

REPORT ON SWARM MASTER CURRICULA

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University of Nis



Strengthening of master curricula in water resources management
for the Western Balkans HEIs and stakeholders

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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 WP2.3 Innovation of existing and development of new master curricula for WRM in WB 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).

Inspired by the European Institution of Innovation and Technology (EIT), which is a body of the European Union, the aim of the specific activity WP2.3 is that the proposed master curricula (existing but ameliorated and new ones) doesn’t only provide the students with skills and knowledge necessary to succeed, but also to know what to do and how to solve real life problems. The goal of the proposed master programmes is to foster students to become more creative, innovative and entrepreneurs.

The present report initially presents the strategy that was followed for developing new courses and updating existing ones under the aim of innovative approaches. The latter chapters of the report present the list of the new courses, the purpose of the study program, aims and objectives, competencies, and curriculum structure per WB University.

2. Implemented strategy for courses innovation

The strategy that was proposed to be followed in order to integrate innovation issues in the existing and new courses is interconnected with the principal aim of the current programme, i.e. the strengthening of master curricula by promoting innovative but also well-established approaches. The proposed strategy is based on two principal issues:

- Utilization of knowledge produced during previous work packages and relevant actions, and
- Continuous consultation with the project partners for the selection of approaches and the decision making processes.

2.1 Utilization of knowledge produced during previous WPs

Regarding the utilization of the knowledge and work that was conducted during the first phases of the programme, the work that was implemented during previous actions of Work Package 2 (WP2) is utilized in the present activity WP2.3. The most characteristic example is the Catalogue of competences that was defined in activity WP2.1 (depicted in the Table 2.1), where, afterwards, the WB partners used these competencies to make the appropriate links among subjects and competencies.

The competences were obtained as a result of researching the existing water sector competence requirements and job profiles. This activity was performed by a heterogeneous team, consisting of stakeholders such as curriculum developers, teachers, educational managers, field experts and representatives from water sector. Together they analyzed and collected information about the competencies within the WRM domain and identified the competencies.

Table 2.1 Generic, engineering and water resources management competencies

General Competencies	Engineering Competencies	Water Resources Management Competencies
• communicating, verbally and in writing, clearly and effectively, • critical thinking, • scenario modeling, • creativity, • initiative, • prediction of solutions and consequences, • collaboration, • working in	• 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	• understanding of climate changes and hydrological hazards and their effects on WRM, • devising strategies and developing methodology and methods of emergency as part of WRM,

multidisciplinary team, • working in an international context, • working autonomously, • 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	and/or fieldwork safety guidance and precautions, • mastering of methods, procedures and processes of risk identification, • statistical data processing in order to define and make 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	• 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, • defining objectives for simple projects in a variety of disciplines and to develop and implement basic work plans, • 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
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material critically, effectively and efficiently	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 needs for research, 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	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.
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Further examples and references of material that was produced in WP1 and WP2 and are used during the implementation process of WP2.3 are mentioned in the following section.

2.2 From competence catalogue to curriculum development

As for the consultation process, in WP2.2 entitled as “Development of courses content and syllabi”, the WB project partners with the assistant of the EU partners proposed a set of courses per university and provided the courses content and syllabi. To do so, the procedure that was adopted and implemented is consisted of the following 4 interconnected steps:

- **Step 1.** The EU project partners created a report entitled as “EU Universities’ Courses and Syllabi”. In the report the relevant courses on the thematic of water resources management that are within the curricula of the EU Universities were identified and described. The report was used by the WB Universities as guidance to develop their proposed courses.
- **Step 2.** The project partners concluded on the new courses as well as the existing courses that wanted to be updated. The output of this process, i.e. the proposed number of courses per institution, which is clearly described in the WP2.1 and WP2.2 is summarized in the Table 2.2.

Table 2.2 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

- **Step 3.** A common format for the description of the courses was agreed among the WB project partners. The general form that was proposed and approved is presented in the Table 2.3.

Table 2.3 Form for courses description

Study programme:				
Level:				
The name of the course:				
Lecturer (Name, middle name, last name):				
Course status:				
Number of ECTS:				
Prerequisites:				
Course objective				
Learning outcomes				
Content				
Literature				
Number of classes of active teaching				Other
Lectures:	Exercises:	Other form of lectures:	Study and research work:	
Teaching methods				
Grade (maximum number of credits 100)				
Pre-exam requirements		Credits	Final exam	Credits
activity during lectures			written exam	
practical teaching			oral exam	
colloquia				
seminar paper				

- **Step 4.** The WB partners proposed the syllabus of the proposed courses. A consolidated document that included all the syllabi was created and was sent to the EU partners for their comments and reviews.
- **Step 5.** EU partners proceeded in the review of the proposed courses, their content, objective and teaching outcomes. A consolidated review was sent to the WB project partners.
- **Step 6.** The WB partners carefully deliberated the revised courses. Many comments were accepted, but there were also a lot of comments that couldn't be accepted, such as the change of the name of a course, since this is a process that needs approval at Ministerial level. The final report, i.e. the WP2.2 SWARM unique set of courses was produced.

It should be noted that all the aforementioned issues relative to learning outcomes, and teaching methods were introduced in the proposed syllabus per WB HEI.

In Table 2.4 the SWARM undergraduate study programme courses were summarized.

Table 2.4 SWARM undergraduate study programme courses

WB HEI	Course title	Type of course	ECTS
UNI	Hydrotechnical Facilities	Mandatory	5
	Water energy management	Elective	5
	Water Supply and Sewerage of Buildings	Elective	5
	Municipal Hydrotechnics	Elective	5
UPKM	Water Resources Management	Mandatory	5
	Modern methods in the preparation of drinking water	Mandatory	6
	Advanced techniques in wastewater treatment	Mandatory	6
	Protection and water resources management	Elective	5

In Table 2.5 the SWARM master study programme courses were summarized.

Table 2.5 SWARM master study programme courses

WB HEI	Course title	Type of course	ECTS
UNI	Water Resources Management	Elective	5
	Hydrological Risks Management	Elective	4
UNS	Environmental Practicum	Elective	7
	Groundwater Flow	Elective	7
	Alternative Separation Processes in Water Treatment	Mandatory	7
	Water Quality Management and Methods for Sediment Remediation	Mandatory	6
	Open Channel Hydraulics	Mandatory	6
	Fundamentals in hydrotechnics, hydromechanics and geotechnics	Elective	6
UNSA	Sewage Systems	Mandatory	5
	Water Protection I	Mandatory	5
	Treatment of drinking water	Mandatory	6
	Integral Water Resources Management	Elective	5
UNMO	Sustainable Management of Communal Water Supply Enterprises	Mandatory	6
	Water Protection	Elective	5
	Urban hydrology	Elective	5
UPKM	Groundwater use, protection and management	Elective	6
	Water treatment technologies in industry	Elective	5
UoM	Hydraulic Engineering	Mandatory	5
	Groundwater hydraulics	Mandatory	5
	Measurements in hydrotechnics	Mandatory	5

	River Engineering	Mandatory	5
TCASU	Basic Principles of Water Resources Management and Policy	Mandatory	6
	Fundamentals of Water Resources Protection	Mandatory	6
	Water and Wastewater Treatment Methods and Technologies	Mandatory	6

3. University of Nis

The University of Nis (UNI) will establish new bachelor and master programme studies in Engineering management with new courses related to water resources management. We intend to achieve the above by introducing new courses at the undergraduate level (first cycle qualifications). Also, appropriate courses related to water resources management will be introduced in the master study program in Engineering management (second cycle qualifications).

Programme input and output of new study programmes on our institution is shown on Figure 3.1 for undergraduate study, and Figure 3.2 for master study.

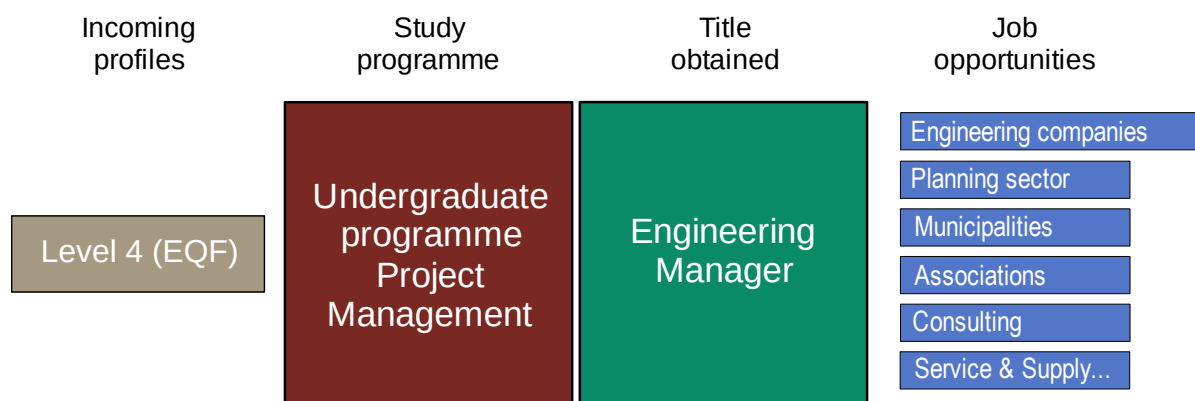


Figure 3.1 Input and output of the undergraduate study programme

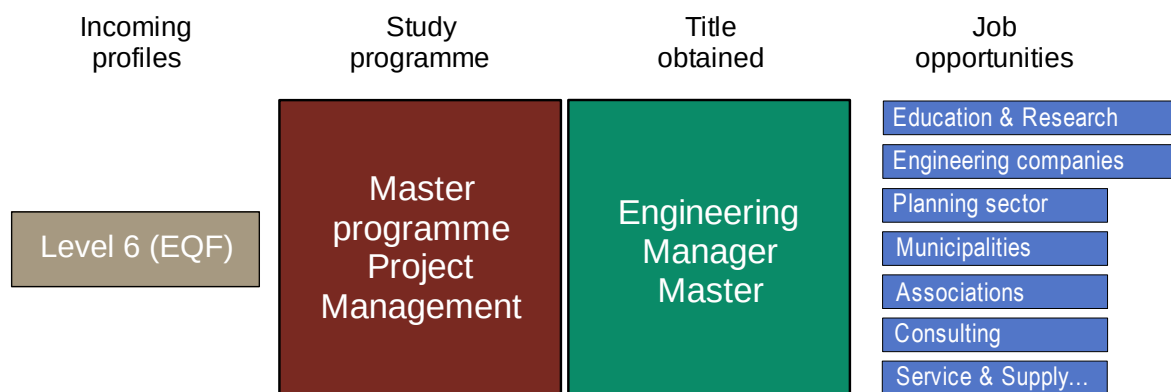


Figure 3.2 Input and output of the master study programme

The following sections will briefly give an overview of the study programs with the list of the new courses, the purpose of the study program, aims and objectives, competencies, and curriculum structure.

3.1 Programme description for undergraduate academic studies

Programme	Project management
Level:	Undergraduate academic studies
EQF level:	6th level
Academic title:	Engineering Manager – 240 ECTS
Language:	Serbian
Duration:	4 years – 8 semesters
ECTS credits:	240 ECTS
Knowledge:*	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles.
Skills:*	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialized field of
Responsibility and autonomy:*	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups.
* - in accordance with the European Qualifications Framework (EQF)	

Table 3.1 shows existing courses and courses which will be introduced on undergraduate study programme related to water resources management.

Table 3.1 Existing and new courses on the bachelor study programme

Existing courses	New courses
Fluid Mechanics (ES, III semester)	Hydrotechnical Facilities (OS, V semester)
Basics of Hydrology (ES, IV semester)	Water energy management (ES, V semester)
Hydrotehnics (OS, V semester)	Water Supply and Sewerage of Buildings (ES, VII semester)
Hydropower (ES, V semester)	Municipal Hydrotechnics (ES, VII semester)
Groundwater (ES, VI semester)	
Urban Hydrotehnics (ES, VII semester)	

OS - obligate subject, ES - elective subject

3.1.1 Purpose

The study programs in the field of engineering management at the Faculty of Civil Engineering and Architecture in Nis have a direct social mission to educate staff for the same large branch of industry, whose role in the overall development of society is crucial. Poor qualification and age structure of the staff is one of the consequences of the long stagnation in this industry. For this reason, there is a clear need for skilled engineering managers who need to get involved in working in this industry, and thus for their adequate education.

