State’s Standards of education
Environmental engineering
First and second degree studies/education
I. **General ascertainment**
Education ends with an Engineer’s degree.
The education lasts at least 7 semesters. The number of hours should be at least 2400, and the number of ECTS points not less than 210.

II. **Graduate qualifications**
A graduate of the studies should possess knowledge as regards the basics of the mathematical, biological and technical sciences and should be able to put this knowledge into practical use in everyday life, while respecting rules of law and ethics. In particular, the graduate should: (1) possess knowledge in the field of internal and external environmental engineering, (2) possess the ability to solve problems connected with the design, development and exploitation of devices, installations and objects of environmental management, planning and protection, (3) have a fully-developed sense of responsibility for his/her own actions.
The graduate should be prepared to design, work on and operate technical devices and objects, including those required for field tests, diagnostic measurements and quality control in respect of technologies and devices employed. The graduate should also acquire an ability to use the professional literature, and to gather, process and transfer information. He should know a foreign language at least the B2 level of fluency within the Common European Framework of References for Languages, and be able to use technical language in the field of environmental engineering. The graduate should be prepared to take up second degree studies.

III. **Framework plan of education**

III.1 **Groups of educational matters, minimum number of activity hours and minimum number of ECTS points**

| A. Group of the basic course /basic study | 630 | 64 |
| B. Group of the major course | 300 | 30 |
| **Total** | **930** | **94** |

III.2 **Elements of educational matters within groups, minimum number of activity hours and minimum number of ECTS points.**

<table>
<thead>
<tr>
<th>A. GROUP OF THE BASIC COURSE /BASIC STUDY</th>
<th>hours</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mathematics</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>2. Physics</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>3. Chemistry</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>4. Biology and Ecology</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>5. Environmental Protection</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>6. Technical Drawing and Descriptive Geometry</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>7. Computer-Aided Design</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>8. Technical Thermodynamics</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>9. Fluid Mechanics</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td>10. Materials Science</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>
### III. 3 Specification of educational matters and educational effects

#### A. Basic courses

1. **EDUCATION IN MATHEMATICS**
   **Educational effect – abilities and qualifications:** employing mathematical methods in environmental engineering; mathematical description of environmental phenomena and processes.

2. **EDUCATION IN PHYSICS**
   **Educational effect – abilities and qualifications:** recognition and understanding of physical phenomena and processes in the environment; the use of physical principles in techniques and in everyday life; measurement and definition of basic physical magnitudes.

3. **EDUCATION IN CHEMISTRY**

Educational effect – abilities and qualifications: understanding chemical processes occurring in the environment and of importance as regards environmental technologies; the forecasting, planning and application of chemical methods in pollution neutralization.

4. EDUCATION IN BIOLOGY AND ECOLOGY

Educational effect – abilities and qualifications: understanding biological processes in the environment; understanding the processes accompanying neutralisation of contaminants and reclamation of degraded areas; assessment of biological threats to the internal and external environment.

5. EDUCATION IN ENVIRONMENTAL PROTECTION

Educational effect – abilities and qualifications: understanding the processes, phenomena and interactions present in the environment; understanding the connection between global phenomena and anthropopressure.
6. EDUCATION IN TECHNICAL DRAWING AND DESCRIPTIVE GEOMETRY
Educational effect – abilities and qualifications: application of technical drawing; visualisation of engineering works.

7. EDUCATION IN COMPUTER-AIDED DESIGN
Educational effect – abilities and qualifications: employing computers to collect and store information; carrying out engineering calculations and designing engineering works.

8. EDUCATION IN TECHNICAL THERMODYNAMICS
Educational effect – abilities and qualifications: understanding the processes of energy and heat transmission; applying knowledge of thermodynamics in the solving of technical problems.

