Univerza v Ljubljani
Fakulteta za gradbeništvo in geodezijo

Presentation of the study programme

1st CYCLE ACADEMIC STUDY PROGRAMME
WATER SCIENCE AND ENVIRONMENTAL ENGINEERING (BA)

Valid for study year 2017/18

1. Information about the study programme

The first cycle bachelor degree study programme *Water Science and Environmental Engineering* is a 180-credit 3-year programme (6 semesters). The study programme does not include orientations.

2. Basic goals of the programme and general competences

Graduates of the bachelor's study programme *Water Science and Environmental Engineering* will acquire general fundamental knowledge of natural and social sciences, as well as applicable expert (civil) engineering skills for solving elementary administrative procedures and designing, planning, implementing and maintaining less demanding (according to the Construction Act) civil engineering structures (according to the uniform classification of types of constructions CC-SI) in the areas of water management, municipal and environmental engineering.

Besides gaining general theoretic knowledge, students will also learn the traditional principles of water science and the latest achievements of the profession, presented in a modern way using state-of-the-art technology. By working in groups, involvement in project work, field work and by solving problem tasks, students will acquire the essentials of interdisciplinary teamwork and public speaking skills and will be able to coherently present scientific and engineering ideas to expert and lay public. They will become acquainted in business with clients in administrative procedures, procedures of public procurement, and designing of structures and measures. The students will have the opportunity to test all the acquired theoretical knowledge to the largest possible extent within practical exercises and real-life case studies, which will help them, together with practical training as part of the study, to get involved in practical work after the finished bachelor's study. Another goal of the programme is also to provide the students with sufficient basic engineering knowledge to allow the development of abstract thinking and successful continuation of the study at different second cycle (i.e. master's degree) programmes.

General competences

General competences acquired by the graduates of the bachelor's study programme Water Science and Environmental Engineering are:

- general overview of academic areas,
- development of abilities to frame, comprehend and creatively solve problems, principles and theories,
- high level of creativity and innovation as a result of the interdisciplinary nature of the study,
- critical reading and understanding of relevant literature, independent knowledge gathering and literature search,
- development of the abilities of critical, analytical and synthetic thinking,
- competences for transferring and applying theoretical knowledge into practice and solving professional and practical problems,
- development of professional and ethical responsibilities,
- development of verbal and numerical literacy, public speaking skills and competences to communicate with clients as well as the lay and professional public,
- ability to use a foreign language in professional written and oral communication,
- ability to use information and communication technologies, also in an international setting,
- ability to establish local and international interdisciplinary connections,
- compliance with safety, functional, economic and environmental aspects of work,
- development of high ethical and moral standards (maintaining integrity when working with clients, providing unbiased advice, sustaining independence and expertise according to valid legislation),
- developing an objective view of the environment and society,
- accepting responsibilities to customers and employers as well as the society as a whole,
- ability to design and implement constructions in compliance with quality and price standards and carry out independent technical evaluations supported by scientific analysis and synthesis, all based on the acquired fundamental knowledge of basic natural and social sciences and fundamental expertise from the area of civil engineering, water science and municipal engineering,
- ability to consider the basics of engineering economy and the issues of environment protection in designing structures in the area of environmental civil engineering.

Course-specific competences acquired with the programme

Course-specific competences the students acquire within the program *Water Science and Environmental Engineering* are mainly the following:

- understanding the role and importance of water management in modern society,
- taking part in planning, organisation, management and implementation of the construction of less demanding civil engineering structures in the area of water management,
- independently designing of individual elements of less demanding civil engineering structures in the area of water management but does not design the entire structures,
- independently and creatively performing certain (less demanding) tasks from the area of water management, environmental and municipal engineering,
- taking part (within a group) in planning, design and implementation of different interventions into the aquatic environment
- involvement in the preparation of spatial planning acts,
- coordinating work between investors, designers and contractors,
- knowing the basics of legal, institutional and administrative system essential for water management and for managing and recording water resources,
- the graduates are qualified to oversee smaller water management companies.

3. Enrolment requirements and selection criteria in case of restricted enrolment

The first cycle bachelor's study programme *Water Science and Environmental Engineering* is available to the candidates who:

a) passed the general matura exam;

b) passed the professional matura exam at a secondary school programme and additionally one of the courses of the general matura exam; the selected course should not be the same as already passed by the candidate for the professional matura exam;

c) finished any of the four-year secondary school programmes before 1. 6. 1995.

The study programme is also available for candidates who acquired equivalent education abroad.
The number of places is determined in the Call for enrolment into first cycle study programmes of the University of Ljubljana individually for each academic year.

In case of restricted enrolment the following conditions shall be considered:

the candidates under items a) and c) shall be selected according to their:

general success in general matura exam or school-leaving exam	60 %
general success in the 3rd and 4th years of the secondary school	40 %

the candidates under item b) shall be selected according to their: general success in the professional matura exam	40 %
general success in the 3rd and 4th years of the secondary school	40 %
success in extra matura examination	20 %

4. Criteria for recognising knowledge and skills acquired before enrolment in the programme

Certain knowledge and skills comparable to the content and scope of the programme Water Science and Environmental Engineering can be recognised by the Study Board of the Department of Environmental Civil Engineering UL FGG. The Board makes decisions regarding the recognition of knowledge and skills acquired before enrolment based on the student's written application, enclosed certificates and other documents evidencing successfully acquired knowledge and skills, and in accordance with the Rules on the procedure and criteria for the acknowledgement of informally acquired knowledge and skills, adopted on 29 May 2007 at the 15th meeting of the Senate of UL.

