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

	hours	ECTS
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.

	hours	ECTS
A.GROUP OF THE BASIC COURSE /BASIC STUDY	630	64
1. Mathematics	120	
2. Physics	60	
3. Chemistry	60	
4. Biology and Ecology	60	
5. Environmental Protection	30	
6. Technical Drawing and Descriptive Geometry	30	
7. Computer-Aided Design	60	
8. Technical Thermodynamics	45	
9. Fluid Mechanics	45	
10. Materials Science	30	

11. Mechanics and Strength of Materials	30	30
12. Civil Engineering	30	
13. Hydrology and Earth Science	30	
B. GROUP OF THE MAJOR COURSE	300	
1. Air Protection		
2. Water Management and Conservation		
3. Water and Wastewater Technology		
4. Sanitary Systems and Networks		
5. Waste Management		
6. Heating, Ventilation and Air Conditioning		
7. Soil Science and Remediation		
8. (Environmental) Protection against Noise (and Vibrations) - optional		
9. Geographical Information Systems		

III. 3 Specification of educational matters and educational effects

A. Basic courses

1. EDUCATION IN MATHEMATICS

Scope: Real and complex numbers. Sequences and series. Elementary functions. Differential and integral calculus of one variable. Elements of linear algebra – matrixes, determinants, and the use of matrix calculus to solve sets of equations. Linear transformations. Eigenvalues and eigenvectors, matrix diagonalization. Fundamentals of analytical geometry – calculus of vectors, planes and lines in space. Quadratic surfaces. Differential calculus of multi-variable functions – limits, continuity and extremes of the calculus of several variables. Implicit functions. Application of differential calculus in the solving of extreme technical problems. Integral calculus of multi-variable functions. Elements of field theory. Ordinary differential equations. Functional and Fourier series.

Educational effect – abilities and qualifications: employing mathematical methods in environmental engineering; mathematical description of environmental phenomena and processes.

2. EDUCATION IN PHYSICS

Scope: Fundamentals of classical mechanics and phenomenological thermodynamics. Elements of hydromechanics. Gravitation. Vibrations and waves in elastic media. Electrical and magnetic properties of matter. Electricity. Electromagnetic waves. Polarization, interference and diffraction of waves. Elements of wave and geometric optics. Elements of acoustics and noise. Elements of solid-state physics. Natural and induced radioactivity. Elements of nuclear 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 CHEMISRTY

Scope: Basic chemistry: laws and rules. Atomic structure, the periodic table of elements. Properties of elements. Chemical compounds – types and molecule structure. Intermolecular interactions. Synthesis, structure and properties of inorganic and complex compounds. Synthesis, structure and properties of organic compounds: aliphatic and aromatic hydrocarbons, alcohols, phenols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, heterocyclic and halogenoorganic compounds. Structure and properties of dyes, sugars, amino

acids, peptides, proteins and nucleic acids. Structure and properties of plastics. States of matter: gases, liquids, solids. Solutions. Types of chemical reaction. Elements of chemical thermodynamics, thermochemistry. Elements of irreversible process thermodynamics. Elements of chemical kinetics. The osmosis effect. Phase boundary effects – adsorption. Electrochemistry – electrode potential, cells, electrolysis. Elements of molecular spectroscopy.
Educational effect – abilities and qualifications: understanding chemical processes occurring in the environment and of importance as regrds environmental technologies; the forecasting, planning and application of chemical methods in pollution neutralization.