9. EDUCATION IN FLUID MECHANICS
Educational effect – abilities and qualifications: understanding the principles and phenomena connected with the flow of fluids; applying knowledge of fluid mechanics in designing environmental engineering devices.
10. EDUCATION IN MATERIALS SCIENCE
Educational effect – abilities and qualifications: evaluation and selection of materials for the needs of environmental engineering.

11. EDUCATION IN MECHANICS AND THE STRENGTH OF MATERIALS
Educational effect – abilities and qualifications: understanding the general principles of the motion and balance of objects and knowledge about physical phenomena which influence the object as a result of external strains; application of the knowledge of mechanics and the strength of materials in designing environmental engineering devices.

12. EDUCATION IN CIVIL ENGINEERING
Educational effect – abilities and qualifications: understanding the role and main tasks of buildings including their structural elements; evaluation of technical specifications which buildings have to fulfil.

13. EDUCATION IN HYDROLOGY AND EARTH SCIENCES
Educational effect – abilities and qualifications: understanding of geosystem functioning; understanding the processes and principles determining the water cycle in the environment.

B. MAJOR COURSES.

1. EDUCATION IN AIR PROTECTION
Educational effect – abilities and qualifications: understanding the processes and phenomena in the atmosphere; understanding the principles of operation, design and utilisation of the facilities and technologies applied in air protection.

2. EDUCATION IN WASTE MANAGEMENT AND CONSERVATION
Educational effect – abilities and qualifications: understanding hydrological processes and phenomena; preparing hydrological and water-resource documentation; preparing water management balances; forecasting water supply in different branches of the economy.

3. EDUCATION IN WATER AND WASTEWATER TECHNOLOGY
Scope: Removal of dissolved substances, colloids and suspended solids from water. Methods, technological parameters and efficiency of surface and ground water treatment. Types, principles of operation and exploitation and parameters of water treatment facilities. Technology and device selection depending on the type of purified water, its quality, requirements and purpose. Examples of technological solutions and designed water treatment plants preparing potable water or water for industry. Management principles for wastewater from water treatment processes. Wastewater characteristics. Wastewater receivers. Unit processes and devices for mechanical, chemical and biological wastewater treatment. Nutrient

Educational effect – abilities and qualifications: understanding the processes applied in facilities of water and wastewater treatment; designing constructions and devices for water and wastewater treatment; designing and applying water supply and wastewater removal systems.

4. EDUCATION IN SANITARY SYSTEMS AND NETWORKS


Educational effect – abilities and qualifications: exploitation of water intakes, pumping stations, water tanks, water supply and wastewater networks; the designing and applying of sanitary and gas installations.

5. EDUCATION IN WASTE MANAGEMENT


Educational effect – abilities and qualifications: understanding principles of waste management; understanding processes used for waste utilization and neutralization and of the application of methods and techniques in waste management.

6. EDUCATION CONCERNING HEATING, VENTILATION AND AIR CONDITIONING


**Educational effect – abilities and qualifications:** understanding processes in heating, ventilation and air-conditioning systems; designing and exploitation heating, ventilation and air conditioning systems.

**7. EDUCATION IN SOIL SCIENCE AND REMEDIATION**


**Educational effect – abilities and qualifications:** understanding the processes and phenomena taking place in the soil environment, and in degraded areas.

**8. EDUCATION IN SOIL MECHANICS AND GEOTECHNICS**


**Educational effect – abilities and qualifications:** understanding the strength properties of soils, understanding of changes in soil influenced by different loads, assessments of environmental influences on soils.

**9. EDUCATION IN MELIORATION**

**Scope:** Aims and tasks of the melioration of urbanized and agricultural areas. Factors influencing water condition in soils. Admissible levels of groundwater – reasons for flooding and water shortages. Characteristics of irrigation systems. Regulation of water conditions in soil – drainage. Drainage of roads, streets and squares – cambering, roadside ditches, slope ditches, discharge ditches, culverts, troughs, soakaways of evaporation tanks, storm water inlets.

**Educational effect – abilities and qualifications:** understanding the processes involved in watering and dewatering systems, designing of watering and dewatering systems.