The recognition process considers the following:

- certificates and other documents (recognition of »non-typical certificates«, portfolios, documents about finished courses and other forms of education),
- evaluation of finished products, services, publications and other original works of the student (possibility of performing study obligations – e.g. exams, preliminary exams, etc. - by evaluating products, e.g. projects, made by the student before the enrolment),
- evaluation of knowledge acquired by the student with self-education or empirical learning (possibility of completing study obligations – e.g. exams, preliminary exams, etc. - without participation at lectures, practical work, seminars),
- adequate work experience (e.g. recognition of practical training and other course units of the program that are based on practical work and experience).

Should the Study Board of the department establish that the acquired knowledge may be recognised, this shall be evaluated with the same number of credits according to ECTS as the number of credits in the subject.

5. Progression requirements

Conditions for the progression to the next year of study

Students are allowed to enrol to the second study year after completing by the end of the academic year all the obligations foreseen by the study plan thus achieving 60 credit points according to ECTS.

Students may enrol to the third study year after completing by the end of the academic year the obligations foreseen by the study plan and achieving at least 54 credit points according to ECTS.

Under exceptional circumstances students may be permitted to proceed without successful completion of the obligations defined to proceed to the higher year of the study programme, provided they have justifiable reasons as defined by Article 153 of the Statute of UL (maternity, extended illness, exceptional family and social circumstances, certified status of a person with special needs, active participation in top expert, cultural and sports events, active participation on University bodies).

Under the conditions set out in the above paragraph, students may enrol in a higher year with at least 45 ECTS-credits collected. The decision to permit enrolment is adopted by the Study Board of the Department of Environmental Civil Engineering of UL FGG.

Faculty of Civil and Geodetic Engineering has an established tutorship and supervision system in place for its students, offered also in the framework of the bachelor's study programme *Water Science and Environmental Engineering*. Students have class mentors in all three years, and smaller groups of students have individual tutors who will either be academic staff members or higher year students who will help their protégés in choosing study orientations, elective courses etc.

Students with above average study results will be allowed faster advancement, if applicable with regard to the study process. Based on the student's application the decision is adopted by the Study Board of the Department of Environmental Civil Engineering of UL FGG. With a decree of the Study bard the principles of faster progress are determined.

Conditions for repeat enrolment in the same year

Failing to meet the obligations defined by the study programme for advancement in a higher year, students may enrol in the same year for the second time, provided that they have obtained at least 30 ECTS-credits.

6. Completion requirements

Students finish the study by accomplishing the prescribed obligations totalling 180 credit points according to ECTS, including practical training and diploma thesis.

According to the Professional and Academic Titles Act the graduate is awarded with the academic title:
diplomirani inženir okoljskega gradbeništva (UN), abbreviated as dipl. inž. ok. gradb. (UN), level 6/2.
In compliance with the Professional and Academic Titles Act (Official Gazette No. 61/2006) professional and scientific titles as well as titles acquired by education shall not be translated to foreign languages. However, as

reference only, the title acquired according corresponds to the English title Bachelor of Environmental Civil Engineering (UN).

7. Transfers between study programmes

Transfer between programmes shall mean termination of education in the student's original study programme (first programme) and continuation of education in the first cycle bachelor study programme of *Water Science and Environmental Engineering* (second programme), in which a part of the completed study requirements from the first study programme are recognised as completed.

Transfers are possible from the first cycle study programmes, and until their expiration also from the undergraduate academic study programmes adopted before June 11 2004, where the competences of the finished studies are comparable and according to the acknowledgement criteria at least half of the obligations according to ECTS from the first study programme related to compulsory courses of the second study programme can be acknowledged. Considering the scope of acknowledged obligations from the first study programme in the Republic of Slovenia or abroad student may enrol to the same or higher year in the second study programme. Transferring students shall fulfil the conditions for the enrolment to the second study programme.

Applications of candidates for the transfer to the first cycle bachelor study programme *Water Science and Environmental Engineering* and the scope of acknowledged obligations in the study programme will be examined individually by the Study Board of the Department of Environmental Civil Engineering. If in the procedure of acknowledging obligations for the purpose of transfer the candidate is approved at least the amount of credit points and those point that are required for the enrolment to the higher year of the first cycle bachelor study programme *Water Science and Environmental Engineering*, the candidate may enrol to the higher year of the first cycle bachelor study programme *Water Science and Environmental Engineering*.

8. Methods of assessment

Knowledge is tested and assessed in individual courses. The teaching process in each course finishes with the examination of knowledge and acquired skills. The forms of testing (oral or written examinations, preliminary examinations, seminar works, work logs, practical assignments, projects, portfolios, peer evaluation) are defined in the syllabus of each course. General rules of knowledge testing are regulated by the Rules on study in the first and second cycle study programmes at UL, FGG, adopted by the Senate of UL FGG. The details are defined by the annual syllabus of each subject.

Students receive a single exam grade consisting of all the required obligations in each course. Each obligation should be evaluated with a positive grade.

Knowledge acquired at lectures, tested based on written or oral preliminary or partial examinations, seminars, seminar papers, practical or home projects, logs etc., amounts at least 30% of the total grade.