The program of undergraduate academic studies, being the first in a series of these programs, is primarily aimed at acquiring knowledge in the fundamental sciences related to

the engineering management profession, without neglecting the professional knowledge necessary for day-to-day engineering work. For students who will complete this degree, the program provides a wide range of competencies. Students who choose to pursue higher level academic studies receive a solid enough foundation for successfully pursuing more complex disciplines in advanced courses.

3.1.2 Aims and objectives

The Engineering Management study program was established with the following objectives:

- training students to apply the required knowledge in fundamental scientific disciplines (mathematics, physics, mechanics, etc.),
- achievement of professional competences of students in various fields of engineering management through scientific-professional and professional-applied subjects,
- developing students' creative abilities to consider engineering problems and their critical thinking skills,
- developing teamwork skills,
- developing professional ethics,
- developing the ability to publicly present work results,
- training in the use of common computer tools for document creation, presentation, budgeting, and simulation,
- training for continuing education at higher levels.

3.1.3 Competencies

By completing undergraduate Engineering Management study programme, the students acquire the following general competencies:

- identifying, describing and solving engineering problems,
- applying fundamental knowledge to solve practical problems in construction,
- using common computer tools for document creation, presentation, budgeting and simulation,
- sharing information, ideas, problems and solutions with people in and outside the profession,
- collaboration in team professional work,
- taking an ethical stance in solving engineering problems,
- applying critical and strategic thinking,

- social and civil responsibility,
- staying up-to-date with technological development,
- continuing education in graduate academic studies in engineering management or other related fields.

Engineering Management is a program that combines engineering courses with business management principles. Students obtain a comprehensive engineering education consisting of planning, scheduling, monitoring, and control of engineering projects while developing business expertise, social awareness, and organizational communication skills. On the bachelor's level, Engineering Management is a four-year degree that immerses students in a multidisciplinary field that deals with the technical, financial, strategic, and human resources components of the program. Graduates of this degree apply their experiential knowledge and skill set necessary for practical problem solving to address the complexities of the discipline.

3.1.4 Curriculum structure

The basic academic study program in Engineering Management lasts 4 years (divided into 8 semesters) and is worth 240 ECTS credits. The academic title acquired after graduation is a civil engineer. Curriculum structure encompasses distribution of courses over eight semesters, the fund of teaching hours during 30 working weeks of 1 school year and ECTS credits distribution (30 ECTS¹ in each of the eight semesters).

The study program covers fundamentally theoretical subjects such as mathematics, physics, design geometry, geology or mechanics. In addition, students gain basic practical knowledge in the application of computer technology.

All subjects of the study program are one-semester courses, and in most of them active teaching consists of lectures and computational exercises. Laboratory exercises (physics, construction materials, fluid mechanics, etc.) exist in a number of subjects. In addition to attending classes, students' obligations include a two-week professional internship worth 4 ECTS credits. Final year work is a compulsory part of the studies and is worth 15 ECTS credits.

Upon completion of this study program, students may continue their studies in the Master Academic Program in Engineering Management at the Faculty of Civil Engineering and Architecture in Nis or related studies in the country and abroad.

¹ 1 school year = 60 ECTS;

1 ECTS = 25-30 working hours;

1 school year = 60 x (25-30) = 1500-1800 working hours in all forms of engagement (active teaching, individual work, exams, etc.)

3.1.5 Enrolment

Minimal qualification is a completion of secondary school (4th level of EQF).

To apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

3.2 Programme description for master academic studies

Programme	PROJECT MANAGEMENT MASTER
Level:	Master academic studies
EQF level:	7 th level
Academic title:	Engineering Manager Master – 300 ECTS
Language:	Serbian
Duration:	1 year – 2 semesters
ECTS credits:	60 ECTS
Knowledge:*	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research. Critical awareness of knowledge issues in a field and at the interface between different fields.
Skills:*	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields.
Responsibility and autonomy:*	Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.
* - in accordance with the European Qualifications Framework (EQF)	

Table 3.2 shows existing courses and courses which will be introduced on master study programme related to water resources management.

Table 3.2 Existing and new courses on the master study programme

No	Existing courses	New courses
1	Water Treatment Plant Management (OS)	Water Resources Management (ES)
2	Drinking Water Purification (ES)	Hydrological Risks Management (ES)
3	Water Resources Management (ES)	

OS - obligate subject, ES - elective subject

3.2.1 Purpose

The study programs in the field of engineering management at the Faculty of Civil Engineering and Architecture in Nis have a direct social purpose to educate staff for the same large branch of industry, whose role in the overall development of society is crucial. At the moment, engineering projects in Serbia is experiencing a strong expansion after years of stagnation, which has caused poor qualification and age structure of staff. For this reason,

there is an evident need for qualified engineering managers who need to be involved in this process, and thus for their adequate education.

The Master's Degree Program in Project Management is primarily designed as a natural extension of the basic academic degree program of the same name, where students acquire fundamental scientific knowledge and expertise in the field of project management. Students who pursue studies in this program gain additional knowledge in specific fields of engineering management that do not represent day-to-day engineering practice, but rather complex fields that require additional knowledge and ability to perceive and address them. Also, this program represents a necessary intermediate step in academic education at the highest level. Students who choose to pursue academic studies in doctoral or specialist studies receive with this program a solid enough bases for further scientific and professional development.

The Faculty of Civil Engineering and Architecture in Nis is adapting to the new times in an effort to meet the current needs of society in this industry, while ensuring the highest academic standards, through the updated structural engineering and structural management study programs.

3.2.2 Aims and objectives

The Master's Degree Program in Engineering Management has been established with the following objectives:

- achievement of professional competences of students in various fields of engineering management (extended and deepened in relation to basic academic studies) and training for top professional jobs in the given field,
- training in development or scientific research in the chosen field of project management,
- training in the application of advanced computational models to solve technical problems,
- developing students' creative abilities to consider engineering problems and their critical thinking skills,
- developing professional ethics,
- training for further academic training in doctoral or specialist studies.

3.2.3 Competencies

By completing the Master's Degree Program in Engineering Management, the student acquires general academic and personal skills for:

- critical and self-critical evaluation of arguments, assumptions, concepts and data in decision making,

- solving engineering problems in a creative way,
- implementation of advanced computational models in solving technical problems,
- communication with the international environment,
- application of acquired knowledge in further academic education,
- research activities to analyze and solve specific problems in management theory and practice.

Through programme mastering, the student acquires the following competencies specific to the field of Engineering Management:

- ability to coordinate and administer programs, activities and protocols. Ability to manage resources, monitor activities and assess environmental risk, safety, and quality control associated with the program,
- evaluates and approves moderately complex program/project specifications for completeness, compatibility, compliance with engineering principles, standards, codes and design needs; performs inspections/audits to ensure that proper procedures are followed,
- manages moderately complex programs/projects for completeness, compatibility, and compliance with engineering principles and design needs and standards. Identifies and resolves project/program changes. Develops, communicates and defends moderately complex programs/projects. Ensures program/project stays within budget and/or schedule,
- mastering of methods, procedures and processes of risk identification,
- using acquired theoretical and practical knowledge to solve new engineering problems,
- applying ICT in water resources management,
- understanding of the Water Framework Directive and its implementation processes.

3.2.4 Curriculum structure

Graduate Academic Studies - Master's Degree Program in Engineering Management takes 2 semesters and is worth 60 ECTS credits. The academic title acquired after graduation is a Engineering Manager- Master.

Applicants with a previously completed undergraduate degree in engineering management who have earned at least 240 ECTS credits may apply for admission to the program of study. An enrollment list is formed based on success in undergraduate studies.

Master academic studies in engineering management are intended to deepen the academic competencies of students who have completed a previous degree in engineering management. In the course structure, the modules represent specific fields of engineering

management that do not represent everyday engineering practice, but rather complex fields that require additional knowledge and skills to understand and solve them.

All courses of the study program are listened to in one semester and are worth 30 ECTS credits, while the second semester is reserved for study research work on the preparation of the diploma thesis (worth 10 ECTS credits) and the preparation of the diploma thesis (20 ECTS credits).

Upon completion of this program, students may continue their education in the Doctoral Studies program in Engineering Management at home or abroad. In addition, students who complete this degree program also have a degree in specialist academic studies.

3.2.5 Enrolment

Minimal qualification is undergraduate academic degree in Engineering Management.

Minimal number of ECTS credits acquired during previous education is 240.

In order to apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

4. University of Novi Sad

The University of Novi Sad, Faculty of Technical Sciences will innovate existing programme studies in Water Treatment and Protection Engineering with new courses related to water resources management. We intend to achieve the above by introducing new courses in the master study program in Water Treatment and Protection Engineering (second cycle qualifications).

Programme input and output of study programmes on department of Environmental Engineering and Occupational Safety and Health at our institution is shown on Figure 4.1 for master study.

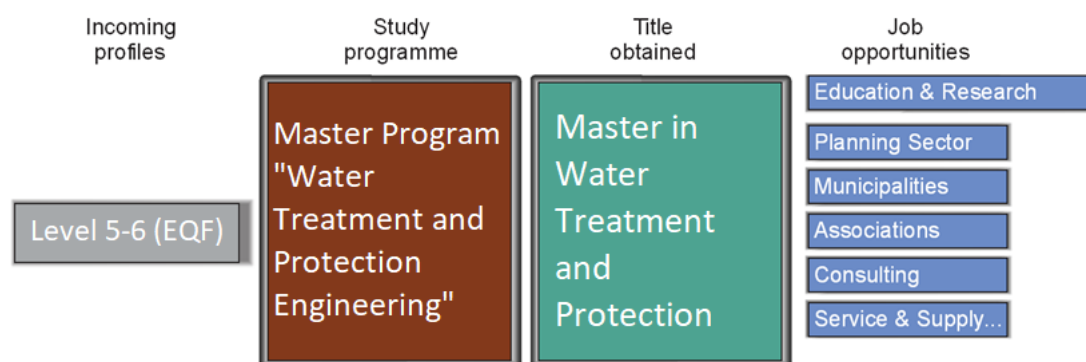


Figure 4.1 Input and output of the master study programme

The following sections will briefly give an overview of the study program with the list of the new courses, the purpose of the study program, aims and objectives, competencies, and curriculum structure.

4.1 Programme description for master academic studies

Programme	WATER TREATMENT AND SAFETY ENGINEERING
Level:	Master academic studies
EQF level:	7 th level
Academic title:	Master in Water Treatment and Protection 300 ECTS
Language:	Serbian
Duration:	2 years – 4 semesters
ECTS credits:	120 ECTS
Knowledge:*	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research. Critical awareness of knowledge issues in a field and at the interface between different fields.
Skills:*	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields.

Manage and transform work or study contexts that are complex, Responsibility unpredictable and require new strategic approaches; take and autonomy:* responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.

* - in accordance with the European Qualifications Framework (EQF)

Table 4.1 and Table 4.2 show existing courses and new courses (presented in red).