**10. EDUCATION IN ENVIRONMENTAL PROTECTION AGAINST NOISE AND VIBRATIONS**

**Scope:** Properties of acoustic waves. Acoustic and vibration signals. Sources of vibrations and noise in the environment. The influence of vibrations and noise on human beings. Methods of

Educational effect – abilities and qualifications: understanding the factors causing acoustic threats; measuring and modelling acoustic pressure distribution from typical noise sources in different topographical conditions.

11. EDUCATION IN GEOGRAPHICAL INFORMATION SYSTEMS

Scope: Modelling of real space, the reduction of space to a two- and one-dimensional form. Databases and data structure. Space projections in a vector model. The geometric and thematic division of objects, rules for the projection of object structures. Spatial and information integration. Object dependences in topological models. The raster model – a two-dimensional spatial transformation into one-dimensional form, integration of the information with raster elements. Block structures - effective information organization in the thematic sets. Numerical models of terrain surfaces. GIS tools and typical tasks in the field of environmental engineering solved by spatial information systems.

Educational effect – abilities and qualifications: operation of spatial information systems, solving tasks in the field of environmental engineering using spatial information systems.

IV. Work experience

Work experiences should last not less than 4 weeks.

B. Second-degree studies

I. General ascertainment

Education ends with a Master’s degree. Education lasts at least 3 semesters. The number of hours should be at least 900, and the number of ECTS points not less than 90.

II. Graduate qualifications

A graduate of these studies should possess advanced knowledge as regards the mathematical, environmental and technical sciences, as well as specialized knowledge in a selected part of environmental engineering. The graduate should possess the skills needed to solve problems relating to the internal and external environment, the implementation and coordination of research work and the capacity to cope with the basic legal and administrative problems faced by economic entities. The graduate should be able to communicate in regard to matters of environmental engineering with specialists and non-specialists, as well as to organize collective activity and direct teamwork. The graduate should be prepared to work at scientific and research institutes and design offices, as well as in the fields of atmosphere protection, water supply, sanitation, wastewater treatment, solid waste management and wasteland reclamation, or else local or central administration. A graduate should be prepared to undertake research tasks and take up third-level studies.
III. Framework plan of education

III.1 Groups of educational matters, minimum number of activity hours and minimum number of ECTS points

<table>
<thead>
<tr>
<th></th>
<th>hours</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Group of basic courses/basic study</td>
<td>120</td>
<td>13</td>
</tr>
<tr>
<td>B. Group of major courses</td>
<td>60</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>180</td>
<td>19</td>
</tr>
</tbody>
</table>

III.2 Elements of educational matters by groups, minimum number of activity hours and minimum number of ECTS points.

<table>
<thead>
<tr>
<th></th>
<th>hours</th>
<th>ECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. GROUP OF BASIC COURSES /BASIC STUDY</td>
<td>120</td>
<td>13</td>
</tr>
<tr>
<td>1. Statistics</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>2. Environmental Chemistry</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>3. Spatial Planning</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4. Reliability and Security of Engineering Systems</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>5. Environmental Management</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>B. GROUP OF MAJOR COURSES</td>
<td>60</td>
<td>6</td>
</tr>
<tr>
<td>1. Environmental Monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Pro-environmental Technologies</td>
<td></td>
<td></td>
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<tr>
<td>3. Alternative Sources of Energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Automatics, the Steering and Operation of Technical Devices</td>
<td></td>
<td></td>
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<tr>
<td>5. Technology and Organization of Fitting Works</td>
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<td></td>
</tr>
</tbody>
</table>

3 Specification of educational matters and educational effects

A. GROUP OF BASIC COURSES/BASIC STUDY
1. EDUCATION IN STATISTICS

2. EDUCATION IN ENVIRONMENTAL CHEMISTRY
Scope: characteristics of geo-ecosystems. The atmosphere and its role in the Earth’s radiation budget, atmospheric reactions – cycles of the basic elements; acid rain, smog, ozone depletion. Water and its role in the environment. Forms of inorganic and organic substances in natural water. The lithosphere – its role and properties, chemical substances in the
environment – a systematic classification, micro- and macro-elements, basic organic and inorganic pollutants, Cycles of chemical elements in the ecospheres – the carbon cycle, the nitrogen, sulphur and phosphorus cycles. Chemical contamination of the environment – self-decontamination and chemical methods of decontamination.