According to the Statute of the University of Ljubljana the following grading scale is used:
10 – (91–100 %: excellent: exceptional results with negligible faults),
9 – (81–90 %: very good: outstanding knowledge but showing some faults),
8 – (71–80 %: very good: solid knowledge),
7 – (61–70 %: good: good knowledge but showing some larger faults)
6 – (51–60 %: adequate: knowledge meeting minimal criteria),
5 to 1 – (50 % and less: inadequate: knowledge not meeting minimal criteria).

A candidate successfully completes an exam if he receives a grade between adequate (6) and excellent (10). The exam may be graded only by completed – non completed, where such grades are defined in the syllabus of the subject.

9. Study programme courses, Syllabus

1st YEAR									
	Contact hours								
1st semester	**L**	**S**	**ST**	**LT**	**FW**	**OW**	**ΣCH***	**ΣSO***	**ECTS***
Mathematics I	75	-	75	-	-	-	150	**300**	**10**
Physics	75	15	45	-	-	-	135	**270**	**9**
Fundamentals of Freshwater Ecology	30	-	-	20	10	-	60	**120**	**4**
Introduction to Environmental Engineering	45	15	30	-	-	-	90	**180**	**6**
Total 1st semester	**225**	**30**	**150**	**20**	**10**	-	**435**	**870**	**29**
2nd semester	**L**	**S**	**ST**	**LT**	**FW**	**OW**	**ΣCH***	**ΣSO***	**ECTS***
Mathematics II	60	-	60	-	-	-	120	**240**	**8**
Basic chemistry	30	-	-	30	-	-	60	**120**	**4**
Geodetic Engineering	30	-	-	30	-	-	60	**120**	**4**
Hydrology	30	25	-	30	5	-	90	**180**	**6**
Construction and Building Materials	30	-	-	30	-	-	60	**120**	**4**
Digital Design and Programming	15	-	-	60	-	-	75	**150**	**5**
Total 2nd semester	**195**	**25**	**60**	**180**	**5**	-	**465**	**930**	**31**

2nd YEAR									
3rd semester	**Contact hours**								
	L	**S**	**ST**	**LT**	**FW**	**OW**	**ΣCH***	**ΣSO***	**ECTS***
Hydromechanics	45	-	-	30	-	-	75	**150**	**5**
Introduction to Mechanics	75	-	45	-	-	-	120	**240**	**8**
Mathematics III	60	-	45	-	-	-	105	**210**	**7**
Secondary and Waste Materials Management	45	-	45	-	-	-	90	**180**	**6**
Elective course Statistics	30	-	30	-	-	-	60	**120**	**4**
Total 3rd semester	**255**	**-**	**165**	**30**	**-**	-	**450**	**900**	**30**
4th semester	**L**	**S**	**ST**	**LT**	**FW**	**OW**	**ΣCH***	**ΣSO***	**ECTS***
Introduction to Sanitary Engineering	30	-	-	30	-	-	60	**120**	**4**
Hydraulics	30	15	-	30		-	75	**150**	**5**
Applied Ecology and Ecotoxicology	30	-	-	30	-	-	60	**120**	**4**
Soil Mechanics and Engineering Geology	60	-	-	40	5	-	105	**210**	**7**
Communal Technical Infrastructure	30	-	30	-	-	-	60	**120**	**4**
Organization of Construction Works and Operation	45	-	45	-	-	-	90	**180**	**6**
Total 4th semester	**225**	**15**	**75**	**130**	**5**	-	**450**	**900**	**30**

3rd YEAR									
5th semester	**Contact hours**								
	L	**S**	**ST**	**LT**	**FW**	**OW**	**ΣCH***	**ΣSO***	**ECTS***
Introduction to Economic Analysis	45	-	-	-	-	-	45	**90**	**3**
Roads and Traffic	45	-	-	45	-	-	90	**180**	**6**
Introduction to timber and steel structures	30	-	30	-	-	-	60	**120**	**4**
Geotechnical Engineering	45	10	-	30	5	-	90	**180**	**6**
Introduction to Drainage Engineering	40	-	15	-	5	-	60	**120**	**4**
Basic Elements in Spatial Planning	45	-	-	60	-	-	105	**210**	**7**
Total 5th semester	**250**	**10**	**45**	**135**	**10**	-	**450**	**900**	**30**
6th semester	**L**	**S**	**ST**	**LT**	**FW**	**OW**	**ΣCH***	**ΣSO***	**ECTS***
Introduction to Concrete and Masonry Structures	45	-	45	-	-	-	90	**180**	**6**
Practical Training	6	-	-	-	-	80	34	**120**	**4**
Elective course 2	60	-	45	-	-	-	105	**210**	**7**
Elective course 3	60	-	60	-	-	-	120	**240**	**8**
Diploma work	-	-	-	-	-	75	75	**150**	**5**
Total 6th semester	**171**	**90**	**135**	-	-	**80**	**424**	**900**	**30**