Types of courses:

AGE - Academic general education,

SE - Scientific-Expert,

TM - Theoretical and methodological,

PA - Professional and applicative

Table 4.1 Study program and distribution of courses per semester - first year (S-semester; T-Teaching; E-Exercises; SR – Study Research; OFT - Other forms of teaching, O – obligatory; E – elective; EC – Elective choice)

No.	Course code	Course title		S	Type	Status	Active lessons				Other classes	ECTS
							T	E	SR	OFT		
FIRST YEAR												
1	17.Z506	Advanced Course in Mathematics 1		1	AGE	O	2	1	0	1	0.00	3
2	17.MPK005	Analysis of environmental protection systems		1	TM	O	2	2	0	1	1.00	6
3	17.MPKI1	Elective Course 1 (choose 1of 2)		1		EC	2	3	0	0	0.00	6
		17.MPK04A	Fundamentals in hydrotechnics, hydromechanics and geotechnics	1	SE	E	2	3	0	0	0	6
		17.MPK21A	Chemical sources and environmental pollution	1	SE	E	2	3	0	0	0	6
4	17.MPKI3	Elective Course 2 (choose 1of 3)		1		EC	3	0-3	0	0-3	0.00-1.00	7
		17.Z503A	Environmental Practicum	1	TM	E	3	0	0	3	1	7
		17.MPK009	Hazards and Environment	1	TM	E	3	3	0	0	0	7
		17.MPK029	Groundwater flow	1	TM	E	3	2	0	1	0	7
5	17.MPKI11	Elective Course 3 (choose 1of 2)		1		EC	2	2	0	0	0.00	4
		17.MPK27A	Environmental Protection Systems Management	1	TM	E	2	2	0	0	0	4
		17.MPK015	Renewable Energy Technologies	1	TM	E	2	2	0	0	0	4
6	17.Z520	Material Flow Analysis		1	SE	O	2	0	0	2	0.00	4
7	17.MPK026	Technological processes in water quality control		2	SE	O	3	2	0	0	0.00	8
8	17.MPK028	Hydrotechnical Facilities and Systems		2	PA	O	2	2	0	1	0.00	6
9	17.MPK012	Waste Management		2	TM	O	2	2	0	0	0.00	5
10	17.MPK014	Monitoring and management of systems		2	PA	O	3	0	0	3	0.00	6
11	17.MPKI2	Elective Course 4 (choose 1of 2)		2		EB	2	2	0	0	0.00	5
		17.MPK022	Hydrometry	2	TM	E	2	2	0	0	0	5
		17.MPK023	Basics biological principles of environmental protection	2	TM	E	2	2	0	0	0	5
Active lessons - total							52					
											Total ECTS:	60

Table 4.2 Study program and distribution of courses per semester - second year (S – semester; T –Teaching ; E – Exercises; SR – Study Research; OFC - Other forms of teaching; O – obligatory; E – elective; EC – Elective choice)

No.	Course code	Course name		S	Type	Status	Active lessons				Other classes	ECTS
							T	E	SR	OFT		
SECOND YEAR												
12	17.MPK025	Drinking Water Treatment Process Design		3	SE	O	3	2	0	0	1.00	7
13	17.MPK16	Alternative separation processes in water treatment		3	PA	O	3	0	0	3	0.00	6
14	17.MPK18A	Water Quality Management and Methods for Sediment Remediation		3	PA	O	3	3	0	0	0.00	6
15	17.MPK0SP	Professional Practice		3	SE	O	0	0	0	0	6.00	4
16	17.MPK19	Open channel hydraulics		3	PA	O	2	2	0	0	0.00	6
17	17.MPK024	Designing of wastewater treatment processes		4	SE	O	3	3	0	0	0.00	5
18	17.MPKI21	Elective Course 1 (choose 1of 2)		4		EB	2	0-2	0	0-2	0.00	4
		17.Z452A	Designing environmental management system	4	TM	E	2	0	0	2	0	4
		17.MPK003	Advanced Sanitary Engineering	4	SE	E	2	2	0	0	0	4
19	17.MPKSIM	Master thesis - study research work		4	SE	O	0	0	10	0	0.00	12
20	17.MPK0ZR	Master thesis - preperation and defense		4	SE	O	0	0	0	0	7.00	10
Active lessons - total							41					
											Total ECTS	60

4.1.1 Purpose

The purpose of the curriculum is to educate students for the profession of Master in Water Treatment and Protection Engineering, in accordance with the basic needs of society. The curriculum Water Treatment and Protection Engineering is designed to provide acquisition of competence and skills that are socially justified and useful.

Graduate Master Students of Water Treatment and Protection Engineering are competent and qualified to solve complex multidisciplinary problems, both from the theoretical and practical point of view. Competencies include, above all, developing skills of critical and independent thinking, skills of problem analysis, solution synthesis, prediction and behavior of selected budget solutions with a clear idea of good and bad sides of the chosen solution.

An integrated part of the curriculum in Water Treatment and Protection Engineering is constituted by professional practice and practical work, for a total amount of 80 hours. This can be implemented in the relevant scientific research institutions, in organizations for innovation activities, in organizations which provide infrastructural support to innovation activities, in enterprises and public institutions. The educational goal of professional practice is to gain a direct knowledge about the working principles and the organization of those companies and institutions dealing with matters for which the student is getting qualifications and where he/she has the possibility of applying the acquired knowledge into

practice. The students learn how to apply the previously acquired theoretical and professional knowledge to solve specific practical engineering problems in the selected companies or institutions.

The issue of professional practice is to introduce the students into the activities of the selected companies or institutions, their ways of doing business and management. Performing professional practice is done in agreement with the management of companies or institutions, and in accordance with the needs of the profession for which the student is qualified.

4.1.2 Aims and objectives

The Master's Degree Program in Water Treatment and Protection has been established with the following objectives:

- achievement of professional competences of students in various fields of Water Treatment and Protection and training for top professional jobs in the given field,
- training in development in the chosen field of Water Treatment and Protection,
- developing students' creative abilities to consider engineering problems and their critical thinking skills,
- developing professional ethics.

4.1.3 Competencies

By completing the Master's Degree Program in Water Treatment and Protection, the student acquires general academic and personal skills for:

- critical and self-critical evaluation of arguments, assumptions, concepts and data in decision making,
- solving problems in a creative way,
- implementation of advanced computational models in solving technical problems,
- communication with the international environment,
- application of acquired knowledge in further academic education,
- research activities to analyze and solve specific problems in theory and practice,
- demonstrated theoretical knowledge and understanding in the field of environmental engineering, also increased by the knowledge gained at undergraduate studies. It is the basis to develop critical and independent thinking.
- apply knowledge for solving complex problems in the new or unknown environment,
- ability to integrate knowledge, solve complex engineering problems and to reason on the basis of information available, including considerations and responsibilities,

- ability to clearly and unambiguously transfer the knowledge and way of reasoning to professionals and general public,
- intensive use of ICT in acquiring knowledge and solving problems,
- knowledge transfer to the professional and wider public clearly and unambiguously,
- retrieving, analyzing and synthesizing data and information, with the use of necessary technologies,
- ability to continue their studies in individual way.

Through programme mastering, the student acquires the following competencies specific to the field of Water Treatment and Protection:

- design and construction of water treatment facilities,
- preparation of pre-investment studies and valuation of construction works and structures,
- application of methods for assessing the environmental impact of construction facilities and technical environmental measures in the process of planning, designing, constructing and maintaining the facilities.

4.1.4 Curriculum structure

Academic Studies - Master's Degree Program in Water Treatment and Protection takes 4 semesters and is worth 180 ECTS credits. The academic title acquired after graduation is a Master in Water Treatment and Protection

Applicants with a previously completed undergraduate degree who have earned at least 180 ECTS credits may apply for admission to the program of study. An enrollment list is formed based on success in undergraduate studies and entrance examination.

The curriculum of graduate academic studies in Water Treatment and Protection Engineering is designed for the purpose of achieving defined goals and competencies. The structure of the curriculum includes elective courses with at least 30% points. Through elective courses, students meet their affinities profiled during undergraduate academic studies. The fundamental scientific disciplines, which are studied at this level, define the research character of the program and enable even better understanding of the complex processes in the environment. They also lie the foundations for further scientific research at academic level. All courses last one semester and carry a certain number of points (one point corresponds to about 30 hours of student activities).

The study program includes the description of each course containing the name, the type of article, the year and the semester, the number of ECTS credits, the name of the teacher, the aims of the course and the expected outcomes, the knowledge and the competencies, the prerequisites for attending the course, the course content, the recommended literature, the methods of teaching, the way of testing and assessment knowledge. The study program

is consistent with European standards in terms of conditions of enrolment, duration of study, conditions of transition to the next year, graduation, and modes of study

4.1.5 Enrolment

A student has to complete the undergraduate studies with a minimum of 180 ECTS and to pass an entrance examination in order to be enrolled in the curriculum.

In order to apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

5. University of Sarajevo

The University of Sarajevo, Faculty of Civil Engineering will innovate existing programme studies in Water and Environmental Engineering with improving existing courses related to water resources management. We intend to achieve the above in the master study program in Water and Environmental Engineering (second cycle qualifications).

Programme input and output of study programmes on department of Water Engineering at our institution is shown on Figure 5.1 for master study.

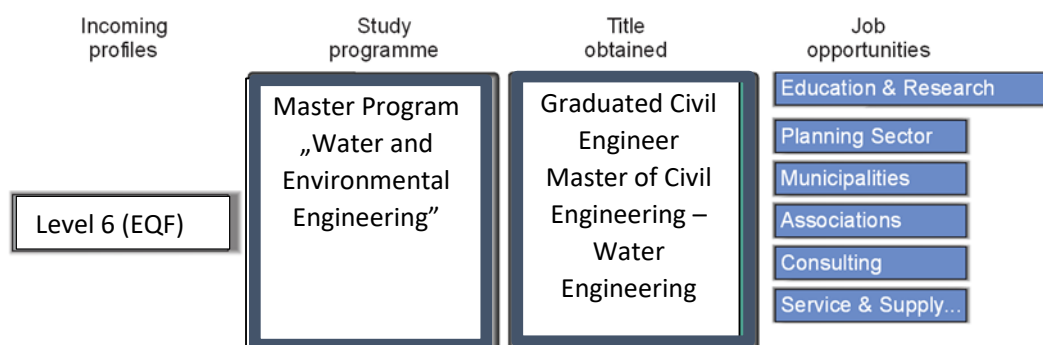


Figure 5.1 Input and output of the master study programme

The following sections will briefly give an overview of the study program with the list of the new courses, the purpose of the study program, aims and objectives, competencies, and curriculum structure.

5.1 Programme description for master academic studies

Programme title:	CIVIL ENGINEERING MASTER -WATER AND ENVIRONMENTAL EENGINEERING
Level:	Master academic studies
EQF level:	7 th level
Academic title:	Graduated Civil Engineer Master in Civil Engineering – 300 ECTS
Language:	Bosnian
Duration:	2 years – 4 semesters
ECTS credits:	120 ECTS
Knowledge:*	Highly specialized knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research. Critical awareness of knowledge issues in a field and at the interface between different fields.

- Skills:* Specialized problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields.
- Responsibility and autonomy:* Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.
- * - in accordance with the European Qualifications Framework (EQF)

Table 5.1 shows existing courses, existing courses which will be update.

