectures are combined with visits to relevant industries, and students actively participate in data collection on specific examples, their processing, presentation and analysis of results.

Practical classes Solving the tasks of concrete examples that accompany theoretical teaching. Visits to commercial plants and plants for wastewater preparation and treatment.
Literature 1. D. Povrenović, M. Knežević: Osnove tehnologije prečišćavanja otpadnih voda, TMF, 2013. 2. B. Dalmacija: Osnovi upravljanja otpadnim vodama, PMF, Novi Sad, 2010. 3. М. Шћибан, М. Клашња: Технологија воде и отпадних вода, Технолошки факултет, Нови Сад, 2008. 4. G. Tchobanoglous, F. L. Burton (Editor), H. David Stensel: Wastewater Engineering: Treatment and Reuse, McGraw-Hill Science/Engineering/Math; 4th edition, 2002. 5. L. K. Wang, Y. T. Hung, and N. K. Shammas (eds.): Advanced Physicochemical Treatment Processe, Humana Press, Totowa, NJ, 2006. 6. L. K. Wang, N. K. Shammas, and Y. T. Hung (eds.): Advanced Biological Treatment Processes, Humana Press, Totowa, NJ, 2009.

Number of classes of active teaching				Other
Lectures: 2	Exercises: 2	Other form of lectures:	Study and research work:	

Teaching methods
Classes are conducted through lectures and calculation exercises.

Grade (maximum number of credits 100)			
Pre-exam requirements	**credits**	Final exam	**Credits**
activity during lectures	10	written exam	
practical teaching	10	oral exam	50
colloquia	15		
seminar paper	15		

6.1.4 Protection and water resources management

Study programme: Environmental and occupational safety engineering
Level: Undergraduate Academic Studies
The name of the course: Protection and water resources management
Lecturer (Name, middle name, last name): Gordana Milentijević
Course status: Elective
Number of ECTS: 5
Prerequisites: -
Course objective Introduction to the basic elements of the natural and social environment and the way they affect the water system, as well as introduction to the water management system and the way they function.
Learning outcomes Having mastered the material, the student should: understand the water system and locate the place and significance of his work in it, analyze possible mechanisms of water management and apply strategic documents and recommendations in water resources management.
Content Theoretical classes Introduction. Status and importance of water as a natural resource. Economic and social frameworks for water management. Sustainable and adaptive water management. Natural frames. Water management objectives. Water management instruments. Sustainable and adaptive water management. Water system. Certain functions and activities. The role of global, regional and local

institutions and mechanisms. World trends. Climate change and water. Water monitoring. EU water directives. The situation in our country. Practical classes Computational exercises, auditory exercises, field exercises and visits.
Literature 1. Гордана Грујић, Водни ресурси Републике Србије, Анализа стања ISBN 978-86-917021-2-0 2. Бранко Вучјак, Вода за живот: Основе интегралног управљања водним ресурсима, 2011 3. Емина Хаџић и остали, Приручник за обуку о управљању водним ресурсима, SWARM 2020

Number of classes of active teaching				Other
Lectures: 2	Exercises: 2	Other form of lectures:	Study and research work:	

Teaching methods

Classes are held in the form of lectures and auditory exercises. The theoretical part of the material is presented at the lectures, while the exercises are done with tasks - practical examples from certain areas that accompany the lectures. Students who have not passed the exam through the colloquium must take the entire final exam.

Grade (maximum number of credits 100)			
Pre-exam requirements	**credits**	Final exam	**Credits**
activity during lectures	5	written exam	
practical teaching	5	oral exam	40
colloquia	30		
seminar paper	20		

6.2 Master academic study programme

6.2.1 Groundwater use, protection and management

<table>
<tr><td colspan="5">Study programme: Environmental and occupational safety engineering</td></tr>
<tr><td colspan="5">Level: Master Academic Studies</td></tr>
<tr><td colspan="5">The name of the course: Groundwater use, protection and management</td></tr>
<tr><td colspan="5">Lecturer (Name, middle name, last name): Gordana Milentijević</td></tr>
<tr><td colspan="5">Course status: Elective</td></tr>
<tr><td colspan="5">Number of ECTS: 6</td></tr>
<tr><td colspan="5">Prerequisites: -</td></tr>
<tr><td colspan="5">Course objective
Acquisition of knowledge and theoretical foundations about natural groundwater systems and its way of functioning. Introduction to the problems of use and management of groundwater with special emphasis on the problems of monitoring and protection of groundwater.</td></tr>
<tr><td colspan="5">Learning outcomes
The student should understand the groundwater system (phenomena, processes, management goals, use, and protection). The student should master certain ways of perceiving and forecasting the transformation of groundwater quality. The student should have the skills to distinguish between criteria and ways of protection and to apply certain protection procedures in the field.</td></tr>
<tr><td colspan="5">Content
Theoretical classes
Introduction. The status of groundwater as a natural resource. Groundwater management objectives. Composition and properties of released groundwater. Self-purification processes. Specifics of groundwater resource management. Protected areas. Criteria and method of protection. Sustainable and adaptive groundwater management. Groundwater monitoring. The situation in our country.
Practical classes
Computational exercises, field exercises and visits.</td></tr>
<tr><td colspan="5">Literature
1. Dusan Polomcic, Vesna Ristic Vakanjac Vodosnabdevanje podzemnim vodama u Srbiji - stanje i perspektive: Univerzitet u Beogradu, Rudarsko-geološki fakultet
2. Вујасиновић С., Загађење и заштита подземних вода-практикум, Универзитет у Београду, Београд, 1990
3. Димкић А. М., Самопречишћавајући ефекти филтрације подземне воде, Задужбина Андрејевић, Београд, 2007
4. Институт за водопривреду „Јарослав Черни“, Водопривредна основа Републике Србије, Министарства за пољопривреду и шумарство 2001</td></tr>
<tr><td colspan="4">Number of classes of active teaching</td><td rowspan="2">Other</td></tr>
<tr><td>Lectures:
2</td><td>Exercises:
2</td><td>Other form of lectures:</td><td>Study and research work:</td></tr>
<tr><td colspan="5">Teaching methods
Lectures, exercises</td></tr>
<tr><td colspan="5">Grade (maximum number of credits 100)</td></tr>
<tr><td>Pre-exam requirements</td><td>credits</td><td>Final exam</td><td colspan="2">Credits</td></tr>
<tr><td>activity during lectures</td><td>5</td><td>written exam</td><td colspan="2"></td></tr>
<tr><td>practical teaching</td><td>5</td><td>oral exam</td><td colspan="2">40</td></tr>
<tr><td>colloquia</td><td>30</td><td></td><td colspan="2"></td></tr>
<tr><td>seminar paper</td><td>20</td><td></td><td colspan="2"></td></tr>
</table>