ELECTIVE PROFESSIONAL COURSES	**Contact hours**								
	L	**S**	**ST**	**LT**	**FW**	**OW**	**ΣCH***	**ΣSO***	**ECTS***
Elective course Statistics:									
a) Basic statistics in water science	30	-	30	-	-	-	60	**120**	**4**
b) Advanced statistical methods in water science	30	-	30	-	-	-	60	**120**	**4**
Construction Technologies in Water Works	30	-	30	-	-	-	60	**120**	**4**
Operational research in civil engineering	45	-	30	-	-	-	75	**150**	**5**
Hydroinformatics	10	10	-	40	-	-	60	**120**	**4**
Hydrometry	30	-	20	-	10	-	60	**120**	**4**
Natural Disasters and their Impact on Environment and Society[1]	60	30	-	-	-	-	90	**180**	**6**

L – lectures; S – seminar; SP – seminar practicals; LP – laboratory practicals; FW – field work; OW – other work; CH – contact hours; SO – study obligations

***** student obligations total 60 ECTS/year, which agrees with 1800 hours/year; hours include contact hours + independent work

[1] The course is intended exclusively to students of other study programmes, mainly from social sciences.

10. Possibilities of elective courses and mobility

The bachelor's study programme *Water Science and Environmental Engineering* foresees elective courses totalling 19 ECTS. One elective course is foreseen in the 3rd semester and two in 6th semester. 8 ECTS may be selected freely (from other study programs at the University of Ljubljana). Students are recommended to select their courses from the four professional elective courses proposed at the study programme *Water Science and Environmental Engineering* or among other professional elective courses proposed at the first cycle study programmes of UL FGG. They are recommended to select courses from the areas of civil engineering in either municipal or traffic module, and from the area of geodesy and geoinformatics.

Students may transfer 30 ECTS-credits of the programme (one study semester, regardless of compulsory and elective units) from any other water science and environmental engineering programme in Slovenia or abroad, provided that UL FGG has a signed agreement with the institution in question.

11. Presentation of individual courses

Mathematics I (10 ECTS)
Sets and mappings; natural, real and complex numbers; geometric vectors; numerical sequences and series; limits and continuity of a function of one real variable; derivative of a function of one real variable; matrices, systems of linear equations, determinants, eigenvectors end eigenvalues of matrices; integral of a function of one real variable; power series.

Physics (9 ECTS)
Physics and measurements, kinematics, forces, torque, dynamics, momentum and rotation, work, power, energy, gravitation (Keppler's laws, Newton's gravity law, potential energy, satellites), oscillations and waves, structure of matter, deformations, liquids, temperature, the first law of thermodynamics, electrostatics, electric current (Ohm's law, work and power, electric instruments), magnetism, induction, electromagnetic waves, radiation, light, light sources (Sun, absorption of light in atmosphere), geometric optics (reflection, refraction, glass, lenses, optic instruments), wave optics, photons, special theory of relativity.

Fundamentals of Freshwater Ecology (4 ECTS)
The elucidation of the following terms: biology, microbiology, ecology, environmental protection; abiotic characteristics of the running and standing inland waters; the physical structure of ecosystems, habitats and ecological niches. Inland water chemistry, circulation of matter, with an emphasis on organic matter and nutrients. Biotic characteristics of standing water, biological communities of plankton and benthos. Trophic status, causes and consequences of eutrophication. Biotic characteristics of running water, biological communities of periphyton and benthic invertebrates. Saprophytic status, self-cleaning processes, methods of biological evaluation of the ecological status of inland waters. Pollution and loading of aquatic ecosystems, biological treatments and the role of microorganisms in decomposition processes, tertiary treatment and ecoremediation

Introduction to Environmental Engineering (6 ECTS)
Environmental Engineering brings together many disciplines, needed for designing a healthy living and natural environment for people and all living beings on our planet. It promotes the use of renewable natural resources in efficient and sustainable way, how to minimize negative and maximize positive human environmental impacts and how to ensure public health. Introduction to Environmental Engineering gives an overview to this complex interconnection of disciplines and uses practical examples to explain engineering methods for analyzing and predicting environmental processes. Acquired knowledge will help students to overcome the gap between theoretical and practical subjects. Practical exercises will be design in a way that students can predict and understand possible outcomes and facilitate the understanding of theoretical background.

Mathematics II (8 ECTS)
Scalar and vector functions of several real variables; continuity, partial derivatives, extrema; double and triple integrals, integrals with parameter; differential geometry in three dimensional space: curves and surfaces; vector analysis: line and surface integrals, integral theorems; ordinary differential equations.

Basic Chemistry (4 ECTS)
Structure of matter, atomic structure, elements and compounds, mass and energy in chemical reactions, the periodic table and the electronic structure of atoms, chemical bonds, ideal and real gases, water and solutions, crystals, chemical kinetics and chemical equilibrium, surface chemistry, electrolytes and nonelectrolytes, electrochemistry, the chemistry of the main group elements and transition elements, ecology: air, water, energy.

Geodetic Engineering (4 ECTS)

Definition od geodesy, fields of geodesy (geodetic engineering), tasks of geodetic engineering. Shape and dimensions of the Earth. Coordinate systems, coordinates, cartographic projections. Geodetic networks. Theory of geodetic surveying (measuring, basic principles of theory of errors and adjustment). Terrestrial surveying (tools, angle measurements, distance mesurements, height differences measurements, relative measurement techniques). Modern measurement systems and methods (TPS systems, 3D scanners, GNSS measurements). Basic principles of point coordinates determination (observation and coordinate space - calculation). Detail surveying (spatial data acquisition). Plans and maps (characteristics, methods of manufacture, type, usability). Geodetic evidences (land cadastre, building cadastre, DTM, GIS). General about surveying in the construction of buildings and other spatial planning (land use, obtaining land use permits, implementation of intervention). Basic methods of stakeout. Geodetic work for building structural engineering (stakeout, construction monitoring, determination of the stability of the building – practical examples). Geodetic work for infrastructural engineering (geodetic layers, stakeout, construction monitoring, measuring the load tests, determination of stability and deformation of the object - practical examples). Hydrographic measurements.