Table 5.1 Master Study program and distribution of courses per semester - existing courses, existing courses which will be updated through the SWARM project

First semester

No.	Year/Semester	Course Title	M(andatory) /E(lective)	Classes	ECTS
1	I/I	Engineering Mathematics III	M	3+2	6
2	I/I	Hydrology	M	3+2	6
3	I/I	Water supply	M	3+2	6
4	I/I	Hydraulic	M	3+2	6
5	I/I	Treatment of drinking water	M	3+2	6

Second semester

No.	Year/Semester	Course Title	M(andatory) /E(lective)	Classes	ECTS
6	I/II	Environmental Protection	M	2+2	6
7	I/II	Sewage systems	M	3+2	6
8	I/II	Hydrogeology	M	3+2	6
9	I/II	Water Resources and Systems	E	3+2	6
10	I/II	Solid Waste Management	E	3+2	6
11	I/II	Hydrodynamic of ground water	E	3+2	6
12	I/II	Stochastic hydrology	E	3+2	6
13	I/II	Elective subject from others Department	E	3+2	6

Third semester

No.	Year/Semester	Course Title	M(andatory)/E(lective)	Classes	ECTS
14	II/III	Project management	M	2+2	5
15	II/III	Hydropower	M	3+2	7
16	II/III	Water Protection I	M	3+2	6
17	II/III	Treatment of waste water	M	3+2	6
18	II/III	River Engineering	M	3+2	6
19	II/III	Numeric hydraulic	E	3+2	6
20	II/III	Melioration system	E	3+2	6

Fourth semester

No.	Year/Semester	Course Title	M(andatory)/E(lective)	ECTS
1	II/IV	Master thesis - preparation work and defense	M	30

Table 5.2 Master Study program and distribution of courses per semester – changes made through the SWARM project, **existing courses – updated syllabus and changed course name**

First semester

No.	Year/Semester	Course Title	M(andatory)/E(lective)	Classes	ECTS
1	I/I	Engineering mathematics III	M	3+2	6
2	I/I	Hydrology	M	3+2	6
3	I/I	Water supply	M	3+2	6
4	I/I	Hydraulic	M	3+2	6
5	I/I	Treatment of drinking water	M	3+2	6

Second semester

No.	Year/Semester	Course Title	M(andatory)/E(lective)	Classes	ECTS
6	I/II	Environmental Protection	M	2+2	5
7	I/II	Sewage systems	M	3+2	5
8	I/II	Hydrogeology	M	3+2	6
9	I/II	Integral Water Resources	E	3+2	5

		Management			
10	I/II	Solid Waste Management	E	3+2	6
11	I/II	Hydrodynamic of ground water	E	3+2	5
12	I/II	Stochastic hydrology	E	3+2	5
13	I/II	Elective subject from others Department	E	According to subject	

Third semester

No.	Year/Semester	Course Title	M(andatory)/E(lective)	Classes	ECTS
14	II/III	Project management	M	2+2	5
15	II/III	Hydropower	M	3+2	5
16	II/III	Water Protection I	M	3+2	5
17	II/III	Treatment of waste water	M	3+2	5
18	II/III	River Engineering	M	3+2	5
19	II/III	Numeric hydraulic	E	3+2	5
20	II/III	Melioration system	E	3+2	5

Fourth semester

No.	Year/Semester	Course Title	M(andatory)/E(lective)	ECTS
1	II/IV	Master thesis - preparation work and defense	M	30

5.1.1 Purpose

The master study programme Water and Environmental Engineering covers the most important aspects of water resources and environmental engineering. Many of the courses included in the programme contain practical elements, which allow students to deepen their understanding of the more theoretical components and to develop both professional and academic skills. Regarding a vital role, there is an evident need for qualified civil - water engineers who need to be involved in this process, and thus for their adequate education.

The Master's Degree Program Water and Environmental Engineering is designed as a natural extension of the basic academic degree program, where students acquire fundamental scientific knowledge and expertise in the field of design and construction of various types of building structures that are of standard or lesser capacity. Students who pursue studies in this program gain additional knowledge in specific fields of water and environmental engineering resources, river engineering, ground water, designing of hydraulic

structures, application of fluid mechanics, hydroelectric-power development, water supply, irrigation and navigation, water protection etc.

The master study programme Water and Environmental Engineering covers the most important aspects of water resources and environmental engineering. Many of the courses included in the programme contain practical elements, which allow students to deepen their understanding of the more theoretical components and to develop both professional and academic skills.

Also, this program represents a necessary intermediate step in academic education at the highest level - doctoral studies and presents solid enough basis for further scientific and professional development.

5.1.2 Aims and objectives

The Master's Degree Program Water and Environmental Engineering has been established with the following objectives:

- achievement of professional competences of students in various fields of Water Treatment and Protection and training for top professional jobs in the given field,
- training in development or scientific research in the chosen field of water engineering,
- training in the application of advanced computational models to solve technical problems,
- developing students' creative abilities to consider engineering problems and their critical thinking skills,
- developing professional ethics,
- training for further academic training in doctoral or specialist studies.

5.1.3 Competencies

By completing the Master's Degree Program in Water Treatment and Protection, the student acquires general academic and personal skills for:

- critical and self-critical evaluation of arguments, assumptions, concepts and data in decision making,
- solving problems in a creative way,
- implementation of advanced computational models in solving technical problems,
- communication with the international environment,
- application of acquired knowledge in further academic education,
- research activities to analyze and solve specific problems in theory and practice,

- demonstrated theoretical knowledge and understanding in the field of environmental engineering, also increased by the knowledge gained at undergraduate studies. It is the basis to develop critical and independent thinking.
- apply knowledge for solving complex problems in the new or unknown environment,
- ability to integrate knowledge, solve complex engineering problems and to reason on the basis of information available, including considerations and responsibilities,
- ability to clearly and unambiguously transfer the knowledge and way of reasoning to professionals and general public,
- retrieving, analyzing and synthesizing data and information, with the use of necessary technologies,
- ability to continue their studies in individual way.

Through programme mastering, the student acquires the following competencies specific to the field of Water and Environmental Engineering:

- demonstrated capacity to solve problems by applying basic engineering and scientific principles, engineering processes and generic skills,
- identification and analysis of problems in WRM,
- design and construction of all types of hydrotechnical-construction,
- design and construction of all types of structures in the field of geotechnics,
- development and implementation of construction and equipment management projects,
- preparation of pre-investment studies and valuation of construction works and structures,
- provide technical and commercial management,
- devising strategies and developing methodology and methods of emergency as part of WRM,
- application of methods for assessing the environmental impact of construction facilities and technical environmental measures in the process of planning, designing, constructing and maintaining the facilities.

5.1.4 Curriculum structure

Graduate Academic Studies - Master's Degree Program Water and Environmental Engineering takes 4 semesters and is worth 120 ECTS credits. The academic title acquired after graduation is a Bachelor of Civil Engineering - Master.

Applicants with a previously completed undergraduate degree in civil engineering who have earned at least 180 ECTS credits may apply for admission to the program of study. An enrollment list is formed based on success in undergraduate studies.

Master academic studies in water and environmental engineering are intended to deepen the academic competencies of students who have completed a previous degree in civil engineering. In the course structure, the modules represent specific fields of civil engineering that do not represent everyday engineering practice, but rather complex fields that require additional knowledge and skills to understand and solve them.

The Structures module handles objects that should enable engineers to design and construct non-standard structures such as pipelines, river engineering structures, drinking and wastewater treatment plant, dams, irrigation systems, pumps stations, underground structures and the like. Elective courses include important theoretical subjects that provide the basis for more serious research.

All courses of the study program are listened to in three semester and are worth 120 ECTS credits, while the fourth semester is reserved for study research work on the preparation of the master thesis (worth 30 ECTS credits).

Upon completion of this program, students may continue their education in the Doctoral Studies program in Civil Engineering at home or abroad. In addition, students who complete this degree program also have a degree in specialist academic studies.

5.1.5 Enrolment

A student has to complete the undergraduate studies with a minimum of 180 ECTS and to pass an entrance examination in order to be enrolled in the curriculum.

In order to apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

6. Dzemal Bijedic University of Mostar

Dzemal Bijedic University of Mostar – UNMO within SWARM project will innovate existing programme studies in Civil engineering with courses related to water resources management. We intend to achieve the above by improving the existing courses at the master study program (second cycle qualifications).

Programme input and output of study programmes at Faculty of Civil Engineering on our institution (UNMO) is shown on Figure 6.1 for undergraduate study and Figure 6.2 for master study.

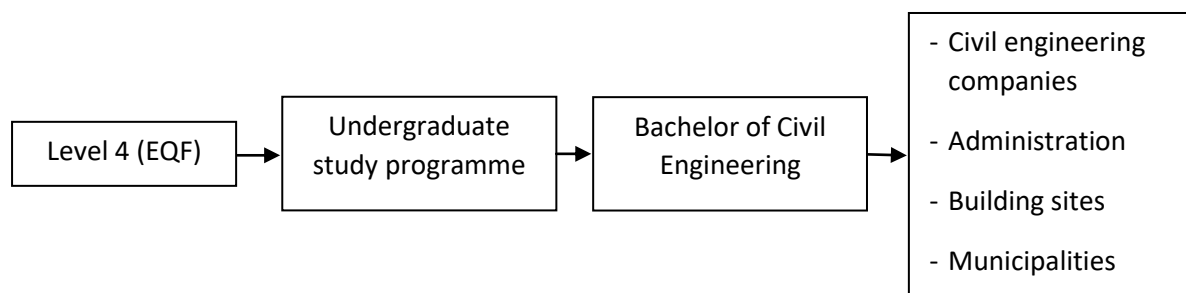


Figure 6.1 Input and output of the undergraduate study programme

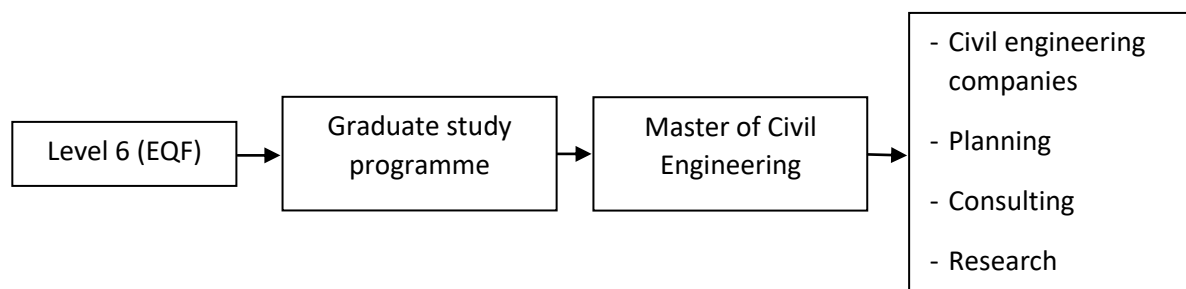


Figure 6.2 Input and output of the master study programme

The following sections will briefly give an overview of the study programs with the list of the courses that will be improved, the purpose of the study program, aims and objectives, competencies, and curriculum structure.

6.1 Programme description for undergraduate academic studies

Programme	CIVIL ENGINEERING – General studies
Level:	Undergraduate academic studies
EQF level:	6th level
Academic title:	Bachelor of Civil Engineer – 180 ECTS
Language:	Bosnian
Duration:	3 years – 6 semesters
ECTS credits:	180 ECTS
Knowledge:*	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles.
Skills:*	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of
Responsibility and autonomy:*	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups.
* - in accordance with the European Qualifications Framework (EQF)	

Table 6.1 shows existing courses on undergraduate study programme related to water resources management.

Table 6.1 Existing courses on the undergraduate study programme

Course title	Semester	Type of courses
Hydromechanics	III	Mandatory
Water supply and wastewater disposal	VI	Mandatory
Hydrotechnical buildings	VI	Mandatory

6.1.1 Purpose

The undergraduate study programme in the field of civil engineering at the Faculty of Civil Engineering, Dzemal Bijedic University of Mostar, has a mission to educate staff for the civil engineering industry sector. This part of the industry has always been in the need for qualified professionals, and the Dzemal Bijedic University of Mostar provided educated staff.

The undergraduate study programme, the first in a series of academic programmes, is primarily aimed at acquiring knowledge in the fundamental sciences related to the civil engineering profession, without neglecting the professional knowledge necessary for day-to-day engineering work. For students who will complete this degree, the program provides a wide range of competencies in the field of designing and executing various types of building structures that are standard or of lesser capacity. By completing these studies, the students can continue their studies in master study programme.

6.1.2 Aims and objectives

The Civil Engineering study program was established with the following objectives:

- training students to apply the required knowledge in fundamental scientific disciplines (mathematics, mechanics, geometry etc.),
- achievement of professional competences of students in various fields of civil engineering through scientific-professional and professional-applied subjects,
- developing teamwork skills,
- developing professional ethics,
- training in the use of common computer tools for document creation, presentation, budgeting, and simulation,
- training for continuing education at higher levels.

6.1.3 Competencies

By completing undergraduate Civil Engineering study programme, the students acquire the following general competencies:

- applying fundamental knowledge to solve practical problems in construction,
- using common computer tools for document creation, presentation, budgeting and simulation,
- communicating, verbally and in writing, clearly and effectively,
- sharing information, ideas, problems and solutions with people in and outside the profession,
- collaboration in team professional work,
- taking an ethical stance in solving engineering problems,
- solving complex multidisciplinary problems in theory and practice applying acquired knowledge,
- strategic thinking,
- staying up-to-date with technological development,
- retrieving, analyzing and synthesizing data and information, with the use of necessary technologies,
- continuing education in graduate academic studies in civil engineering or other related fields.