4. EDUCATION IN BIOLOGY AND ECOLOGY
Scope: Characteristics of Procaryota and Eucaryota. The structure and functions of cell organelles. The role of plant and animal tissues in physiological processes. Identification of selected microorganism groups: viruses, bacteria, fungi, algae and their role in biosphere. Nutrition methods: heterotrophy, autotrophy (chemo- and photosynthesis), mixotrophy. Metabolism – catabolism and anabolism. The respiratory chain. Systems of ATP generation – substrate, oxidative phosphorylation and photooxidation. Aerobic and anaerobic respiration and fermentation. Photosynthesis as a basic anabolic process. The role of microorganisms in biogeochemical circulation of carbon, nitrogen, sulphur and iron in the environment. The role of mocroorganisms in destroying different utility materials and objects. Fundamentals of ecology. Population ecology. Ecological tolerance. Liebieg's Law. Shelford's Law. Ecology of the biocenosis. Trophic levels. Ecology of inland waters. Degradation of bodies of water. Organization of the agrocenosis and forest community. Air as a factor in organisms' presence in the biosphere. Atmospheric air degradation. Water and soil as a living environment for organisms and a place for transmission of pathogenic organisms.
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
Scope: History of environmental protection. Contemporary initiatives in environmental protection – sustainable development. Ecological aspects of environmental protection – protection of the biosphere, landscape, ecosystem and biocenosis, species diversity. Ecological balance. Legal and economic aspects of environmental protection. Air protection – the greenhouse effect, the ozone hole, acid rain, photochemical and acidic smog. Hydrosphere protection – water pollution, eutrophication, technical, economical and legal aspects of water protection. Mineral deposits and lithosphere protection – types of lithosphere interactions, minerals using persistency. Soil protection – types of degradation, soil hazards in Poland. Forests protection: forest hazards, means of forest protection. Influence of pollution and noise on human health. Fundamentals of toxicology – poisons and toxins, radioactivity, contaminant elimination. Ventures and technical measures in environmental protection – the concept of clean technologies.
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

Scope: Orthogonal projection and dimensioning. Graphic symbols (designation). Principles of drawing and dimensioning. Projection of space elements on a plane. Projection methods and their use in engineering practice. Basic information on polyhedrons and spaces in the aspect of their practical use. Drawing views and sections. Technical and construction drawings. Installation drawing. Drawings of machine elements and parts of equipment. Architectural and constructional drawing: principles of realization, their use in internal water supply and wastewater network documentation. Technological schemes of installations applied in environmental engineering.

Educational effect – abilities and qualifications: application of technical drawing; visualisation of engineering works.

7. EDUCATION IN COMPUTER-AIDED DESIGN

Scope: Programming. Loops and control instructions. Logical operators. Functions and variables. Strings and matrices. Pointers. Numeric and symbolic calculations with the use of CAD (computer aided design). Fundamentals of programming – program communication, types of coordinates and units, model and sheet space, drawing borders. Precise drawing, deleting/removing objects, transformations of objects. Layer operations: lines and styles, text introduction, text styles. Block operations. Object dimensioning and drawing to scale. Printing options. Three-dimensional modelling. Printouts of 3D drawings.

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

Scope: Basic concepts of thermodynamics. Substantial and energetic balance. Ideal, half-ideal and real gases. Laws of Thermodynamics. Thermodynamic processes and cycles. Phase change. Water vapour as a thermodynamic factor. Humid air theory, parameters of humid air. Main alterations of humid air. Heat exchange mechanisms: conduction, convection, radiation. Complex heat exchange. Stabilized and unstabilized heat exchange. General characteristics of thermal transmission.

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

Scope: Liquidity and continuity of fluids. Parameters describing the liquid state. Physical properties of fluids. Hydrostatics – hydrostatic pressure and pressure force, equations of equilibrium, objects' buoyancy. Hydrostatic pressure force on planar and curved surfaces. Basic concepts of fluid kinetics. Flow continuity equations. The Bernoulli equation for ideal and real liquids. Laminar and turbulent flow. Motion energy loss. Calculation of flows in conduits under pressure. The water hammer effect. Reaction force of a flow. Liquid outflows through holes and add-on devices. Overflows and spillways. Liquid motion in the channels and open waterways. Groundwater movement. Water inflow to common and artesian wells and to drains and channels. Cooperation of a group of wells. Calculations regarding flows of gases. The Bernoulli equation for gases in the adiabatic process. Gas outflow through holes and nozzles. Pressure distribution in the atmosphere.

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

Scope: physical and mechanical properties of materials. Iron, ferro-alloys with carbon – heat treatment, cementation, plastic working, application. Plastic installation materials – application in sanitary technique. Mineral, ceramic and concrete materials – application in sanitary networks and installations. Materials selection for facilities of networks and installations applied in environmental engineering.