6.2.2 Water treatment technologies in industry

<table>
<tr><td colspan="5">Study programme: Environmental and occupational safety engineering</td></tr>
<tr><td colspan="5">Level: Master Academic Studies</td></tr>
<tr><td colspan="5">The name of the course: Water treatment technologies in industry</td></tr>
<tr><td colspan="5">Lecturer (Name, middle name, last name): Nataša M. Elezović</td></tr>
<tr><td colspan="5">Course status: Elective</td></tr>
<tr><td colspan="5">Number of ECTS: 5</td></tr>
<tr><td colspan="5">Prerequisites: -</td></tr>
<tr><td colspan="5">Course objective
The general goal of the course is to acquire basic theoretical and practical knowledge about physico-chemical and biological processes in water preparation in industry. The special goal is to consider the importance and obligation to reduce water consumption in all industrial plants, as well as the necessity of its reuse and recirculation with the aim of more concrete application of the basic principle of sustainable development.</td></tr>
<tr><td colspan="5">Learning outcomes
Students will acquire basic theoretical and practical knowledge of physico-chemical and biological processes in water treatment and treatment of waste sludge in industry, students will gain skills to implement water saving measures in industry through the introduction of new advanced technologies.</td></tr>
<tr><td colspan="5">Content
Theoretical classes
The main content of this course is to study and find ways to improve old and apply new water treatment technologies with the aim of more efficient, economical and acceptable from the aspect of environmental protection ways to provide as much water quality as possible for many purposes in industry, including waste sludge treatment. Mechanical separation processes, physico-chemical processes of removing pollutants (including gases), biological processes, water disinfection.
Practical classes
Solving specific examples that accompany theoretical teaching. Expert visit to industrial plants in which water-thermal energy, metallurgy, petrochemistry, food and pharmaceutical industry, etc. are prepared.</td></tr>
<tr><td colspan="5">Literature
1. Б. Далмација, J. Агбаба, М. Клашња: Савремене методе у припреми воде за пиће, ПМФ Нови Сад, 2009.
2. В. Кораћ: Технологија воде за потребе индустрије, УТВСИ, Београд, 1985.
3. J. Crittenden et al: Water Treatment: Principles and Design, MWH, John Wiley&Sons, 2005.
4. L. K. Wang, Y. T. Hung, N. K. Shammas (eds.): Advanced Physicochemical Treatment Processes Humana Press, Totowa, NJ, 2006.
5. Wang, N. K. Shammas, Y. T. Hung (eds.): Advanced Biological Treatment Processes, Humana Press, Totowa, NJ, 2009.</td></tr>
<tr><td colspan="4">Number of classes of active teaching</td><td>Other</td></tr>
<tr><td>Lectures:
2</td><td>Exercises:
2</td><td>Other form of lectures:</td><td>Study and research work:</td><td></td></tr>
<tr><td colspan="5">Teaching methods
Classes are conducted through lectures and calculation exercises.</td></tr>
<tr><td colspan="5">Grade (maximum number of credits 100)</td></tr>
<tr><td>Pre-exam requirements</td><td>credits</td><td>Final exam</td><td colspan="2">Credits</td></tr>
<tr><td>activity during lectures</td><td>10</td><td>written exam</td><td colspan="2"></td></tr>
<tr><td>practical teaching</td><td>10</td><td>oral exam</td><td colspan="2">50</td></tr>
<tr><td>colloquia</td><td>15</td><td></td><td colspan="2"></td></tr>
<tr><td>seminar paper</td><td>15</td><td></td><td colspan="2"></td></tr>
</table>