Through undergraduate programme, the student acquires the following competencies specific to the field of Civil Engineering:

- organization and management of smaller sites,
- designing smaller and simpler objects,
- analysis, understanding and drawing of projects,
- performing laboratory testing of building materials,
- execution of construction works on all types of low-capacity buildings,
- knowledge and application of various building materials and appropriate technologies,
- application of computational models for solving engineering problems in construction,
- understanding the wider context of the engineering discipline, its practical applications, societal impact and limitations,
- using computer systems to access learning resources, receive communications regarding the degree programme, undertake assessments and submit assignments,
- producing sketches to communicate ideas and concepts,
- defining objectives for simple projects in a variety of engineering disciplines and developing and implementing basic work plans,
- using acquired theoretical and practical knowledge to solve new engineering problems,
- devising strategies and developing methodology and methods of emergency as part of WRM,
- applying specialized civil engineering fields in WRM,
- holistic and proactive approach to WRM issues,
- respecting natural environment,
- implementing water supply and water efficiency plans and programs,
- reviewing the principles for environmental impact assessment of building structures.

6.1.4 Curriculum structure

The undergraduate academic study program in Civil Engineering lasts 3 years (divided into 6 semesters) with 180 ECTS credits. The academic title acquired after graduation is Bachelor of Civil engineering. Curriculum structure encompasses distribution of courses over six semesters, the fund of teaching hours during 30 working weeks of 1 school year and ECTS credits distribution (30 ECTS² in each of the six semesters).

² 1 school year = 60 ECTS;

1 ECTS = 25-30 working hours;

1 school year = 60 x (25-30) = 1500-1800 working hours in all forms of engagement (active teaching, individual work, exams, etc.)

The study program covers fundamentally theoretical subjects such as mathematics, design geometry, geology or mechanics. In addition, students gain basic practical knowledge in the application of computer technology for construction purposes.

The study program educates engineers whose role is to design and construct structures such as residential and commercial smaller buildings, industrial structures, retaining walls and more. Important theoretical subjects such as structures' static and material resistance are studied as well as professional subjects important for application in construction (concrete structures, metal structures, wooden structures).

Also, the study program empowers students to participate in the implementation of construction projects from a technical and technological standpoint, as well as from the point of view of organizing the project construction, finance, legal and professional regulations.

All subjects of the study program are one-semester courses, and in most of them active teaching consists of lectures and exercises. Laboratory exercises exist in a few number of subjects (materials, concrete technology). In addition to attending classes, students' obligations include a two-week professional internship in construction companies (design offices or construction sites) worth 3 ECTS credits. Final work is a compulsory part of the studies and is 5 ECTS credits.

Upon completion of this study program, students may continue their Master studies at Faculty of Civil Engineering (UNMO) or related studies in the country and abroad. At Faculty of Civil Engineering currently there are 3 active programmes at Master studies:

- General,
- Structural,
- Environmental infrastructure management.

6.1.5 Enrolment

Minimal qualification is a completion of secondary school – high school (4th level of EQF).

To apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

6.2 Programme description for master academic studies (Environmental infrastructure management)

Programme	Environmental infrastructure management
Level:	Master academic studies
EQF level:	7 th level
Academic title:	Master in Civil Engineering – Environmental infrastructure
Language:	Bosnian
Duration:	2 year – 4 semesters
ECTS credits:	120 ECTS
Knowledge:*	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research. Critical awareness of knowledge issues in a field and at the interface between different fields.
Skills:*	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields.
Responsibility and autonomy:*	Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.
* - in accordance with the European Qualifications Framework (EQF)	

Table 6.2 shows courses which will be introduced on undergraduate study programme related to water resources management.

Table 6.2 New courses on the master study programme

Course title	Semester	Type of courses
Water Protection	I	Elective
Urban hydrology	I	Elective
Sustainable Management of Communal Water Supply Enterprises	II	Mandatory

6.2.1 Purpose

The Environmental Infrastructure Management study program is a graduate program (2nd cycle of study program) at the Faculty of Civil Engineering, Džemal Bijedić University in Mostar. The program is intended for students with prior education in technical fields, to develop specific knowledge in the field of environmental infrastructure management. The program consists of two years of study (4 semesters) and research in the field of urban infrastructure. The program is developed through Erasmus+ project KLABS (Creating the Network of Knowledge Labs for Sustainable and Resilient Environments).

The program combines a variety of teaching and learning techniques, including lectures, seminar papers and a studio project covering activities in multiple subjects. It is designed to answer the need of specific trained staff in the field of environmental infrastructure management. In Bosnia and Herzegovina there is growing need for professionals that can cover fields such as water management, construction waste, use of renewable energy and materials. This program is providing it with high rate of success. The program is implemented through: obligatory courses, elective courses and master thesis.

Students who pursue studies in this program gain additional knowledge in specific fields of civil engineering that do not represent day-to-day engineering practice, but rather complex fields that require additional knowledge and ability to perceive and address them. Also, this program represents a necessary intermediate step in academic education at the highest level. Students who choose to pursue academic studies in doctoral or specialist studies receive with this program a solid enough bases for further scientific and professional development.

6.2.2 Aims and objectives

The Master's Degree Program Environmental Infrastructure Management has been established with the following objectives:

- achievement of professional competences of students in various fields of civil engineering (extended and deepened in relation to basic academic studies) and training for top professional jobs in the given field,
- training for further academic training in doctoral or specialist studies,
- performing high-level tasks in various branches of construction in the field of infrastructure: planning, design, construction, supervision and maintenance of complex construction structures, interventions and systems,
- transferring the acquired knowledge to future generations of students and presenting it to the public,
- interdisciplinary work and application of results in a context different from the one in which they were produced,
- conducting research activities,
- laying the foundations for development, scientific research and innovation.

6.2.3 Competencies

By completing the Master's Degree Program Environmental Infrastructure Management, the student acquires general academic and personal skills:

- critical and self-critical evaluation of arguments, assumptions, concepts and data in decision making,

- has the ability to integrate knowledge and deal with complex issues, and to formulate opinion based on incomplete or limited information, but with reflection on social and ethical responsibilities related to the application of their knowledge or courts,
- can convey their conclusions, knowledge and reflections upon which they are based, using appropriate language, to a non-specialist audience that is specialized, clear and unambiguous,
- has learning skills that allowing to continue studies in a way that will be mostly self-directed and autonomous,
- has acquired interdisciplinary and teamwork skills appropriate to different learning and employment contexts, demonstrates ability to lead and / or launch an initiative and contribute to application and development.

Through programme mastering, the student acquires the following competencies specific to the field of Environmental infrastructure management:

- integrates knowledge and skills in the field of water and utilities management,
- integrates knowledge and skills in the field of enterprise management for road planning, design, construction, monitoring and maintenance,
- integrates knowledge and skills in the field of durability of materials and structures,
- integrates knowledge and skills in the field of renewable energy and energy efficiency,
- acquires interdisciplinary, teamwork and communication skills appropriate to different learning and employment contexts, demonstrates the ability to lead and / or launch an initiative and contribute to application and development.

6.2.4 Curriculum structure

Graduate Academic Studies - Master's Degree Program in Environmental infrastructure management takes 4 semesters and is worth 120 ECTS credits. The academic title acquired after graduation is a Master of Civil Engineering - in Environmental infrastructure management.

Applicants with a previously completed undergraduate degree in technical sciences who have earned at least 180 ECTS credits may apply for admission to the program of study. An enrollment list is formed based on success in undergraduate studies.

Master academic studies in environmental infrastructure management are intended to deepen the academic competencies of students who have completed a previous degree in civil engineering or similar technical fields. In the course structure, specific fields of civil engineering that do not represent everyday engineering practice are studied, but rather complex fields that require additional knowledge and skills to understand and solve them.

The master study program consists of several complex areas:

- Water and waste management,

- Road management,
- Durability and sustainability of materials and structures,
- Renewable sources of energy,
- Urban planning,
- Energy efficiency.

All courses of the study program are listened to in three semesters and are worth 90 ECTS credits, while the last semester is reserved for study research work on the preparation of the master thesis (worth 30 ECTS credits). In addition, all three semesters have course Studio project, which is a form of students practice. The Studio project is an interdisciplinary research project and is realized through interactive teaching of several related subjects (primarily: instruments and tools of sustainable development, energy efficiency, optimization of buildings, sustainable energy sources, sustainable management of utility companies, wastewater disposal, geotechnical aspects of landfills, management and road maintenance). The course is designed to familiarize students with the complexities of infrastructure systems and projects implemented within them as well as to have direct contact with the economy.

Upon completion of this program, students may continue their education in the Doctoral Studies program at home or abroad.

6.2.5 Enrolment

Minimal qualifications are undergraduate academic degree in Civil Engineering or related Technical field.

Minimal number of ECTS credits acquired during previous education is 180.

In order to apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

7. University of Pristina in Kosovska Mitrovica

The University of Pristina in Kosovska Mitrovica (UPKM) will innovate existing programme studies in Environmental and occupational safety engineering with new courses related to water resources management. We intend to achieve the above by introducing new courses at the undergraduate level (first cycle qualifications). Also, appropriate courses related to water resources management will be introduced in the master study program in Environmental and occupational safety engineering (second cycle qualifications).

The undergraduate and master study programme of Environmental and occupational safety engineering was modernised. The following sections will briefly give an overview of the study programs with the list of the new courses, the purpose of the study program, aims and objectives, competencies, and curriculum structure.

7.1 Programme description for undergraduate academic studies

Programme	ENVIRONMENTAL AND OCCUPATIONAL SAFETY ENGINEERING
Level:	Undergraduate academic studies
EQF level:	6th level
Academic title:	Civil Engineer – Structural Civil Engineer – 240 ECTS
Language:	Serbian
Duration:	4 years – 8 semesters
ECTS credits:	240 ECTS
Knowledge:*	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles.
Skills:*	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialized field of work Manage complex technical or professional activities or projects, taking
Responsibility and autonomy:*	responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups.
* - in accordance with the European Qualifications Framework (EQF)	

Table 7.1 shows courses which will be introduced on undergraduate study programme related to water resources management field.

Table 7.1 Introduced courses on the undergraduate study programme

Course title	Number of ECTS	Type of courses
Water Resources Management	5	Mandatory
Modern methods in the preparation of drinking water	6	Mandatory
Advanced techniques in wastewater treatment	6	Mandatory
Protection and water resources management	5	Elective

7.1.1 Purpose

The study programs in the field of Environmental and occupational safety engineering at the Faculty of Technical Sciences in Kosovska Mitrovica have a direct social mission to educate staff for the same large branch of industry, whose role in the overall development of society is crucial. Poor qualification and age structure of the staff is one of the consequences of the long stagnation in this industry. For this reason, there is a clear need for skilled environmental and occupational safety engineers who need to get involved in working in this industry, and thus for their adequate education.

The program of undergraduate academic studies, being the first in a series of these programs, is primarily aimed at acquiring knowledge in the fundamental sciences related to the environmental and occupational safety engineering profession, without neglecting the professional knowledge necessary for day-to-day engineering work. For students who will complete this degree, the program provides a wide range of competencies in the field of designing and executing various types of building structures that are standard or of lesser capacity. Students who choose to pursue higher level academic studies receive a solid enough foundation for successfully pursuing more complex disciplines in advanced courses.

7.1.2 Aims and objectives

The Environmental and occupational safety engineering study program was established with the following objectives:

- training students to apply the required knowledge in fundamental scientific disciplines (mathematics, physics, mechanics, etc.),
- achievement of professional competences of students in various fields of civil engineering through scientific-professional and professional-applied subjects,
- developing students' creative abilities to consider engineering problems and their critical thinking skills,
- developing teamwork skills,
- developing professional ethics,
- developing the ability to publicly present work results,
- training in the use of common computer tools for document creation, presentation, budgeting, and simulation,
- training for continuing education at higher levels.