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

Scope: Principles of statics, force, moment, constraints. Systems of forces, reduction, balance conditions. Internal and external forces: trusses, beams and frames. String calculations. Friction. Mass geometry, moments of inertia. Strengths of materials. Determining the mechanical properties of materials. Straight-bar strength calculations – compression and tension. State of stress and state of deformation. Pure bending, skew bending, and bending with shear stress. Strength hypotheses. Bending instability, shear and torsion. Forces balance, friction. Moments of inertia of a planar surface. Point motion on the surface, rotational and plane motion, complex point motion. Analysis of uniaxial, two-dimensional, tensile and compression stresses. Thin-walled tanks. Energy of elastic deformation. Combined stress. Bending instability. Material fatigue. Experimental analysis of stresses. Fundamentals of dynamics.

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

Scope: Buildings elements: roofs, ceilings, walls, stairs, foundations – general concepts, types and tasks. Constructions – buildings rigidity. Air shafts and exhaust ducts. Building barriers – strength, insulation and fire-resistance conditions. Brickwork, reinforced concrete, steel and wooden constructions – characteristics, application conditions. Technical specifications for using buildings.

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 NAD EARTH SCIENCES

Scope: Earth sciences in natural science. History of the Earth. Geological structure of the Earth. Geophysical information sources of the Earth's interior. Factors shaping the land surface: truncation, rivers, winds and glaciers activity. The World Ocean. Hydrogeology, engineering geology, mineral deposits geology, natural sources of energy. Influence of geological conditions on the environment. The water cycle as a physical system. Evaluation of high tides typical for controlled rivers. Typical states. Analysis of high and low water stages. Storage reservoirs – utility and fire-protection capacity. Methods of moving/spreading hydrological information to uncontrolled places. Mathematical modelling of hydrological processes. Algorism of the mathematical model. Hydrological systems – their properties and relations. Models of hydrological systems. Models of drainage basins under anthropological influence. Identification and verification of hydrological models. Statistical and genetic methods of hydrological phenomena forecasting.

Educational effect – abilities and qualifications: understanding of geoecosystem functioning; understanding the processes and principles determining the water cycle in the environment.

B. MAJOR COURSES.

1. EDUCATION IN AIR PROTECTION

Scope: Principles of air protection and air pollution. Air composition. Gas and dust contaminants in the air. Sources of air pollution – natural and anthropogenic (point, linear and surface sources). Methods of gathering information on pollution emissions. Influence of meteorological phenomena on pollution dispersion – turbulence, winds, and temperature changes. Mathematical models of pollutant dispersion in the atmosphere. Determination of gas contaminant concentrations and ash deposition in the context of maximum permissible amounts. Legal regulations concerning air protection – maximum permissible amounts of air contaminants. Methods, technologies and facilities by which to stop particulate pollution and gas pollution – gas dedusting, removal of gas components. Technologies for minimizing emissions of sulphur dioxide, oxides of nitrogen, carbon dioxide, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), furans and dioxins. Air protection against odorous substances. Protection against global changes in the atmosphere.
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

Scope: The terrestrial phase of the water cycle. Methods of hydrometric measurement. Hydrological states and flows. The water balance of catchments. Extreme hydrological phenomena – high and low water stages. Water and wastewater management in housing estates and in agglomerations in the context of regional and catchment-based water management. Water resources and water demand in catchments, agglomerations and housing estates – the water balance taking water quality into account. Relations between available resources of water and amounts and degrees of wastewater pollution. Water and wastewater management in selected branches of the economy. Water and municipal wastewater management. Legal aspects of natural water exploitation. Water cadastres. The amount and quality of surface and ground water in relation to water- and wastewater management. Strategies of water management, the protection of water resources. National available water resources as an ecological indicator of socio-economic development. Hydrological forecasts. The condition of water resources in Poland. Management of water resources and administration of water management in Poland and the EU.
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