6.3 Link between competencies and courses

		Undergraduate Studies				Master Studies	
		Mandatory Courses			Elective Courses	Elective Courses	
		Water Resources Management	Modern methods in the preparation of drinking water	Advanced techniques in wastewater treatment	Protection and water resources management	Groundwater use, protection and management	Water treatment technologies in industry
Generic Competencies	communicating, verbally and in writing, clearly and effectively	☒	☒	☒	☒	☒	☒
	critical thinking					☒	☒
	scenario modeling		☒	☒		☒	☒
	creativity	☒		☒			☒
	initiative				☒	☒	☒
	prediction of solutions and consequences				☒	☒	
	collaboration	☒	☒	☒	☒	☒	☒
	working in multidisciplinary team					☒	☒
	working autonomously					☒	
	working in an international context						
	generating new research ideas						☒
	intensive use of ICT in acquiring knowledge and solving problems	☒	☒	☒	☒	☒	☒
	solving complex multidisciplinary problems in theory and practice applying acquired knowledge		☒			☒	
	social and civil responsibility		☒		☒		☒
	development of professional ethics and responsibility				☒	☒	☒
	effective leadership					☒	
	strategic thinking	☒	☒				☒
	experience-based critical decision making	☒			☒		
	staying up-to-date with technological development			☒			☒
	knowledge transfer to the professional and wider public clearly and unambiguously		☒			☒	☒
	applying knowledge in practice					☒	

	retrieving, analyzing and synthesizing data and information, with the use of necessary technologies						
	designing and managing projects						☒
	demonstrating social, professional and ethical commitment and sensitivity to gender issues		☒			☒	
	being critical and self-critical	☒		☒	☒	☒	
	responding to written material critically, effectively and efficiently						☒
Engineering Competencies	understanding the wider context of the engineering discipline, its practical applications, societal impact and limitations		☒	☒	☒	☒	☒
	acceptance of the general principles and practices of engineering professional codes of conduct			☒		☒	
	following general laboratory, workshop and/or fieldwork safety guidance and precautions	☒				☒	☒
	mastering of methods, procedures and processes of risk identification		☒		☒		☒
	statistical data processing to define and derive adequate conclusions			☒			☒
	understanding and using appropriate methods for research design regarding data collection and analysis, particularly focused on contemporary qualitative and quantitative methods, cognizant of the needs of special populations						☒
	using appropriate engineering software packages as an aid to research, analysis, problem solving and presentation of results		☒			☒	
	using computer systems to access learning resources, receive communications regarding the degree programme, undertake assessments and submit			☒		☒	☒

	assignments						
	preparing technical drawings by hand (following appropriate training)						☒
	producing sketches to communicate ideas and concepts						☒
	using appropriate equipment competently and safely (following appropriate training)			☒	☒	☒	☒
	forming logical, reasonable conclusions and make sound recommendations based on available data and/or observations	☒	☒				
	obtaining necessary data from scientific and technical documents, reports, and other reference materials				☒	☒	
	undertaking work with a high level of initiative and commitment to the task in hand					☒	
	preparing, processing, and interpreting data and/or observations using appropriate techniques					☒	☒
	defining objectives for simple projects in a variety of engineering disciplines and developing and implementing basic work plans						
	drafting proposals, funding requests, and requests for proposals						
	defining information needs, including research needs , inventory, baseline studies, and follow-up monitoring		☒		☒		☒
	developing innovative solutions to complex or intractable issues						☒
	using acquired theoretical and practical knowledge to solve new engineering problems		☒	☒			☒
	presenting written technical reports to others and to make oral presentations that are reasoned, logical and time-limited, to a variety of audiences					☒	

	presenting ideas, key facts, problem solutions and results effectively, both orally and in writing, in a variety of settings including group/team work					☒	☒
WRM Competencies	understanding of climate changes, hydrological hazards and their effects on WRM	☒			☒		☒
	devising strategies and developing methodology and methods of emergency as part of WRM		☒				
	optimizing and managing available resources in WRM systems	☒		☒	☒	☒	☒
	applying ICT in WRM					☒	☒
	development of human resources in WRM						
	applying specialized civil engineering fields in WRM					☒	
	writing documents dealing with natural resource issues and technical information, drawn from a variety of sources		☒				
	understanding of the Water Framework Directive and its implementation processes					☒	
	using of mathematical models for the simulation of water related processes			☒		☒	☒
	understanding the environmental pricing concept with emphasis to the value of the water						
	understanding the hydrologic cycle, the various natural processes and the simulation methods.	☒			☒		☒
	defining the interaction of water with other sections, the water-energy-food-environment (WEFE) nexus approach	☒	☒				
	obtaining knowledge on the EU legislation for the water resources		☒		☒		☒
	applying modern tools that facilitate the spatiotemporal management of the water resources.					☒	

	Geographic Information Systems (GIS) and WRM						
	identification and analysis of problems in WRM		☒				☒
	holistic and proactive approach to WRM issues			☒	☒		
	respecting natural environment		☒		☒		☒
	identifying needs and priorities, including facilitation of group efforts to define and prioritize broad water resource program needs		☒			☒	
	implementing water supply and water efficiency plans and programs		☒			☒	

7. University of Montenegro

7.1 Master academic study programme

7.1.1 Hydraulic Engineering

UNIVERSITY OF MONTENEGRO		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering

GENERAL INFORMATION	
Study program	CIVIL ENGINEERING INFRASTRUCTURE
Study Module (if applicable)	**Water Engineering**
Course title	Hydraulic Engineering
Level of study	Master
Type of course	Mandatory
Semester	Winter
Year of study	4th
Number of ECTS allocated	5
Name of lecturer/lecturers	Ivana Ćipranić
Teaching mode	Lectures; Group tutorials; Practical examples , Laboratory exercises

PURPOSE AND OVERVIEW (max. 5 sentences)
Acquisition of basic knowledge in hydraulics with a focus on application in civil engineering. Students' ability to participate in the design and construction of hydrotechnical facilities.
SYLLABUS (brief outline and summary of topics, max. 10 sentences)
Fluids properties and classification. Hydrostatics: basic hydrostatics equations. Hydrodynamics: Basic concepts of energy and head in flow, concepts, and equations of energy degradation (head loss). Pipe flow, Energy equation, friction losses in pipes. Momentum and continuity equation. Experimental tests of friction resistance, Colebrook´s formula and Manning´s formula. Minor losses in pipes: entrance and exit, sudden contraction and expansion, bend, valves and fittings. Steady flow in open channels with prismatic cross-section. Velocity and pressure distribution in a

channel section; energy principle: specific energy; momentum principle: specific force; hydraulic jump Weirs as structures for water overflow and for discharge measurement. . Broad crested weir, Shaft weir, side weir, and spillway. Flow through orifices. Leakage through holes, short pipes, vertical pipes. Independent work of students; homework, Laboratory exercises - Base module for experiments in fluid mechanics, Laboratory equipment for testing principles in hydrodynamics, Open channel and closed channel flow.
LANGUAGE OF INSTRUCTION
Serbian (complete course)

ASSESSMENT METHODS AND CRITERIA			
Pre exam duties	Points	Final exam	points
Activity during lectures	3	Written examination	
Practical teaching	8	Oral examination	49
Teaching colloquia	40	OVERALL SUM	100
*Final examination mark is formed in accordance with the Institutional documents			

7.1.2 Groundwater Hydraulics

UNIVERSITY OF MONTENEGRO		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering

GENERAL INFORMATION	
Study program	CIVIL ENGINEERING INFRASTRUCTURE
Study Module (if applicable)	**Water Engineering**
Course title	Groundwater hydraulics
Level of study	Master
Type of course	Mandatory

Semester	Spring
Year of study	5th
Number of ECTS allocated	5
Name of lecturer/lecturers	Milan Radulović
Teaching mode	Lectures; Group tutorials; Practical examples , Laboratory exercises

PURPOSE AND OVERVIEW (max. 5 sentences)

Gaining basic knowledge of the laws of occurrence and movement of groundwater in different areas as well as the manner of their protection and exploitation

SYLLABUS (brief outline and summary of topics, max. 10 sentences)

Definition of groundwater, role of groundwater in hydrological cycle, groundwater bearing formations, classification of aquifers, flow and storage characteristics of aquifers, Darcy's law, anisotropy and heterogeneity. Governing Equations for groundwater flow. Wells and Well Hydraulics. Groundwater Conservation. Groundwater Quality. General problem of contamination of groundwater, sources, remedial and preventive measures, seawater intrusion in coastal aquifers. Groundwater Flow Modeling. Role of groundwater flow models, reference to hydraulic, introduction to numerical modeling.
Independent work of students; homework, Laboratory exercises - Base module for experiments in fluid mechanics, Three-dimensional investigations; demonstration of lowering of groundwater; investigation of excavation pits

LANGUAGE OF INSTRUCTION

Serbian (complete course)

ASSESSMENT METHODS AND CRITERIA

Pre exam duties	Points	Final exam	points
Activity during lectures	2	Written examination	50
Practical teaching	8	Oral examination	0
Teaching colloquia	40	OVERALL SUM	100

*Final examination mark is formed in accordance with the Institutional documents

7.1.3 Measurements in hydrotechnics

UNIVERSITY OF MONTENEGRO		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering

GENERAL INFORMATION	
Study program	CIVIL ENGINEERING INFRASTRUCTURE
Study Module (if applicable)	**Water Engineering**
Course title	Measurements in hydrotechnics
Level of study	Master
Type of course	Mandatory
Semester	Spring
Year of study	5th
Number of ECTS allocated	5
Name of lecturer/lecturers	Ivana Ćipranić
Teaching mode	Lectures; Group tutorials; Practical examples , **Laboratory exercises**

PURPOSE AND OVERVIEW (max. 5 sentences)
Gaining basic knowledge about measuring techniques and methods of measuring basic hydraulic and hydrological parameters (characteristics) that are relevant for hydraulic engineering projects

SYLLABUS (brief outline and summary of topics, max. 10 sentences)
Basic characteristics of physical values: classification of measured data, deterministic values, stochastic values. Dynamic characteristics of physical systems. Types of converters and distribution, sensors (instrumentation) for pressure and differential pressure, flow depth, velocity, discharge sacrificing parameters, position. Measurements in systems under pressure. Measurements in open channel flow. Measurements in hydrometeorology, characteristics, organization, data collecting, home works. Telemetry detection in hydraulics, basic concepts. Data acquisition systems, telemetry, data bases. Measurement errors and their evaluation Independent work of students; homework, Laboratory exercises - Comparison of different measuring methods and determining the flow coefficient, Static pressure and total pressure distribution