7.1.3 Competencies

By completing undergraduate Environmental and occupational safety engineering study programme, the students acquire the following general competencies:

- identifying, describing and solving engineering problems,
- applying fundamental knowledge to solve practical problems in environmental and occupational safety engineering,
- using common computer tools for document creation, presentation, budgeting and simulation,
- sharing information, ideas, problems and solutions with people in and outside the profession,
- collaboration in team professional work,
- taking an ethical stance in solving engineering problems,
- social and civil responsibility,
- intensive use of ICT in acquiring knowledge and solving problems,
- prediction of solutions and consequences,
- continuing education in graduate academic studies in environmental and occupational safety engineering or other related fields.

Through undergraduate programme, the student acquires the following competencies specific to the field of Environmental and occupational safety engineering:

- design and construction of high-rise buildings and associated facilities,
- design of construction organization and technology,
- execution of construction works on all types of low-capacity buildings,
- knowledge and application of various building materials and appropriate technologies,
- application of computational models for solving engineering problems in environmental and occupational safety engineering,
- reviewing the principles for environmental impact assessment of building structures.

7.1.4 Curriculum structure

The basic academic study program in Environmental and occupational safety engineering lasts 4 years (divided into 8 semesters) and is worth 240 ECTS credits. The academic title acquired after graduation is an environmental and occupational safety engineer. Curriculum structure encompasses distribution of courses over eight semesters, the fund of teaching

hours during 30 working weeks of 1 school year and ECTS credits distribution (30 ECTS³ in each of the eight semesters).

The study program covers fundamentally theoretical subjects such as mathematics, physics, design geometry, geology or mechanics. In addition, students gain basic practical knowledge in the application of computer technology for construction purposes.

The study program educates engineers whose role is to design and execute structures such as residential and commercial buildings, industrial structures, retaining walls, antenna columns and more. Important theoretical subjects such as structural theory are studied as well as professional subjects important for application in construction (concrete structures, metal structures, wooden structures).

Also, the study program empowers students to participate in the implementation of construction projects from a technical and technological standpoint, as well as from the point of view of organizing the execution of all project work, development of information systems, finance, legal and professional regulations.

All subjects of the study program are one-semester courses, and in most of them active teaching consists of lectures and computational exercises. Laboratory exercises (physics, construction materials, fluid mechanics, etc.) exist in a number of subjects. In addition to attending classes, students' obligations include a two-week professional internship in construction companies (design offices or construction sites) worth 2 ECTS credits. Final year work is a compulsory part of the studies and is worth 12 ECTS credits.

Upon completion of this study program, students may continue their studies in the Master Academic Program in Environmental and occupational safety engineering at the Faculty of Technical Sciences in Kosovska Mitrovica or related studies in the country and abroad.

7.1.5 Enrolment

Minimal qualification is a completion of secondary school (4th level of EQF).

To apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

³ 1 school year = 60 ECTS;

1 ECTS = 25-30 working hours;

1 school year = 60 x (25-30) = 1500-1800 working hours in all forms of engagement (active teaching, individual work, exams, etc.)

7.2 Programme description for master academic studies

Programme	Environmental and occupational safety engineering
Level:	Master academic studies
EQF level:	7 th level
Academic title:	Graduated Civil Engineer Master – Structural Engineer – 300 ECTS
Language:	Serbian
Duration:	1 year – 2 semesters
ECTS credits:	60 ECTS
Knowledge:*	Highly specialised knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research. Critical awareness of knowledge issues in a field and at the interface between different fields.
Skills:*	Specialised problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields.
Responsibility and autonomy:*	Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.

* - in accordance with the European Qualifications Framework (EQF)

Table 7.2 shows courses which will be introduced on master study programme related to water resources management field.

Table 7.2 Introduced courses on the master study programme

Course title	Number of ECTS	Type of courses
Groundwater use, protection and management	6	Elective
Water treatment technologies in industry	5	Elective

7.2.1 Purpose

The study programs in the field of Environmental and occupational safety engineering at the Faculty of Technical Sciences in Kosovska Mitrovica have a direct social purpose to educate staff for the same large branch of industry, whose role in the overall development of society is crucial. At the moment, construction in Serbia is experiencing a strong expansion after years of stagnation, which has caused poor qualification and age structure of staff. For this reason, there is an evident need for qualified environmental and occupational safety engineers who need to be involved in this process, and thus for their adequate education.

The Master's Degree Program in Environmental and occupational safety engineering is primarily designed as a natural extension of the basic academic degree program of the same name, where students acquire fundamental scientific knowledge and expertise in the field of design and construction of various types of building structures that are of standard or lesser capacity. Students who pursue studies in this program gain additional knowledge in specific fields of Environmental and occupational safety engineering that do not represent day-to-day engineering practice, but rather complex fields that require additional knowledge and ability to perceive and address them. Also, this program represents a necessary intermediate step in academic education at the highest level. Students who choose to pursue academic studies in doctoral or specialist studies receive with this program a solid enough bases for further scientific and professional development.

The Faculty of Technical Sciences is adapting to the new times in an effort to meet the current needs of society in this industry, while ensuring the highest academic standards, through the updated Environmental and occupational safety engineering study programs.

7.2.2 Aims and objectives

The Master's Degree Program in Environmental and occupational safety engineering has been established with the following objectives:

- achievement of professional competences of students in various fields of environmental and occupational safety engineering (extended and deepened in relation to basic academic studies) and training for top professional jobs in the given field,
- training in development or scientific research in the chosen field of environmental and occupational safety engineering,
- training in the application of advanced computational models to solve technical problems,
- developing students' creative abilities to consider engineering problems and their critical thinking skills,
- developing professional ethics,
- training for further academic training in doctoral or specialist studies.

7.2.3 Competencies

By completing the Master's Degree Program in Environmental and occupational safety engineering, the student acquires general academic and personal skills for:

- critical and self-critical evaluation of arguments, assumptions, concepts and data in decision making,
- solving engineering problems in a creative way,

- working in multidisciplinary team,
- intensive use of ICT in acquiring knowledge and solving problems,
- staying up-to-date with technological development,
- being critical and self-critical,
- implementation of advanced computational models in solving technical problems,
- communication with the international environment,
- application of acquired knowledge in further academic education,
- research activities to analyze and solve specific problems in construction theory and practice.

Through programme mastering, the student acquires the following competencies specific to the field of Environmental and occupational safety engineering:

- design and execution of works on rehabilitation and reconstruction of damaged buildings,
- design and construction of all types of structures in the field of geotechnics,
- development and implementation of construction and equipment management projects,
- preparation of pre-investment studies and valuation of construction works and structures,
- application of methods for assessing the environmental impact of construction facilities and technical environmental measures in the process of planning, designing, constructing and maintaining the facilities.

7.2.4 Curriculum structure

Graduate Academic Studies - Master's Degree Program in Environmental and occupational safety engineering takes 2 semesters and is worth 60 ECTS credits. The academic title acquired after graduation is a Bachelor of Environmental and occupational safety engineering - Master.

Applicants with a previously completed undergraduate degree in environmental and occupational safety engineering who have earned at least 240 ECTS credits may apply for admission to the program of study. An enrollment list is formed based on success in undergraduate studies.

Master academic studies in Environmental and occupational safety engineering are intended to deepen the academic competencies of students who have completed a previous degree in Environmental and occupational safety engineering. In the course structure, the modules represent specific fields of Environmental and occupational safety engineering that do not represent everyday engineering practice, but rather complex fields that require additional knowledge and skills to understand and solve them.

All courses of the study program are listened to in one semester and are worth 25 ECTS credits, while the second semester is reserved for study research work on the preparation of the diploma thesis (worth 10 ECTS credits) and the preparation of the diploma thesis (20 ECTS credits). In addition to attending classes, students' obligations include a one-month professional practice (5 ECTS), which is carried out at design bureaus, scientific institutes or government institutions in the field of construction and related fields.

Upon completion of this program, students may continue their education in the Doctoral Studies program in Environmental and occupational safety engineering at home or abroad. In addition, students who complete this degree program also have a degree in specialist academic studies.

7.2.5 Enrolment

Minimal qualification is undergraduate academic degree in Environmental and occupational safety engineering.

Minimal number of ECTS credits acquired during previous education is 240.

In order to apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

8. University of Montenegro

According to the final accreditation of the University of Montenegro and Faculty of Civil Engineering there is an accredited program of Master studies called “Civil Engineering - Water Engineering”. Starting with the study year 2017/18, the basic, master and doctoral studies are organized according to the system of studying 3+2+3.

Master studies of Water Engineering take two years, that is four semesters and they have 120 ECTS credits. The studies offer competence in hhydraulics engineering, urban water management, ground-water hydrology, water resources systems and water resources policy. The study plan and program envisage a total of 18 subjects related to the problem of water engineering.

Programme input and output of study programmes on Faculty of Civil Engineering on our institution is shown on Figure 8.1 for undergraduate study and Figure 8.2 for master study.

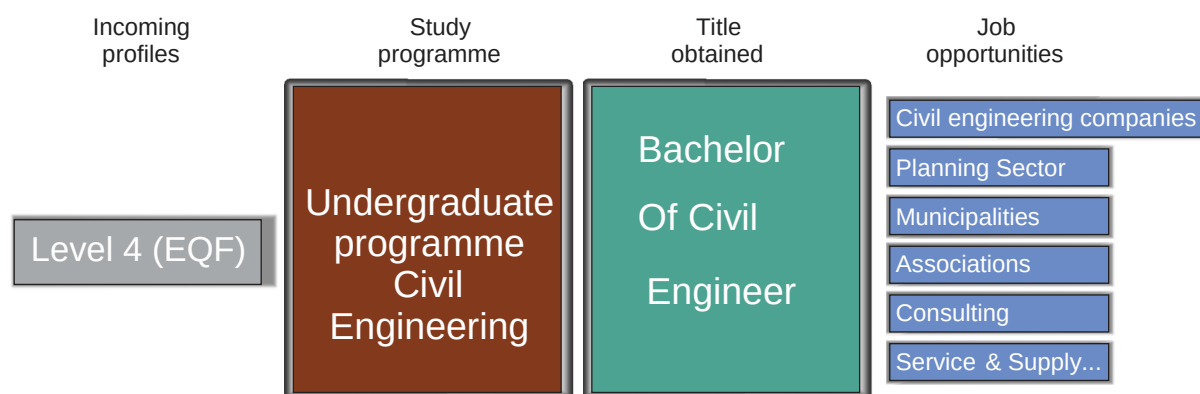


Figure 8.1 Input and output of the undergraduate study programme, first three years

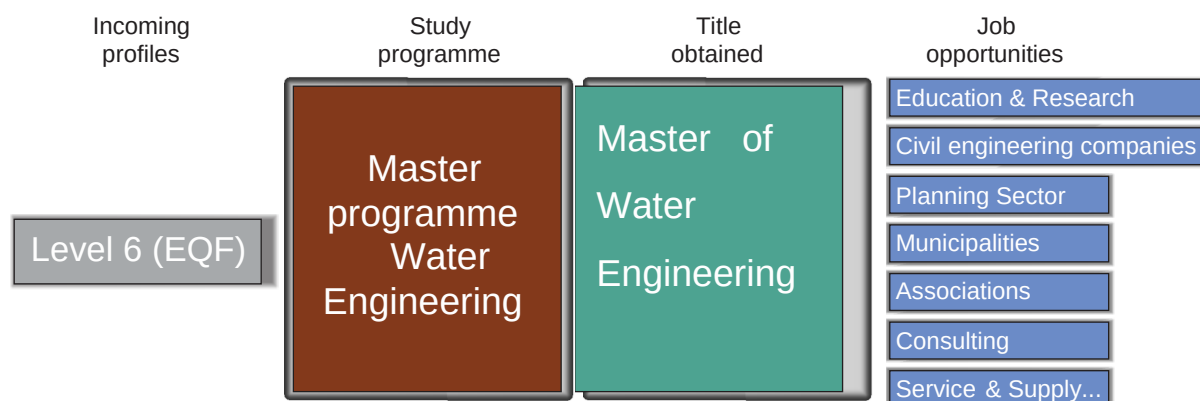


Figure 8.2 Input and output of the master study programme

The following sections will briefly give an overview of the study programs with the list of the courses, the purpose of the study program, aims and objectives, competencies, and curriculum structure.