Educational effect – abilities and qualifications: an understanding of chemical processes and pathways taken by chemical elements and compounds in the environment, foreseeing of the effects of the presence of dangerous and toxic substances in the environment.

3. EDUCATION IN SPATIAL PLANNING


The idea and strategy of eco–development. Standards for the state of the environment and in urban planning. The study of conditions and spatial development study. The local physical development plan. A prognosis of the influence of a development plan on the environment. Problems with modern spatial planning tools.

Educational effect – abilities and qualifications: development of the study of conditions and directions to spatial development and local physical development plans.

4. EDUCATION IN THE RELIABILITY AND SECURITY OF ENGINEERING SYSTEMS


Educational effect – abilities and qualifications: understanding the rules for the design of environmental engineering objects with account taken of reliability; assessment of the reliability of devices used in environmental engineering, identification of dangers and risk assessment connected with irregular performance on the part of objects.

5. EDUCATION IN ENVIRONMENTAL MANAGEMENT

Scope: Enterprise management and sustainable development. Ethical and social aspects of environmental protection. Legal and economic aspects of environmental protection. Clean (pure) production as a philosophy and strategy of environmental protection. Best available technology as a goal of “clean technology” introduction. The testimony of “clean production” as a form of voluntary ecological obligation. ISO 14001 as the basic standard in the assessment of pro-environmental procedure. Systems of environmental management. The financing of investments in environmental protection. The assessment of the pro-environmental activity of an enterprise.

Educational effect – abilities and qualifications: understanding of the relationship between production, services and exploitation of the environment. Active reference to the rules of sustainable development in professional activity.
B. MAJOR COURSES.
1. EDUCATION IN ENVIRONMENTAL MONITORING

Educational effect – abilities and qualifications: conducting the measurements and interpretation of monitoring data; evaluation of environmental condition.

2. EDUCATION IN PRO-ENVIRONMENTAL TECHNOLOGIES
Scope: Legal regulation concerning the use of environment-friendly best available technologies. Comparison of the nuisance for the makin environmental components constituted by different branches of industry. Best available technologies in heat power engineering based on non-renewable sources of energy. The analysis of different fuels and devices to burn them, taking their environmental impacts into account. The use of renewable sources of energy. Analysis of best available technologies in selected branches of industry – environmental influence evaluation. The technologies of natural resources gaining and their influence on the natural environment. The analysis of the effects resulting form pro-ecological activities conducted in the industrial plants. The choice of the best production technologies concerning their influence on the environment.

Educational effect – abilities and qualifications: understanding the negative influence of the industry on the environment; the choice of minimizing anthropopression.

3. EDUCATION IN ALTERNATIVE SOURCES OF ENERGY

Educational effect – abilities and qualifications: understanding the role of alternative sources of energy in civilization development.

4. EDUCATION IN THE FIELD OF AUTOMATICS, CONTROL AND TECHNICAL DEVICE OPERATIONS
Scope: Analysis of time and frequency signals. Mathematical methods of describing the dynamic systems used in automatics. Identification of regulation and control subjects.

**Educational effect – abilities and qualifications:** knowledge of automatic control processes in environmental engineering, practical knowledge of simple steering and control devices.

### 5. EDUCATION IN THE RANGE OF CIVIL ENGINEERING TECHNOLOGY AND ORGANISATION


**Educational effect – abilities and qualifications:** use of investment documentation; understanding the rules organizing civil engineering; calculations and their verification; the management of work on investment