LANGUAGE OF INSTRUCTION			
Serbian (complete course)			
ASSESSMENT METHODS AND CRITERIA			
Pre exam duties	Points	Final exam	points
Activity during lectures	10	Written examination	30
Practical teaching	30	Oral examination	0
Teaching colloquia	30	OVERALL SUM	100
*Final examination mark is formed in accordance with the Institutional documents			

7.1.4 River Engineering

UNIVERSITY OF MONTENEGRO		
Course Unit Descriptor	Faculty	Faculty of Civil Engineering

GENERAL INFORMATION	
Study program	CIVIL ENGINEERING INFRASTRUCTURE
Study Module (if applicable)	**Water Engineering**
Course title	River Engineering
Level of study	Master
Type of course	Mandatory
Semester	Spring
Year of study	4th
Number of ECTS allocated	5
Name of lecturer/lecturers	Sreten Tomović

Teaching mode	Lectures; Group tutorials; Practical examples , Laboratory exercises

PURPOSE AND OVERVIEW (max. 5 sentences)

Gaining basic knowledge in designing and performing of river engineering.

SYLLABUS (brief outline and summary of topics, max. 10 sentences)

Hydrological characteristics of rivers. River morphology. Hydraulic analysis of rivers. Numerical methods for computation of steady and unsteady flow in complex riverbed. Regime channel; tractive force; non-scouring velocity.
River sediment. The beginning and the mechanics of movement of river sediment. Bed forms in alluvial streams and their influence on hydraulic resistance. Basic theories for suspended sediment load based on turbulent diffusion and energy relations.
Physical models of waterways. River trainings. Layout, cross sections, longitudinal profile. Dimensioning of river training structures. Building materials and construction methods.
Independent work of students; homework, Laboratory exercises - Base module for experiments in fluid mechanics, Flow processes on different structures in open and closed channel flows

LANGUAGE OF INSTRUCTION

Serbian (complete course)

ASSESSMENT METHODS AND CRITERIA

Pre exam duties	Points	Final exam	points
Activity during lectures	2	Written examination	50
Practical teaching	8	Oral examination	0
Teaching colloquia	40	OVERALL SUM	100

*Final examination mark is formed in accordance with the Institutional documents

7.2 Link between competencies and courses

		Master Studies			
		Mandatory Courses			
		Engineering hydraulics	Hydraulics of groundwater	Measurements in hydrotechnics	River regulation
Generic Competencies	communicating, verbally and in writing, clearly and effectively	☒	☒	☒	☒
	critical thinking	☒	☒	☒	☒
	scenario modeling	☒	☒	☒	☒
	creativity	☒	☒	☒	☒
	initiative			☒	
	prediction of solutions and consequences	☒	☒		☒
	collaboration	☒	☒	☒	☒
	working in multidisciplinary team		☒	☒	☒
	working autonomously	☒	☒		☒
	working in an international context		☒	☒	
	generating new research ideas	☒	☒	☒	☒
	intensive use of ICT in acquiring knowledge and solving problems	☒	☒	☒	☒
	solving complex multidisciplinary problems in theory and practice applying acquired knowledge	☒	☒	☒	☒
	social and civil responsibility		☒		☒
	development of professional ethics and responsibility	☒	☒	☒	☒
	effective leadership				
	strategic thinking		☒		☒
	experience-based critical decision making	☒	☒	☒	☒
	staying up-to-date with technological development		☒	☒	
	knowledge transfer to the professional and wider public clearly and unambiguously		☒	☒	
	applying knowledge in practice	☒	☒	☒	☒
	retrieving, analyzing and synthesizing data and information, with the use of necessary technologies	☒	☒	☒	☒

	designing and managing projects	☒	☒		☒
	demonstrating social, professional and ethical commitment and sensitivity to gender issues	☒	☒	☒	☒
	being critical and self-critical	☒	☒	☒	☒
	responding to written material critically, effectively and efficiently	☒	☒	☒	☒
Engineering Competencies	understanding the wider context of the engineering discipline, its practical applications, societal impact and limitations	☒	☒	☒	☒
	acceptance of the general principles and practices of engineering professional codes of conduct	☒	☒	☒	☒
	following general laboratory, workshop and/or fieldwork safety guidance and precautions	☒	☒	☒	
	mastering of methods, procedures and processes of risk identification				☒
	statistical data processing to define and derive adequate conclusions		☒	☒	☒
	understanding and using appropriate methods for research design regarding data collection and analysis, particularly focused on contemporary qualitative and quantitative methods, cognizant of the needs of special populations	☒	☒	☒	☒
	using appropriate engineering software packages as an aid to research, analysis, problem solving and presentation of results	☒	☒	☒	☒
	using computer systems to access learning resources, receive communications regarding the degree programme, undertake assessments and submit assignments	☒	☒		☒
	preparing technical drawings by hand (following appropriate training)				☒