Hydrology (6 ECTS)

The overview of the development of the hydrological science in Slovenia and in the world; Physical and chemical characteristics of the water; Water and energy cycle; The use of probability theory and statistics in hydrology (basics of the probability, random variables, properties of random variables, theoretical and empirical distributions, frequency factor and probability papers, regression and correlation); Characteristics of the atmosphere and their measurement; Precipitation (measurements, errors, analyses, intercepted precipitation, snow); Remote sensing in hydrology; Evapotranspiration (measurements, calculation methods, Penman-Monteith equation); Runoff; Soil characteristics; Different types of water in the soil (soil moisture, groundwater, infiltration, Darcy's law); Water balance; Climate change and climate variability; Hydrometry (measurements of water depth, water level and velocity, measurement of discharge); Uncertainty of hydrometric measurements and analyses (theory of error); Basics of river hydraulics.

Construction and Building Materials (4 ECTS)

Systematic review of building materials and their characteristics (classification according to chemical structure, application and origin). Basics of standardization and building materials in standards and regulations for the design and construction of buildings and civil engineering structures (Construction Products Regulation, harmonized standards, Eurocodes). Fundamentals of chemical, physical and mechanical properties of building materials and their identification and quantification by means of testing. Ceramics: stone; building ceramics and glass; mineral binders, mortars and renders and plasters; concretes. Metals: ferrous and non-ferrous metals and metal alloys. Polymer materials: plastics; bitumen and asphalt. Composite materials: plastic composites (particle- and fiber-reinforced plastic, properties, application); natural building materials (wood, paper and other natural fiber materials). Review of methods of the experimental testing of materials.

Digital Design and Programming (5 ECTS)

The course introduces computer aided engineering (CAE) with emphasis on management of geometrical data, CAD basics (computer aided design, documentation, exchange, pre and post processing of geometrical data), problem solving of geometrically defined problems (geometrical complexity and computational models), understanding of data structures for handling of geometrical and non-geometrical engineering data (SQL syntax, tables, queries, reports), automatic processing of alphanumerical data (regular expression, parsing of text, recordings of measurements from sensors, data channels, OLAP, pivot tables, data visualization), algorithms and procedures for input and display of data in 2D and 3D (use of CAD, linking with Matlab, Mathematica).

Hydromechanics (5 ECTS)

Lectures: Fluid properties, comparison of hydromechanics and solid mechanics (differences). Basic equations: continuity, momentum, energy, equation of state. Principles of solving hydrodynamic problems. Hydrostatics: pressures and forces on flat and curved planes, buoyancy, stability of floating bodies. Kinematics of ideal incompressible fluid: streamlines, path lines, streamlines. Velocity curl, examples of rotational flow, irrotational (potential) flow and examples from civil engineering practice, Dynamics of ideal incompressible fluid: energy, Bernoulli, Cauchy equations. Momentum theorem. Groundwater flow, Darcy's law. Flow of real fluid: dynamic similarity, laminar and turbulent flow, boundary layer, fluid drag. Convective-diffusion equation for mass turbulent transport in water. *Exercises:* Computation of forces and their points of application on flat and curved planes, stability and angles of inclination of floating bodies and pontoon bridges. Potential flow – flow in the corner and bend, source and potential vortex, source and parallel flow. The use for groundwater flow. The use of Bernoulli's equation for flow in pipelines. Pumps and turbines in hydraulic systems. The use of momentum theorem for the computation of forces on pipeline bends and turbine shoulder-blades. Real fluid: fluid drag, parachute, air foil, pier. Additionally 7 longer computer-experimental exercises in the laboratory.

Introduction to mechanics (8 ECTS)

Part 1: Statics. Engineering description of various types of structures and their components (supports, connections, loadings and materials). Basic concepts of structural modeling by using trusses, beams, plates and shells. Models of supports, connections, geometry, materials and loadings. Statically determined planar trusses: concepts; definitions of bar and truss; bars are connected by hinges; supports; principles of equilibrium of rigid bodies; local and global equilibrium equations of bar and truss; statically determined trusses; analytical methods for analysis of statically determined planar trusses. Statically determined planar frames: concepts; definitions of beams and frames; supports; kinds of connections between beams; local (differential) and global equilibrium equations; boundary conditions; statically determined beams; methods and methodology for analysis of statically determined planar frames. Displacements, rotations and deformed shape in planar beams: concepts; differential equations for displacements; boundary conditions in terms of displacements; formulation of boundary-value problem; integration of boundary-value problem for continuous tractions combined with various boundary conditions; engineering interpretation of results; deformed shape, internal forces and reactions; extreme values and design concepts. Simple statically indeterminate frames: concepts and definitions; degree of static indeterminacy; basic concepts of displacement-based method of analysis; simple method of solution for frames based on given nodal values. Geometrical characteristics of planar cross-sections: area; static moment; inertial moment; composite cross- sections. Planar frame computer program with graphics: individual mechanical study of various planar frame cases.