8.1 Programme description for undergraduate academic studies

Programme	CIVIL ENGINEERING
Level:	Undergraduate academic studies
EQF level:	6th level
Academic title:	Civil Engineer –Bachelor of Civil Engineering – 180 ECTS
Language:	Montenegrin
Duration:	3 years – 6 semesters
ECTS credits:	180 ECTS
Knowledge:*	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles.
Skills:*	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialized field of
Responsibility and autonomy:*	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups.
* - in accordance with the European Qualifications Framework (EQF)	

Figure 8.3 shows existing course on undergraduate study programme related to water resources management.

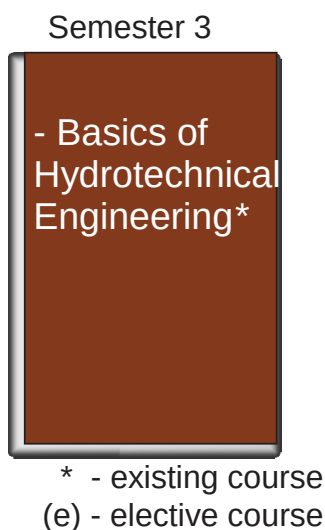


Figure 8.3 Existing course on the undergraduate study programme

8.1.1 Purpose

The Faculty of Civil Engineering is an organizational unit of University of Montenegro and it operates in accordance with the Statute of University of Montenegro. The study programs in the field of civil engineering at the Faculty of Civil Engineering, at University of Montenegro, have a direct social mission to educate staff for the same large branch of industry, whose role in the overall development of society is crucial. The main objective of the Faculty is to improve the teaching process and research activities conducted in cooperation with both national and international subjects.

The program of undergraduate academic studies is primarily aimed at acquiring knowledge in the fundamental sciences related to the civil engineering profession, without neglecting the professional knowledge necessary for day-to-day engineering work. For students who will complete this degree, the program provides a wide range of competencies in the field of designing and executing various types of engineering structures that are standard or of lesser capacity. Students who choose to pursue higher level academic studies receive a solid enough foundation for successfully pursuing more complex disciplines in advanced courses.

8.1.2 Aims and objectives

The Civil Engineering study program was established with the following objectives:

- training students to apply the required knowledge in fundamental scientific disciplines (mathematics, physics, mechanics, etc.),
- achievement of professional competences of students in various fields of civil engineering through scientific-professional and professional-applied subjects,
- developing students' creative abilities to consider engineering problems and their critical thinking skills,
- developing teamwork skills,
- developing professional ethics,
- developing the ability to publicly present work results,
- training in the use of common computer tools for document creation, presentation, budgeting, and simulation,
- training for continuing education at higher levels.

8.1.3 Competencies

By completing undergraduate Civil Engineering study programme, the students acquire the following general competencies:

- identifying, describing and solving engineering problems,
- applying fundamental knowledge to solve practical problems in construction,
- using common computer tools for document creation, presentation, budgeting and simulation,
- sharing information, ideas, problems and solutions with people in and outside the profession,
- working in multidisciplinary team,
- prediction of solutions and consequences,
- solving complex multidisciplinary problems in theory and practice applying acquired knowledge,
- development of professional ethics and responsibility,
- collaboration in team professional work,
- taking an ethical stance in solving engineering problems,
- continuing education in graduate academic studies in civil engineering or other related fields.

Through undergraduate programme, the student acquires the following competencies specific to the field of Civil Engineering:

- design and construction of high-rise buildings and associated facilities,
- design and construction of hydro-technical facilities and hydro-technical infrastructure of lower capacity,
- design of construction organization and technology,
- execution of construction works on all types of low-capacity buildings,
- knowledge and application of various building materials and appropriate technologies,
- application of computational models for solving engineering problems in construction,
- reviewing the principles for environmental impact assessment of building structures.

8.1.4 Curriculum structure

The basic academic study program in Civil Engineering lasts 3 years (divided into 6 semesters) and is worth 180 ECTS credits. The academic title acquired after graduation is a bachelor of civil engineering. Curriculum structure encompasses distribution of courses over six semesters, the fund of teaching hours during 30 working weeks of 1 school year and ECTS credits distribution (30 ECTS⁴ in each of the six semesters).

The study program covers fundamentally theoretical subjects such as mathematics, physics, design geometry, geology or mechanics. In addition, students gain basic practical knowledge in the application of computer technology for construction purposes.

The study program educates engineers whose role is to design and execute structures such as residential and commercial buildings, retaining walls, municipal infrastructure and more. Important theoretical subjects such as structural theory are studied for application in construction (concrete structures, metal structures, wooden structures).

Also, the study program empowers students to participate in the implementation of construction projects from a technical and technological standpoint, as well as from the point of view of organizing the execution of all project work, development of information systems, finance, legal and professional regulations.

All subjects of the study program are one-semester courses, and in most of them active teaching consists of lectures and computational exercises. Laboratory exercises (construction materials, traffic engineering, structural investigation, etc.) exist in a number of subjects. In addition to attending classes, students' obligations include a two-week professional internship in construction companies (design offices or construction sites) worth 2 ECTS credits.

Upon completion of this study program, students may continue their studies in the Master Academic Program in Civil Engineering at the Faculty of Civil Engineering in Podgorica or related studies abroad.

8.1.5 Enrolment

Minimal qualification is a completion of secondary school (4th level of EQF).

To apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

⁴ 1 school year = 60 ECTS;

1 ECTS = 25-30 working hours;

1 school year = 60 x (25-30) = 1500-1800 working hours in all forms of engagement (active teaching, individual work, exams, etc.)

8.2 Programme description for master academic studies

Programme title:	CIVIL ENGINEERING MASTER – STUDY PROGRAMME INFRASTRUCTURE –
Level:	Master academic studies
EQF level:	7 th level
Academic title:	Graduated Civil Engineer Master – WATER ENGINEERING – 300 ECTS
Language:	Montenegrin
Duration:	2 year –4 semesters
ECTS credits:	120 ECTS
Knowledge:*	Highly specialized knowledge, some of which is at the forefront of knowledge in a field of work or study, as the basis for original thinking and/or research. Critical awareness of knowledge issues in a field and at the interface between different fields.
Skills:*	Specialized problem-solving skills required in research and/or innovation in order to develop new knowledge and procedures and to integrate knowledge from different fields.
Responsibility and autonomy:*	Manage and transform work or study contexts that are complex, unpredictable and require new strategic approaches; take responsibility for contributing to professional knowledge and practice and/or for reviewing the strategic performance of teams.
* - in accordance with the European Qualifications Framework (EQF)	

Table 8.1 shows existing courses on master study programme related to water resources management.

Table 8.1 Existing courses on the master study programme

	Name of the subject	Sem.	The number of classes			No. ECTS
			L	E	LB	
FIRST YEAR						
I - COMMON SEMESTER						
1	ENGINEERING GEODESY	I	2	1	1	5
2	ENGINEERING GEOLOGY	I	2	1	1	5
3	PROJECT MANAGEMENT	I	2	1	1	5
4	ENGINEERING HYDRAULICS	I	2	1	1	5
5	HYDROLOGY	I	2	1	1	5
6	MANAGEMENT IN CIVIL ENGINEERING	I	3	1	1	5
Total of active teaching			13	6	6	
Total of ECTS credits						30
MODULE 2 WATER ENGINEERING – II – SEMESTER						
1	ENGINEERING HYDROLOGY	II	2	1	1	5
2	HYDRAULIC STRUCTURES	II	2	1	1	5
3	MUNICIPAL HYDROTECHNICS	II	3	1	1	5
4	WATER PROTECTION AND QUALITY	II	2	1	1	5
5	RIVER REGULATION	II	2	1	1	5
6	MODELING IN HYDRAULIC ENGINEERING	II	1	0	3	5
Total of active teaching			12	5	8	
Total of ECTS credits						30
SECOND YEAR						
MODULE 2 WATER ENGINEERING – III – SEMESTER						
1	WATER TREATMENT	III	2	1	1	5
2	MEASUREMENTS IN HYDROTHETICS	III	2	1	1	5
3	USE OF WATER POWER	III	3	1	1	6
4	DRAINAGE AND IRRIGATION	III	2	1	1	5
5	PORTS AND HARBORS	III	2	1	0	4
6	HYDRAULIC OF GROUNDWATERS	III	2	1	1	5
7	MASTER'S THESIS	IV	13	6	6	30.0
Total of active teaching			26	12	11	
Total of ECTS credits						60

8.2.1 Purpose

The master study programme Water Engineering covers the most important aspects of water resources engineering. Many of the courses included in the programme contain practical elements, which allow students to deepen their understanding of the more theoretical components and to develop both professional and academic skills. At the moment, construction in Montenegro is experiencing a strong expansion after years of stagnation, which has caused poor qualification and age structure of staff. Civil engineers play a vital role in the optimal planning, design and operation of water resource systems too. For this reason, there is an evident need for qualified civil - water engineers who need to be involved in this process, and thus for their adequate education.

The Master's Degree Program Water Engineering is designed as a natural extension of the basic academic degree program, where students acquire fundamental scientific knowledge and expertise in the field of design and construction of various types of building structures

that are of standard or lesser capacity. Students who pursue studies in this program gain additional knowledge in specific fields of water engineering resources, designing of hydraulic structures, application of fluid mechanics, hydroelectric-power development, water supply, irrigation and navigation, etc.

Also, this program represents a necessary intermediate step in academic education at the highest level - doctoral studies and presents solid enough basis for further scientific and professional development.

8.2.2 Aims and objectives

The Master's Degree Program –Water Engineering has been established with the following objectives:

- achievement of professional competences of students in various fields of water engineering and training for top professional jobs in the given field,
- training in development or scientific research in the chosen field of water engineering,
- training in the application of advanced computational models to solve technical problems,
- developing students' creative abilities to consider engineering problems and their critical thinking skills,
- developing professional ethics,
- training for further academic training in doctoral or specialist studies.

8.2.3 Competencies

By completing the Master's Degree Program of Water Engineering, the student acquires general academic and personal skills for:

- critical and self-critical evaluation of arguments, assumptions, concepts and data in decision making,
- solving engineering problems in a creative way,
- implementation of advanced computational models in solving technical problems,
- communication with the international environment,
- application of acquired knowledge in further academic education,
- development of professional ethics and responsibility,
- experience-based critical decision making,
- applying knowledge in practice,

- retrieving, analyzing and synthesizing data and information, with the use of necessary technologies,
- responding to written material critically, effectively and efficiently,
- research activities to analyze and solve specific problems in construction theory and practice.

Through programme mastering, the student acquires the following competencies specific to the field of Water Engineering:

- demonstrated capacity to solve problems by applying basic engineering and scientific principles, engineering processes and generic skills,
- design and construction of all types of hydrotechnical-construction,
- design and construction of all types of structures in the field of geotechnics,
- development and implementation of construction and equipment management projects,
- preparation of pre-investment studies and valuation of construction works and structures,
- provide technical and commercial management,
- application of methods for assessing the environmental impact of construction facilities and technical environmental measures in the process of planning, designing, constructing and maintaining the facilities.

8.2.4 Curriculum structure

Graduate Academic Studies - Master's Degree Program Water Engineering takes 4 semesters and is worth 120 ECTS credits. The academic title acquired after graduation is a Bachelor of Civil Engineering - Master.

Applicants with a previously completed undergraduate degree in civil engineering who have earned at least 180 ECTS credits may apply for admission to the program of study. An enrollment list is formed based on success in undergraduate studies.