	producing sketches to communicate ideas and concepts	☒	☒	☒	☒
	using appropriate equipment competently and safely (following appropriate training)		☒	☒	☒
	forming logical, reasonable conclusions and make sound recommendations based on available data and/or observations	☒	☒	☒	☒
	obtaining necessary data from scientific and technical documents, reports, and other reference materials	☒	☒	☒	☒
	undertaking work with a high level of initiative and commitment to the task in hand	☒	☒	☒	☒
	preparing, processing, and interpreting data and/or observations using appropriate techniques		☒	☒	☒
	defining objectives for simple projects in a variety of engineering disciplines and developing and implementing basic work plans	☒	☒		☒
	drafting proposals, funding requests, and requests for proposals	☒	☒		☒
	defining information needs, including research needs , inventory, baseline studies, and follow-up monitoring	☒	☒	☒	☒
	developing innovative solutions to complex or intractable issues	☒	☒	☒	☒
	using acquired theoretical and practical knowledge to solve new engineering problems	☒	☒	☒	☒
	presenting written technical reports to others and to make oral presentations that are reasoned, logical and time-limited, to a variety of audiences		☒		☒
	presenting ideas, key facts, problem solutions and results effectively, both orally and in writing, in a variety of settings including group/team	☒	☒	☒	☒

	work				
WRM Competencies	understanding of climate changes, hydrological hazards and their effects on WRM		☒		☒
	devising strategies and developing methodology and methods of emergency as part of WRM		☒		☒
	optimizing and managing available resources in WRM systems	☒	☒	☒	☒
	applying ICT in WRM	☒	☒	☒	☒
	development of human resources in WRM			☒	
	applying specialized civil engineering fields in WRM	☒	☒	☒	☒
	writing documents dealing with natural resource issues and technical information, drawn from a variety of sources	☒	☒		☒
	understanding of the Water Framework Directive and its implementation processes				☒
	using of mathematical models for the simulation of water related processes	☒	☒	☒	☒
	understanding the environmental pricing concept with emphasis to the value of the water		☒		☒
	understanding the hydrologic cycle, the various natural processes and the simulation methods.		☒		☒
	defining the interaction of water with other sections, the water-energy-food-environment (WEFE) nexus approach		☒		☒
	obtaining knowledge on the EU legislation for the water resources		☒		
	applying modern tools that facilitate the spatiotemporal management of the water resources. Geographic Information Systems (GIS) and WRM		☒	☒	
	identification and analysis of problems in WRM	☒	☒		☒
	holistic and proactive approach to WRM issues	☒	☒	☒	☒

	respecting natural environment		☒		☒
	identifying needs and priorities, including facilitation of group efforts to define and prioritize broad water resource program needs	☒	☒		☒
	implementing water supply and water efficiency plans and programs		☒		

8. Technical college of applied sciences Urosevac with temporary seat in Leposavic

8.1 Specialist professional study programme

8.1.1 Basic Principles of Water Management and Policy

Study programme: Water Protection
Level: Specialist professional studies
The name of the course: Basic Principles of Water Resources Management and Policy
Lecturer (Name, middle name, last name):
Course status: obligatory
Number of ECTS: 6
Prerequisites: /
Course objective Introduction to the basic elements of the natural and social environment and the way they impact on the water system. Also, students are introduced to the water managementprinciples and how it works. Examination of the basic principles of surface and ground water resources management in the context of increasing water scarcity and uncertainty due to climate change and other factors. Specific topics include reservoir, river basin and aquifer management, conjunctive use of surface and ground water resources, and treated wastewater reuse. Special emphasis is placed on demand management through water conservation, increased water use efficiency and economic measures. Besides the technical aspects of water management, an overview of its legal and institutional framework is provided.
Learning outcomes By completing curriculum course, students should: understand the water system and locate their position and importance of their work within this scope, consider the possible patterns mechanisms and instructions for water management and training for participation in water management. The graduates upon completion of the course are expected to be able to: Deliver key roles in planning, development and management of water resources, conflict resolution sustaining national, regional and local economy and well-being of the people. Analyze those aspects of the environment that are at risk from water shortages, poor water quality, or water development projects. Responding to the water conflicts within wider contexts of socio-economic and environmental challenges, locally, nationally and internationally. Recognizing the importance of and critically treating political processes as an important element to decision making pertaining to acquisition, allocation and utilization of water resources. Be competent in discussion of issues regarding water use, management, and development. Identify the main issues and strategies linked to water resource management. Be able to understand inter-sectoral competition, international allocation treaties, the economic consequences of infrastructure construction

Content Introduction. The status and importance of water as a natural resource. Economic and social framework for water management. Natural frames. The goals of water management. Instruments for water management. Sustainable and adaptive management. Water system. Individual functions and activities. Water management goals and guidelines (water management and sustainable development goals; guidelines for maintaining and improving the water regime; priorities for achieving water management and water management objectives consistent with sustainable development). Additional measures to achieve the identified environmental objectives The role of global, regional and local institutions and mechanisms. Measures for achieving established water management objectives. National strategy of water management. World trends. Implementation of international agreements related to water management and the basic determinants of monitoring and information system for achieving water management at the national level. Climate change and water. Water monitoring. EU directives related to water. The situation in our country.
Literature: 1. Владисављевић Ж., О водопривреди Грађевинска књига 1969 2. Dimkic A.Milan., Brauch Heinz-Jürgen, Kavanaugh Michael Groundwater Management in Large River Basins IWA Publishing 2008 3. Dante A., Caponera, Marcella Nanni Principles of Water Law and Administration Taylor & Frances 2007 4. Daniel P. Loucks, Eelco van Bee Water Resources Systems Planning and Management - an introduction to methods, models and applications UNESCO Publishing 2005 5. Ђорђевић Б Водопривредни системи Грађевинска књига 1990

Number of classes of active teaching				Other
Lectures: 3	Exercises: 3	Other form of lectures: 0	Study and research work: 0	0

Teaching methods Audit lectures and exercises.