*Part 2: Strength of materials:*Concept of continuum: body and its position in mathematical space; mathematical description of particle and body positions in coordinate frame. Strains: concepts; displacements and deformation; strain matrix (tensor); finite and small (linearized) strains; engineering meaning of small strains; specific changes of length, angle, area and volume; coordinate transformation of strain matrix; principal normal and shear strains and their directions; deviatoric and hydrostatic strains; octahedral strains; plane strain state. Stresses: concepts; stress vector as internal specific surface traction; normal and shear components of stress vector; components of coordinate planes stress vectors form stress matrix (tensor); stress resultants (internal forces and moments); local equilibrium equations (differential equations) and boundary conditions; global equilibrium equations; coordinate transformation of stress matrix and stress vector; principal normal and shear stresses and their directions; deviatoric and hydrostatic stresses; octahedral stresses; plane stress state. Material equations (or constitutive equations): linearly elastic material as a material model for steel, concrete and soil; uniaxial, shear and triaxial tests; experimental determination of material parameters; effects of temperature; effects of shrinkage and creep in concrete. Formulation of the boundary-value problem (solution methods are not discussed).

Mathematics III (7 ECTS)

Ordinary differential equations: linear differential equations of order n with constant coefficients, linear systems of differential equations of first order, characteristic polynomial, independence of solutions, matrix solution of initial problem, phase diagrams in two dimensions, boundary value problem. Partial differential equations: classification, equations of mathematical physics, linear equations of first order, method of characteristics, vibrating infinite and finite string, d'Alembert solutions, heat equation, Fourier series, initial and boundary value problem. Basics on graph theory: vertices, edges, isomorphism, adjacency and incidency, matrix presentation, path, cycle, walk, tree, Hamiltonian and Eulerian cycle, the shortest path problem, directed graph, weighted graph, connectedness, spanning trees, planar graphs. Examples of mathematical modelling.

Secondary and Waste Materials Management (6 ECTS)

Historical review of waste materials management; environmental policies; international agreements and legislation; properties and characteristics of secondary raw materials and wastes; classification of waste; processing and treatment of secondary raw materials: physico-chemical processing, biochemical processing, heat treatment; mechanical-biological treatment of mixed municipal waste; landfills; reuse of non-hazardous waste in construction products; circular economy and role of the engineer; requirements for engineering barriers in repositories of high level or low and intermediate level radioactive waste.

Basics of sanitary engineering (4 ECTS)

History of water supply and sewage. Sources, methods and technologies of drinking water supply, drainage of waste water, drinking water treatment, wastewater treatment. Emphasis on the topics of public health, water protection and healthy environment. The provision of safe drinking water sources. The importance of microbiological, physico-chemical, toxicological, and quality of drinking water. Health risks in drinking water and risks of wastewater. The construction of appropriate water and sewage networks/facilities. Students actively participate in exercises and perform laboratory tests. One-day tour of sanitary engineering facilities.

Hydraulics (5 ECTS)

Using the equations of real fluid facilitates the understanding of the hydraulic systems and boundary conditions for the hydraulic design of the most common hydraulic structures. Hydraulic design of water structures, their regulations and devices, which students get to know from their technological and operational aspects in other subjects of water management area. The characteristics and dynamics of real fluid (flow regimes). The flow in pipe systems (local and linear losses, simple pipes, pumps, pipe systems, simulation software). Orifice flow and water level balancing in two vessels (steady and unsteady flow). The flow over sharp-crested weirs, broad-crested weirs and dams. Open channel hydraulics (normal flow, compound channels, hydraulically efficient channel section and local losses). Stable reaches of river channels (lined and unlined channel). Steady non-uniform flow (gradually varied flow profiles, water surface profiles, water surface profile calculation, and simulation software). Groundwater flow (regimes in porous media, permeability coefficient analyses, practical examples).

Applied Ecology and Ecotoxicology (4 ECTS)

Defining ecotoxicology and ecology, historical overview of ecotoxicology, environmental pollution (sources, ways of determining pollution), fundamentals of ecology (defining organism- population, community-ecosystem, interspecies relations), the effects of human activities on ecosystem, effects of chemicals, environmental risk assessment (basic understanding of toxicity tests, types of tests, analysis of data), biomonitoring, environmental policy, emerging, pollutant prevention (nanotoxicology, endocrine disruptors), emerging pollution problems in Slovenia

Soil mechanics and engineering geology (7 ECTS)

Basics of geology (mineralogy, petrology, hydrogeology, tectonics); rocks: magmatic, metamorphic, sedimentary – stratigraphy; geological maps; erosion phenomena in geo environment; basic physical and mechanical properties of soils and rocks; basics of soil behaviour, laboratory and field investigations; classification of soils; standards in geotechnics; primary and additional strengths in ground, ground deformations; ground water, concept of pore pressure, effective and total stresses, water streaming; soil consolidation; ground and slope stability.