removal. Enhanced biological removal of carbon, phosphorus and nitrogen from wastewater. Characteristics of flow and batch systems. Wastewater treatment in natural conditions. Wastewater management of industrial plants – principles, water and wastewater balance. The influence of industrial plant wastewater management on the work of municipal wastewater treatment plants.
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
Scope: Water supply systems. Intakes. Storage tanks. Pumping stations. Water supply networks – solutions, hydraulic calculations, principles of network dimensioning. Materials used for water supply networks. Basic calculations and construction solutions regarding pipes. Water supply workmanship. Surface utilities of water supply networks. Locating of conduits and surface utilities in street section. Demands and tests for water supply technical approval. Basic activities in operating a water supply network. Wastewater systems. Types of wastewater transported by wastewater systems. Pressure and negative pressure systems – range of use. Laying out the channels of wastewater systems. Wastewater channel dimensioning. Materials used in wastewater systems. Armature elements of wastewater systems. Wastewater pumping stations. The locating of conduits and surface utilities in street section. Locating and working on sewer channels and surface utilities in street section. Sewer outlets. Demands and tests of wastewater system technical approval. Basic activities of wastewater network exploitation. Internal gas and sanitary installations – materials and armature. Underground and overground pipelines – assembly, environmental impact during workmanship, exploitation and failure.
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
Scope: Wastes – sources, classification. Municipal wastes: quality and quantity characteristics, methods of treatment – recycling, landfilling, combustion, composting, pyrolisis, materials recovery. Industrial wastes from the extractive, power-supplu, iron and steel, engineering and chemicals industries – characteristics, management and utilization. Dangerous wastes (including radioactive) – risk assessment, storing/landfilling, management. Basic processes, operations and devices for the utilization of wastes. Rational waste management. Low- and no-waste technologies. Local and regional programs of complex raw and recycled materials management. Legal aspects and economic conditionings of waste management in Poland and the EU.
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
Scope: Elements of hygiene, climatology and meteorology. Thermal comfort. Heat transfer in heated rooms. Heat demand calculations. Heating systems. Water central heating installations – fittings and safety devices. Gas installations. Heat centers.

Ventilation and air conditioning in buildings – internal and external air exchange calculations. Heat gains and losses. The quality of indoor air. The aerodynamics of air flows in rooms. Natural ventilation. Mechanical ventilation. Hybrid systems. Systems of indoor air supply. Basic ventilation and air-conditioning systems. Air-shaft calculations. Air preparation in air-handling units.
Educational effect – abilities and qualifications: understanding processes in heating, ventilation and air-conditionig systems; designing and exploitation heating, ventilation and air conditioning systems.

7. EDUCATION IN SOIL SCIENCE AND REMEDIATION
Scope: Genesis of soils. Factors of soil formation. The morphology of soils – basic terms, symbols of genetic soil horizons. Soil as a tree-phase system. Physical and Chemical properties of soils. Organic matter and biological properties of soils. Productivity and fertility of soils. Soil erosion, contamination and monitoring of soils. Soil remediation – legal regulations. Directions of remediation. Phases and methods of remediation. The role of plants in remediation. Classification of remediated soils. Evaluation of remediation progress.
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
Scope: Physical, chemical, mechanical properties of natural and anthropogenic soils., Macroscopic assessment of soils, properties of soils. Stress in soils. Water's influence on the state of stress in soils – effective stress. Descriptions of stress distribution in soils. Compressibility and deformability of soils. The strength of soils, determination of strength parameters of soils. The basis of consolidation theory. The basis of soil reology. Stability of slopes and sides. Stability of propped sides. Principles of the design of retaining walls. Rules for the design of gravity walls. Principles of the design of sheet and cavity walls. Prevention of landslide processes – drainage, gravity wall bolting, the placing of loading supports, the piling of areas prone to landslides. Geotechnical measurements in choice of location, the influence of engineering objects on the environment and assessment of its state. The influence of wastes on the condition of the water–soil environment. The identification of polluted areas. Risk assessment and the design of means of soil remediation.
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

measurement, transduction and analysis of vibroacoustic signals. Propagation of sound in an open space. Measurements and methods of forecasting of acoustic pressure distribution in the environment. Methods of noise and vibration reduction. Mesurements and evaluation of vibrations in the environment. Methods of preparing environmental impact assesments in the field of vibroacoustic interaction. Legal acts. Acoustic plans of cities. Noise monitoring – technical and legal regulations. Acoustic parameters of noise sources, acoustic field distribution, effectiveness of antinoise protection. The influence of vibrations on people and constructions.
Educational effect – abilities and qualifications: uderstanding 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

	hours	ECTS
A. Group of basic courses/basic study	120	13
B. Group of major courses	60	6
Total	180	19