Grade (maximum number of credits 100)			
Pre-exam requirements	**credits**	Final exam	**credits**
activity during lectures	10	written exam	10
practical teaching	20	oral exam	30
Colloquia	10		
seminar paper	20		

8.1.2 Fundamentals of Water Protection

Study programme: Water Protection
Level: Specialist professional studies
The name of the course: Fundamentals of Water Resources Protection
Lecturer (Name, middle name, last name):
Course status: obligatory
Number of ECTS: 6
Prerequisites: /
Course objective Enabling students to acquire professional knowledge and to apply it in practice in the fundamental

fields. Acquiring basic knowledge of natural water characteristics, changes in water quality, causes of changes, as well as activities, measures and plans for water protection. Acquiring knowledge about the physicochemical and biological composition and character of natural waters, basic parameters of water quality, analysis of conditions, influencing factors, legislation, protection measures and control of the functioning of the water protection system. After completing the course, students will gain the ability to determine the environmental impact of the pollutant, forecast the transport of pollutants, plan measures and activities related to the protection of water resources.

Learning outcomes

Acquired knowledge is used as a foundation for further advancement in professional courses. Understanding the importance of an integrated approach in water resource management, that is, protection of water resources. Independent analysis of the state of water resources and solving problems in water protection. Students' ability to work independently in the field of condition control, planning and implementation of water protection measures, keeping a register of pollutants and managing surface water quality.

Content

Fundamentals of hydrology and hydrometry. Physical and chemical properties of water and water solutions. Water quality parameters: thermal conductivity detectors, opacity monitors, pH analysis and application, conductivity analysis and results application. Characteristics of running and standing waters. Classification of surface and groundwater bodies. Pollutants of surface and underground waters. The impact of human activities on the status of surface and groundwater, including the assessment of pollution from concentrated and bulk pollutants, as well as the review of land use, the assessment of pressures on the quantitative status of water. Water quality. Protection of aquatic and coastal ecosystems and achievement of environmental quality standards in accordance with the regulation governing environmental protection and environmental goals. Water monitoring. Measures for control, prevention and reduction of hazardous substances input into surface and ground waters. National regulations in the domain of the environmental water quality. National plan for water resources protection. European directive on water protection.

Literature:

1. Стеван. Ј Прохаска Хидрологија И део, хидро-метеорологија, хидрометрија и водни режим, Рударско – геолошки факултет , Београд 2003.
2. Владисављевић Ж. О водопривреди-погледи и методе Институт за водопривреду "Јарослав Черни" Београд 1969.
3. Вероника Путарић Хидрологија Нови Сад 2003
4. John Pickford Water Laughborough University of Technology 1996
5. Љијић и Сундић Директиве ЕУ о водама Удружење за технологију воде и санитарно инж.Београд 2006

Number of classes of active teaching				Other
Lectures: 3	Exercises: 2	Other form of lectures: 0	Study and research work: 0	0

Teaching methods

Audit lectures and exercises.

Grade (maximum number of credits 100)

Pre-exam requirements	credits	Final exam	credits
activity during lectures	10	written exam	10
practical teaching	20	oral exam	30
colloquia	10		

seminar paper	20		

8.1.3 Water Treatment Methods and Technologies

Study programme: Water Protection
Level: Specialist professional studies
The name of the course: Water and Wastewater Treatment Methods and Technologies
Lecturer (Name, middle name, last name):
Course status: obligatory
Number of ECTS: 6
Prerequisites: /
Course objective Enabling students to acquire theoretical and practical knowledge of procedures and wastewater treatment plants. Presentation of primary, secondary and tertiary treatment procedures and their composition into unique processing lines. Presentation of basic physicochemical and biological procedures for the removal of pollutants from water, calculate treatment lines and acquire basic knowledge in the design of water treatment plants. Computational examples and assignments are combined with classroom teaching.
Learning outcomes A student should use the acquired knowledge in further studies and other complementary areas, for the purpose of solving various practical problems effectively. The overall outcome of the course is to give knowledge of process technology for present and future water purification and wastewater treatment, including construction, dimensioning, operation and management of treatment plants. After the course students should be able to: Calculate how to construct and manage different processes involved in sustainable water and wastewater treatment. Apply chemical and biological knowledge that the processes are based on for use in case studies. Apply innovative technologies for new systems and improvement of old systems to get better function and fulfill the requirement of the society. Propose sludge treatment technologies. Use computer models for development and design of processes. Operate and optimize treatment plants.
Content Introductory definitions (concept of pollution and water protection). Legislation and limits (GHVI) of water pollution. The characteristics of wastewater (physical, chemical and biological). Classification of water (the water I, II, III and IV class). Fundamentals of wastewater treatment processes (mechanical, chemical and biological). Basic methods of sludge treatment and sludge disposal. Different processes in water and wastewater treatment in natural and constructed systems, biological treatment processes particularly for the removal of phosphorus and nitrogen, processes based on filtration and chemical precipitation, sludge treatment technologies, systems and methods for recovery of nutrients from sewage, methods for process control and optimization.
Literature: 1. Љубосављевић Д., Ђукић А., Бабић Б Пречишћавање отпадних вода Грађевински факултет, Београд, 2004 2. Дегремонт Г. Техника пречишћавања отпадних вода ИП „Грађевинска књига“, Београд 1976