Communal Technical Infrastructure (4 ECTS)

Concept and role of municipal activities, cost aspects of municipal activity implementation, technical infrastructure within spatial planning document, building permit and construction of technical infrastructure, acquisition and development of building land, technical – technological characteristics of municipal networks, structures and devices, design and location conditions of technical infrastructure, technical conditions of building land development

Organization of construction works and operation (6 ECTS)

Fundamental concepts from the field of organisation; role, importance and relationships among construction project stakeholders. Resources for construction process. Production factors, productivity, economics of construction. Design of technology process. Fundamentals of work productivity and payment of work: Fundamentals of building/structure price determination and payment options; Time and motion studies. Fundamentals of quality assurance in construction industry, industrialisation of construction. Organisation of construction project; preliminary investigation, preparation works, construction site organisation. Building/structure maintenance and refurbishment management, life cycle of building/structure; relevant legislature. Fundamentals of planning and management, scheduling and planning techniques. Critical Path Method, resource an cost planning

Introduction to Economic Analysis (3 ECTS)

Microeconomics and macroeconomics – basic concepts. Demand and Supply. Consumer equilibrium. Production and costs. Perfect competition. Monopoly, monopolistic competition and oligopoly. Firms in modern market economies. Labour and capital markets. Provision of public services in the field of water management and environmental engineering. Pricing of services in the field of water management and environmental engineering. Investment analysis. The specificity of the markets in the field of water management and environmental engineering. Economic aspects of the implementation of the Water Framework Directive and the new EU Floods Directive.

Roads and traffic (6 ECTS)

History of road construction; legal and technical regulations; traffic systems and networks and organisation, types of traffic surfaces with basic concepts and terminology in traffic engineering; road traffic, traffic flows, traffic structure, traffic loads, capacity; functional and spatial classification, categorisation – rural and urban; bases for the definition of road element dimensions (V-V-O, speed, visibility, traffic safety, road and environment); geometric and technical road elements (road axis, cross-section, carriageways); functional surfaces (junctions, crossings, service and maintenance surfaces); building structures (types, basic demands, typical executions); road drainage (systems, devices, dimensions, purification of drained water); road and

environment (space, living and natural environment, emissions, protection and regulations); traffic signalling and equipment and public lightning; urban road surfaces (types, profiles, compositions); urban traffic systems (tram, public transportation, stops and stations); automatic devices in traffic (systems, traffic arrangement and management, SSN); traffic management and intelligent transportation systems (basics).

Introduction to timber and steel structures (4 ECTS)

Timber structures: Advantages and disadvantages of timber structures. Physical, mechanical and rheological properties of structural wood in dependence of the environmental conditions; criteria for the classification of wood into strength classes. Bases for the design of wood structural elements. Ultimate strength and design of structural elements made of solid wood at axial, axial-bending and shear loading. Specifics of calculation and limitations of displacements of timber structures. Measures for the protection of timber structures against environmental impacts and fire. Basic rules for the execution of joints and detailing of timber structures. *Steel structures:* Mechanical properties of steel. Technological procedures of steel processing and standard steel qualities. Concepts of design of steel structures. Manufacturing and assembly of steel structures. Valid standards and regulations for the analysis and design of steel structural elements. Protection of steel structures against fire and corrosion. Connecting elements and joints (welds, bolts, rivets, pins).

Geotechnical engineering (6 ECTS):

Earth pressures. Bearing capacity of shallow foundations. Shallow foundations (ground investigations, design and technologies). Fundamentals of deep foundations (technologies, bearing capacity, settlements). Criteria for the choice of foundation type. Retaining structures. Ground treatment and fundamentals of soil improvement. Design and construction of embankments and cuts. Balance of soil masses in earthworks. Basic concepts of the use of geosynthetics. Groundwater flow. Fundamentals of design and construction of dams and dykes.

Introduction to drainage engineering (4 ECTS)

Capture, retention and discharging rainfall surface runoff waters: design and implementation of the deep and shallow drainage, design of water reservoirs. Control of smaller surface waters: design and execution (roadside ditches, steep chutes, sills, overflows, canalettes, intake structures, culverts). Surface soil erosion during construction and anti-erosion measures during construction and after. High waters; temporary and permanent flood protection measures; flood-safe construction of buildings; assessment of adequate flood protection of urbanized areas against their own and rainfall surface runoff waters.

Basic Elements in Spatial planning (7 ECTS)

The course focuses on the fundamentals of spatial planning, including the definitions of space, planning, public good, and others. Space is regarded as a finite and limited asset. The stress is on the presentation of interdisciplinarity of the profession and its significance for the overall development of the society, where spatial planners work in line with the professional code and ethical principles. The spatial planning legislation and its connection to sectoral legislation directly affecting spatial development is represented. The students learn about surveying groundwork, basic tools and techniques of spatial planning. Content-wise, the course touches upon all fundamental considerations of spatial planning, and, in more detail, it examines the systems of settlement, infrastructures and open space. The objective of the course is to equip the student with the know-how and understanding of spatial planning as a process, where the essential element is the inclusion of the public and the coordination of all stakeholders' interests in the planning of intended spatial developments.

Introduction to concrete and masonry structures (6 ECTS)

Main mechanical and rheological properties of concrete and reinforcing steel. Bases for the analysis and design of concrete structural elements. Limit states method. Ultimate strength and design of reinforced concrete cross-sections for pure bending and bending combined with axial force (large and small eccentricity of axial force). Application of auxiliary tables and interaction diagrams for the design of concrete cross-sections. Ultimate strength and design of reinforced concrete elements for shear and torsion. Simplified calculation of cracks and displacements of reinforced concrete elements. Basic rules for reinforcing of concrete structural elements. Mechanical properties of bricks, mortar and masonry. Load-carrying mechanisms and design of non-reinforced masonry structures on bending in combination with axial force and shear load. Execution of seismically resistant simple masonry structures.