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

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

3 Specification of educational matters and educational effects

A. GROUP OF BASIC COURSES/BASIC STUDY

1. EDUCATION IN STATISTICS

Scope: Probabilistic and statistical elements. Empirical distribution – properties and description. Random variables, basic distributions of random variables. Parameters to the distribution of one or more random variables. Linear and non-linear regression, the coefficient of correlation. General (Standard) population and random numbers. The confidence interval. The Student's T and Chi-square distributions. The testing of statistical hypotheses. The design of experiments. The least squares method.

Educational effect – abilities and qualifications: use of quantitative methods of description and statistical deduction, use of statistical methods in environmental engineering.

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

Scope: development of the settlement pattern. The evolution of spatial planning in Poland. Diagnosing methods to determine the state of the environment and spatial development. Method of threshold analysis. Methods of matrix conflicts analysis.
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

Scope: Basis of reliability. Rules of reliability studies. Parameters of reliability – choice in the assessment of the operations of environmental engineering systems. The structural reliability of technical systems. Statistical analysis of systems failures. Analysis of objects' reliability, including at the design and operational stages. Assessment criteria regarding system reliability. Alternative solutions in environmental engineering based on knowledge of reliability. The idea of risk and security, methods of risk and security assessment, risk and security management, risk in the functioning of an engineering systems operator. Security control of hydrotechnical structures.
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

Scope: Basic rules and current possibilities for monitoring in water research. Types of monitoring network – the range and scale of conducted studies. Principles underpinning the creation of a network orf system and the environmental monitoring of running water. Data interpretation concerning underground water levels or the size of the water supply (flow). Data interpretation as regards the chemical composition of water. The use of monitoring data in the improvement and optimisation of water management. Air monitoring – measurement stations, pollution level reports. A reference method for calculating pollutant dispersion. The theory of measuring errors, kinds of errors and methods for their calculation. Statistical analysis of data from monitoring measurements. Assessment of results. General and trial populations. Small and large samples. Correlation and regression analysis. Verification of statistical hypotheses.

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

Scope: classification and general description of energy sources – conventional, renewable and unconventional – as regards resources and the influence on the natural environment. Ecological profits and losses. Economic aspects of the use of alternative sources of energy. External costs. Internalisation of external costs. Direct and indirect means of energy use. Description of the primary sources of renewable energy. Water energy. Geothermal energy. Heat pumps. Wind energy and techniques by which to use it. Biomass energy. The use of wood, straw and animal faeces. Willow as a fuel. Bio-fuels. Bio-gas from solid waste landfills. Unconventional sources of energy. Hydrogen as a fuel. Fuel cells. Energy storage. Economic aspects of the use of 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.

Classification of automatic systems – measurement, regulation and protect systems used in environmental engineering. Data storage, conversion and transmission. Control standard algorithms. The stability of automatic systems and evaluation methods by which to regulate quality. Devices of automatic control: transducers, digital controllers, analog regulators and steering devices – types, static and dynamic characteristics, tasks. Principles of automatic device selection and the setting of working conditions. Control of complex processes. Non-standard algorithms of regulation in environmental engineering. Programming of regulators. Statistical analysis of the reliability of automatic systems.
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 ENGENEERING TECHNOLOGY AND ORGANISATION

Scope: Elements and organisation of the investment process. The streamlining of work. Patent conditions. The standardization of building work. The documentation of an investment. The production process and its division. Methods of work. Designing and producing a building. Building site preparation and development. The preparation and planning of earthworks. Earthwork mechanization. The installation of pipes and single structures. Estimation of investment costs. Cost calculations.

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