Number of classes of active teaching				Other
Lectures: 3	Exercises: 3	Other form of lectures: 0	Study and research work: 0	0

Teaching methods

Audit lectures and exercises.			
Grade (maximum number of credits 100)			
Pre-exam requirements	**credits**	Final exam	**credits**
activity during lectures	10	written exam	10
practical teaching	20	oral exam	30
colloquia	10		
seminar paper	20		

8.2 Link between competencies and courses

		Specialist professional studies		
		Mandatory Courses		
		Fundamentals of water protection	Basic principles of water management and policy	Water treatment methods and technologies
Generic Competencies	communicating, verbally and in writing, clearly and effectively	☒	☒	☒
	critical thinking			☒
	scenario modeling		☒	
	creativity	☒	☒	☒
	initiative			
	prediction of solutions and consequences			
	collaboration	☒	☒	☒
	working in multidisciplinary team	☒	☒	☒
	working autonomously			
	working in an international context			
	generating new research ideas			
	intensive use of ICT in acquiring knowledge and solving problems			☒
	solving complex multidisciplinary problems in theory and practice applying acquired knowledge			
	social and civil responsibility	☒	☒	☒
	development of professional ethics and responsibility	☒	☒	☒
	effective leadership		☒	
	strategic thinking		☒	
	experience-based critical decision making		☒	
	staying up-to-date with technological development		☒	
	knowledge transfer to the professional and wider public clearly and unambiguously			
	applying knowledge in practice	☒	☒	☒
	retrieving, analyzing and synthesizing data and information, with the use		☒	

	of necessary technologies			
	designing and managing projects			
	demonstrating social, professional and ethical commitment and sensitivity to gender issues	☒	☒	☒
	being critical and self-critical			
	responding to written material critically, effectively and efficiently		☒	
Engineering Competencies	understanding the wider context of the engineering discipline, its practical applications, societal impact and limitations	☒	☒	☒
	acceptance of the general principles and practices of engineering professional codes of conduct	☒	☒	☒
	following general laboratory, workshop and/or fieldwork safety guidance and precautions			☒
	mastering of methods, procedures and processes of risk identification	☒	☒	
	statistical data processing to define and derive adequate conclusions			
	understanding and using appropriate methods for research design regarding data collection and analysis, particularly focused on contemporary qualitative and quantitative methods, cognizant of the needs of special populations			
	using appropriate engineering software packages as an aid to research, analysis, problem solving and presentation of results			
	using computer systems to access learning resources, receive communications regarding the degree programme, undertake assessments and submit assignments			☒
	preparing technical drawings by hand			

	(following appropriate training)			
	producing sketches to communicate ideas and concepts			
	using appropriate equipment competently and safely (following appropriate training)			☒
	forming logical, reasonable conclusions and make sound recommendations based on available data and/or observations		☒	
	obtaining necessary data from scientific and technical documents, reports, and other reference materials			
	undertaking work with a high level of initiative and commitment to the task in hand		☒	
	preparing, processing, and interpreting data and/or observations using appropriate techniques			☒
	defining objectives for simple projects in a variety of engineering disciplines and developing and implementing basic work plans			
	drafting proposals, funding requests, and requests for proposals			
	defining information needs, including research needs , inventory, baseline studies, and follow-up monitoring		☒	
	developing innovative solutions to complex or intractable issues			
	using acquired theoretical and practical knowledge to solve new engineering problems	☒	☒	☒
	presenting written technical reports to others and to make oral presentations that are reasoned, logical and time-limited, to a variety of audiences			
	presenting ideas, key facts, problem solutions and results effectively, both orally and in writing,			

	in a variety of settings including group/team work			
WRM Competencies	understanding of climate changes, hydrological hazards and their effects on WRM			
	devising strategies and developing methodology and methods of emergency as part of WRM	☒	☒	
	optimizing and managing available resources in WRM systems			
	applying ICT in WRM		☒	☒
	development of human resources in WRM			
	applying specialized civil engineering fields in WRM			
	writing documents dealing with natural resource issues and technical information, drawn from a variety of sources			
	understanding of the Water Framework Directive and its implementation processes	☒	☒	☒
	using of mathematical models for the simulation of water related processes		☒	
	understanding the environmental pricing concept with emphasis to the value of the water			
	understanding the hydrologic cycle, the various natural processes and the simulation methods.	☒		
	defining the interaction of water with other sections, the water-energy-food-environment (WEFE) nexus approach			
	obtaining knowledge on the EU legislation for the water resources			☒
	applying modern tools that facilitate the spatiotemporal management of the water resources. Geographic Information Systems (GIS) and WRM			
	identification and analysis of problems in WRM			

	holistic and proactive approach to WRM issues			
	respecting natural environment		☒	☒
	identifying needs and priorities, including facilitation of group efforts to define and prioritize broad water resource program needs			
	implementing water supply and water efficiency plans and programs		☒	☒