Practical Training (4 ECTS)

Students become acquainted with and perform the work carried out by graduates of this study programme. They mainly learn about the organisational structure of the subjects in the fields of water management and environmental engineering. They learn about career development, self-evaluation of competences and the support to the processes of professional identification in the framework of academic and professional environment. They learn to transfer the theoretical knowledge from the learning process into practical work and vice versa.

Basic statistics in water science (4 ECTS)
Introduction to statistics, data representation; theory of probability (introduction, event, probability of an event), Bayes theorem and its use in simple civil engineering cases, decision trees, project management; random variables and vectors, derived distributions, moments; distributions commonly used in technical applications: binomial, Poisson, exponential, Pearson, normal, log-normal, extreme value distributions; the use in hydrology, structural engineering, traffic engineering; sampling, characteristics of basic statistics, sample mean and variance; parameter estimation (point and interval estimates); hypothesis testing (introduction, some commonly used statistical tests, general statistical tests, e.g. hi-squared goodness- of-fit test); bivariate analyses (hypothesis testing of statistical and linear independence, linear and non-linear regression, the use of the least squares method); analysis of variance with some examples from civil engineering.

Advanced statistical methods in water science (4 ECTS)
Basic Monte Carlo method, random variate/vector generation, generation of random fields, variance reduction methods. Spatial statistics, random fields and processes, variogram, covaraince function, kriging. Robust statistics, the definition of robustness measures of some basic statstics, comparison between common and robust statistics, application of robust statistics in linear regression. Analysis of variance, sampling with or without repetitions, post-anova methods.

Construction Technologies in Water Works (4 ECTS)
Within this course the students will meet with general basics and principles of the design of typical hydraulic structures and construction technological processes: preliminary laboratory and field tests, organization of work in the water influential area, and overview of conventional and non-conventional technologies in the construction of hydraulic structures. Within the practical work of this subject the technological construction project of typical hydraulic structures and use of different construction materials will be provided. A gained competence in the subject is the ability of producing technological project at all stages of placing hydraulic structures in the environment and capability of managing with the quality at all stages of technological process.

Operational research in civil engineering (5 ECTS)
Input-output models, environmental input-output models. Introduction to mathematical programming. Linear programming, Simplex method. Nonlinear programming. Newton method, genetic algorithms. Dynamic programming, discrete dynamic programming. Basics of stochastic processes, Markov chains. Decision problems, decision trees. Basics of simulations, different principles and ways of simulation. Basics of geoinformation, role of GIS technology. Graphical data bases. Overview of spatial analyses.

Hydroinformatics (4 ECTS)
Theoretical basis of hydro-information systems; review of data related to water management (state and municipal level); spatial depiction of hydro-information systems (state and municipal level); preparation of data sources (search, querying, linking, ... in databases) for water systems modelling; data mining on hydro-information systems to support decision-making in water management; querying databases on water utilization; water engineering or water protection; transformations between the various forms of digital records; integration, data mining and synthesis for of a detailed water management planning (pNUV).

Hydrometry (4 ECTS)
Basics of the measuring techniques: terminology and standards (ISO 772). Measurements of the stream channel: classic methods and remote sensing. Measurements of water level: classic methods. Discharge measurements: different methods and discharge curve. Measurements of river sediment transport: sediment sampling, turbidity measurements (suspended solids), measurements of bedload transport, water quality sampling and dissolved solids concentrations. Hydraulic structures for measuring surface flow: weirs. Network of hydrological stations: monitoring system. Analysis of measurement errors and quality control: data recording, data transmission and archiving (data bases), procedures of quality assurance, statistical and analytical errors, uncertainty. Special chapters: weather radar, satellite remote sensing, trace studies (isotopes), dendrochronology, sediment age analysis.

Natural Disasters and their Impact on Environment and Society[1] (6 ECTS)
Definition of the types of natural disasters. Organisation framework for performing the protection and rescue tasks: types and competences of state agencies, regional and municipal bodies in the field of civil protection and rescue; European institutions and mechanisms for civil protection and rescue; EU modules of civil protection and development of new modules; bilateral cooperation; standard protection and rescue cycle; process of activating the protection and rescue services; mechanisms and procedures of intervention management; sources of financing that enable the functioning of the civil protection and rescue system. Legislation in the field of: civil protection and rescue, communication/information and alarming. Behaviour and response of public in case of natural disasters. Mechanisms of risk evaluation, procedures of disaster damage assessment, disaster mitigation and risk reduction. Data validation and selection of adequate models of the final evaluation of consequences and of the scope of

damage, and impact of the data validation process on the response planning. Natural disasters in the Republic of Slovenia for which risk assessments and protection/rescue plans are prepared. Rapid response systems and decision making process in the event of natural disaster: role of experts (environmental civil engineering) in the processes of the civil protection cycle; cooperation and response of the public in the civil protection cycle in the event of natural disaster. Influence of (measured and analysed) data reliability on adequate and timely measures in the event of a disaster and the resulting scope of damage.

Mitigation of natural disasters – competences and procedures. Perception and responses.

[1]The course is intended exclusively to students of other study programmes, mainly from social sciences.