Master academic studies in water engineering are intended to deepen the academic competencies of students who have completed a previous degree in civil engineering. In the course structure, the modules represent specific fields of civil engineering that do not represent everyday engineering practice, but rather complex fields that require additional knowledge and skills to understand and solve them.

The Structures module handles objects that should enable engineers to design and construct non-standard structures such as pipelines, drinking and wastewater treatment plant, dams, irrigation systems, pumps stations, underground structures and the like. Elective courses include important theoretical subjects that provide the basis for more serious research.

All courses of the study program are listened to in three semester and are worth 120 ECTS credits, while the fourth semester is reserved for study research work on the preparation of the master thesis (worth 30 ECTS credits).

Upon completion of this program, students may continue their education in the Doctoral Studies program in Civil Engineering at home or abroad. In addition, students who complete this degree program also have a degree in specialist academic studies.

8.2.5 Enrolment

Minimal qualifications is undergraduate academic degree in Civil Engineering.

Minimal number of ECTS credits acquired during previous education is 180.

In order to apply for the studies, the candidates will submit the following documents:

- Application form,
- Copies of qualifications.

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

Technical College of Applied Sciences Urosevac with temporary seat in Leposavic- TCASU will introduce a new study programme of Specialist professional studies related to water resource management. The new study programme is titled WATER PROTECTION.

General information about study programme:

Level of study: Second degree professional studies

Field of education: Technical- technological

Scientific and specialized field: Water protection and management

Duration of studies: one school year/two semesters

Total ECTS: 60

Title obtained: Water protection engineer of specialist professional studies

Job opportunities: Municipalities, Associations, Consulting, Environmental protection sectors, Service & supply.

Below is presented an overview of the new study programme with the list of all courses, the purpose of the study program, aims and objectives, competencies, and curriculum structure.

9.1 The structure of new specialist professional studies

Our plan is to establish a new study programme of specialist professional studies within the SWARM project objectives. New curricula should be in line with the Bologna requirements and national accreditation standards, and to follow the latest multidisciplinary findings.

New study programme of specialist professional studies will include the following courses:

	Technical College of Applied Sciences Uroševac-Leposavić Accreditation of Study program Water protection
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Curriculum by semesters and the years of study for the study program of the second level of studies

No.	Code	Courses	S	Type	Course Status.	Hours			Other	ECTS
						L	E	Oth.		
FIRST YEAR										
1.		English language – higher course	1	AG	O	2	3	0	-	6
2.		Research methods and scientific communications	1	AG	O	2	3	0	-	5
3.		Hazardous Materials and Hazardous Waste	1	S	O	3	2	0	-	6
4.		Fundamentals of water protection	1	PA	O	3	2	0	-	6
Elective courses 1 (elect 1 out of 2)										
5.		Information and communication technologies in risk management	1	S	E	2	2	0	-	6
6.		Professional risk	1	S	E	2	2	0	-	6
7.		Water Treatment Methods and Technologies	2	PA	O	3	3	0	-	6
8.		Basic Principles of Water Management	2	PA	O	3	3	0	-	6
Elective courses 2 (elect 1 out of 3)										
9.		Management and development of human resources in the protection	2	PA	E	2	3	0	-	6
10.		Sustainable development and environmental protection	2	PA	E	2	3	0	-	6
11.		Professional practice	2	-	O	0	0	0	0	3
12.		Specialist Thesis	2	P	O	0	0	0	0	10
Total hours (lectures / exercises + DON / other classes) and credits per year						20	20			60
Total active classes per year						600				
Total active classes, other classes and credits for all years of study						600				60
NOTE: designations: S= semester; L= lectures; E= exercises; Oth.= other types of lectures; ECTS= number of ECTS credits Status of the course: O= obligatory; E=elective Elective courses: the election of the courses is made at the enrolment of the school year in consultation with the Head of the study program and professor of the elective course. Type: AG - Academic-General Education, PA - Professional-Applied, P - Professional										

Conditions for enrollment in the new study programme will be completed basic studies with total 180 ECTS and passed entrance exam.

Teaching process will be conducted through lectures, exercises and consultations. During the teaching process, emphasis will be placed on the student's independent and research work as well as on his/her enhanced personal involvement in the teaching process. Appropriate didactic means shall be used on lectures. The exercises, which accompany the lectures, will be dealing with the solving of specific tasks related to water protection. The exercises can be performed in the classroom, laboratory, IT laboratory or even in factories or other institutions.

The new study programme of specialist professional studies will contribute to the education of students with the high level of professional competence and skills in line with current world's good practice.

This, among other things, includes the development of creative abilities, consideration of problems and abilities for critical thinking, development of capacities for team work and mastering specific practical skills necessary for successful future profession.

9.1.1 Purpose

The purpose of the new study programme of specialist professional studies Water Protection is to educate students-new experts, in water protection field in accordance with basic needs of society.

The new study programme of specialist professional studies will contribute to the education of students with the high level of professional competence and skills in line with current world's good practice. The Water protection programme is designed to ensure acquisition of competencies and qualifications that are socially justified and useful. Technical college of applied sciences Urosevac-Leposavic defined tasks and goals related to specialist professional studies in order to educate highly competent staff who will be able, upon the completion of the studies, to solve, manage, investigate and research the problems and issues related to water protection and management.

This, among other things, includes the development of creative abilities, consideration of problems and abilities for critical thinking, development of capacities for team work and mastering specific practical skills necessary for successful future profession.

Situation regarding the water in general, including water protection, water supply, water management etc. is very complicated and tentative in Kosovo*, so the need for educating professionals in this area is more than evident.

9.1.2 Aims and objectives

The objective of the Water Protection study program is to achieve competencies and professional skills in the field of Water management and protection. By attending the this study programme, students will be given the opportunity to develop creative thinking skills and the ability to think critically, develop teamwork skills, cooperate, and master specific theoretical as well as practical and professional skills. The aim of the study program is to educate and train students for rapid involvement in direct work related to water protection and treatment. The student should gain basic knowledge of field of water treatment and protection, to master techniques and procedures for applying the acquired knowledge in practice.

The aim is for students to gain knowledge of the complexities of water protection, to learn contemporary research methods and procedures and their application in practice.

One of the specific goals, which is in line with the overall mission of Technical college of applied sciences Urosevac-Leposavic, is to develop awareness among students of the need for continuing education, sustainable development, water protection and therefore the environment. The aim of the study program is also to educate professionals for team work but also the professionals who will be able to engage in scientific and research work.

9.1.3 Competencies

Students who complete the Specialist professional study Water protection study programme will be competent and qualified to solve complex problems related to water protection theoretically and practically. Competencies include the development of critical and independent opinions, problem analysis skills, solution synthesis, prediction and behavioral calculation of the chosen solution with a clear idea of what the good and the bad sides of the chosen solution are.

Competencies that the students will acquire upon the completion of the specialist professional studies are:

- ability to demonstrate theoretical and practical knowledge and understanding of water protection and all necessary actions,
- ability to apply acquired knowledge in solving complex problems in new or unknown environment,
- ability to integrate theoretical and practical knowledge, solve complex water protection related problems on the basis of information obtained,
- social and civil responsibility,
- development of professional ethics and responsibility,
- demonstrating social, professional and ethical commitment and sensitivity to gender issues,
- ability to convey in a clear and unambiguous manner the knowledge and conclusions to professional and general public.

Graduate students will be able to:

- recognize, analyze and formulate engineering problems and based on that offer optimal and high quality solutions,
- through the internship program within the companies dealing with water protections students will acquire a sufficient practical knowledge and will be trained to use, analyze and implement technologies related to water protection,
- to integrate information and data from various resources, as well as to draw appropriate conclusions,
- carry out experimental and other project tasks, as well as to analyze and present the results, and to associate managerial and engineering judgments in order to optimize work and business results.

Students will be trained to design, organize and operate water and environmental systems. During schooling, the student gains the ability to independently plan and conduct statistical processing of results, as well as to formulate and draw appropriate conclusions.

Students will acquire special competences for the sustainable use and management of all natural resources, especially water, in accordance with the principles of sustainable development.

9.1.4 Curriculum structure

Specialist professional studies in Water protection will last one year, or two semesters with total 60 ECTS awarded. The title acquired after the completion of the studies is Water protection engineer of specialist professional studies. The courses will be distributed in two semesters, with in total 600 active classes per year.

The study programme includes 8 obligatory courses and 4 elective courses, including Professional practice and Final or Specialist thesis. In addition to general courses, the programme includes 8 courses closely related to water protection:

- Basic Principles of Water Management,
- Water Treatment Methods and Technologies,
- Fundamentals of water protection,
- Hazardous Materials and Hazardous Waste,
- Sustainable development and environmental protection,
- Management and development of human resources in the protection,
- Professional risk,
- Information and communication technologies in risk management.

An integral part of the curriculum of the study program is professional practice and practical work, which is implemented in appropriate companies or institutions dealing with water protection and public institutions.

All subjects of the study program are one-semester courses.

The curriculum include a description of each course that contains the title, course type, year and semester of study, number of ECTS credits, teacher's name, course objective with expected outcomes, knowledge and competences, prerequisites for attending the course, course content, recommended literature, teaching methods , knowledge and assessment, and other information. The study program is in line with the European standards in terms of

enrollment, study duration, conditions for transfer to the next year, graduation and study methods.

The student completes his/her studies by writing and defending a Specialist thesis, which consists of theoretical and methodological preparation necessary for an in-depth understanding of the field from which the topic of Specialist's thesis is.

9.1.5 Enrolment

The requirements for the enrollment are completion of first degree professional studies in the related field, with total 180 ECTS and good average grade.

Additional requirements are:

- Application form,
- Certificate or certified copy of previously obtained qualifications,
- Certificate on average grade.

10. Innovation achieved in SWARM courses

WB partner universities have organized meetings with the representatives from the water sector to adapt their academic teaching to the requirements of the water sector and related industry, in order to ensure that their graduates are the most employable, and to increase their competitiveness in the international education market. As a result, a new approach of curriculum development has been applied, which has focused on finding the relationship between university education and the competences needed by the graduates in their later careers, by defining exactly which competencies need to be included in the respective courses. Therefore, the SWARM curricula are competency-based curricula emphasizing development of students' competences which means - knowledge, understanding, skills, abilities and attitudes. WB teachers will have to think not only about teaching, but also about the competences their students develop. In principle, the SWARM curricula are learner-centered and adaptive to the changing needs of students, teachers and society. They imply that learning activities and environments are chosen so that learners can acquire and apply the knowledge, skills and attitudes to situations they encounter in everyday life.

SWARM curricula were designed around a set of generic, engineering and water resources management competencies. Competences involved in the Catalogue of competences were obtained based on the required competences by the labor market in the Western Balkan partner countries i.e. researching the existing water sector competence models and job profiles. This is in line with the Bologna Process i.e. *"With labour markets increasingly relying on higher skill levels and transversal competences, higher education should equip students with the advanced knowledge, skills and competences they need through their professional lives"*. The main reason the SWARM project team has selected competence-based approach was the reduction of the gap between the labor market i.e. water-related companies that will employ the SWARM students and the current WB curricula in the field of water resources management.

The developed competence-based curricula can represent an answer to societal changes in the future. In particular, the professional environment in the WRM sector has become more complex, dynamic and knowledge intensive and it requires employees who are well educated, versatile and able to maintain their personal knowledge and skills. The concept of competence can be a mean to think about these changes and requirements.

Technology will be integrated into subject teaching ensuring that young people are able to apply technology responsibly and effectively to support their learning. Using ICT as a set of different tools will make the changes that can inspire learners to succeed. Therefore, purchased hardware and software as well as up-to-date laboratory equipment will support teaching and work especially practical exercises. Using a learning platform will make connections with other sites of learning such as companies in water sector and decision-makers at local, national or regional level.

Developed SWARM curricula involve the application of new technology tools, delivery platforms and pedagogy. Students will be able to use and manage technology tools and devices that use scientific data to prove or achieve objectives and to draw evidence-based conclusions and to be able to discuss and justify conclusions. They can search for, collect, process and apply the information critically and systematically and use ICT tools for critical thinking, creativity and innovation.