

# Framework programmes

of undergraduate studies (1<sup>st</sup> stage studies, Engineer's degree)

## Environmental Engineering

### **Labour hygiene safety and ergonomics**

The purpose of this course is to show the complexity of human labour, the risks of human participation in the labour process, indicating a significant influence of the environment (within the physical parameters of the working environment and technological and organizational factors) on comfort of work, and to familiarize students with the principles of ergonomics in the development of safe working conditions, both in the design of the spatial structure of the workplace, as well as the design of signalling and controlling blocks for machine equipment. Another aim of the course is to familiarise students with the proceedings in the event of accidents and emergencies.

### **Chemistry**

Knowledge of basic definitions and theories used in inorganic and analytical chemistry. Ability to perform chemical calculations, and perform basic water analyses.

### **Economics**

The main objective of this course is to familiarize students with the basic economic categories, knowledge of the essence of the market mechanism, in the context of market goods and services and factors of production. In addition, the student will be familiar with fundamental rights, theories and indicators of the macroeconomic system and the functioning of the economy in the short, medium and long term, ways to counteraction unemployment and inflation, economic growth and development processes and economic trends in contemporary economies.

### **Physics**

The objective of this course is to teach students the basics of physics which makes easier to understand phenomena in the environment, as well as to learn methods of the physical experiments and their interpretation.

### **Computer bases of designing**

During the course elementary knowledge of programming is presented and its application to the engineering calculations is given.

### **Mathematics**

The use of mathematical methods in the description of phenomena and processes, technology use mathematical methods. Complex numbers, the algebraic, trigonometrical and exponential form and basic statements concerning polynomials. Basic concepts of both the statement of the matrix account and the method of dissolving arrangements of linear equations. Elements of the analytical geometry. Border of sequences, numerical rows. The limits of the function and the differential calculus of the function of one variable. Integral calculus of the function of one variable.

### **Environmental protection**

The module covers the broader issues of conservation and environmental engineering, with special emphasis on sustainable development. The module content: basic concepts related to environmental protection, the national environmental policy, Environmental Protection Law in Poland and abroad, protection of water, atmosphere, soil and waste management, protection against noise, problems of sustainable development, climate change, rational use of energy, the passive house concept, renewable energy sources.

### **Technical drawing and descriptive geometry**

The course provides information about geometrical bases of the graphical mappings and their applications in technical drawings of the geodetic, urban planning, building and installation industry.

### **Information technology**

The main aim of studying is widening the knowledge, skills and competences in the field of IT, necessary for living and working in information society. During the course extended knowledge concerning productivity software is presented and its applications to the preparation of technical and other documents, engineering calculations and graphics are described.

### **Biology and ecology**

The module covers the basic issues of systematics of plants, animals, fungi, and prokaryotes (bacteria and cyanobacteria), with particular emphasis on species of particular importance in environmental engineering. It enables students to familiarize themselves with the basic methods of isolation and identification of microorganisms present in soil, water and atmospheric air and sanitary assessment of these environments. The student acquires the ability to assess the condition of the activated sludge and the influence of abiotic factors on that biocenosis using biological assay method.

### **Fieldwork of geodesy**

Knowledge, skills and competencies necessary for the use of geodetic and cartographic measurements and documentation in the environmental engineering. Technical geometrical levelling of vertical network points. Stakeout and measure of sewer network. Map updating. The surface levelling and the designation of the flood line. Determination of 3D coordinates of object's unavailable points. Precise geometrical levelling of vertical network points.

### **Surveying and spatial information systems**

The module provides information about what is and what role the surveying and mapping does in the national economy, particularly in environmental engineering. Basic rules and techniques of land surveying and geodetic calculations, the map, basic surveying and geodetic calculations.

### **Materials science**

The subject gives the knowledge of physical properties and mechanical materials used in environmental engineering as well as the evaluation and selection of materials for the purpose of environmental engineering.

### **Mechanics and strength of materials**

Basic principles of static, degree of freedom, constraints reactions. Concurrent force systems, equilibrium of plane and spatial systems. Statics of solids, composition of plane forces. Reduction of spatial force systems, Varignon's theorem. Equilibrium of plane and spatial force systems. Mass's centre of plane figures. Statics of structures. Plane trusses, principle notions and definitions, analysis. Geometrical characteristics of plane figures, static moment, moment of inertia (M.I.). Steiner's theorem, moment of inertia for turned axis. Statically determinate bar systems, classification of bars, connections of bars and bars systems. General case of spatial loading, definition of internal forces and their reduction. Determination of internal forces in beams and frames.

Definition of stresses, stresses matrix, analysis of stresses in the point, simple tension/compression, Hooke's law. Static tests of tension/compression. Displacement and deformations of bars loaded by stresses axially. Relationship between stresses in element loaded by stresses biaxially. Relationship between stresses in element loaded by stresses triaxially. Generalization of Hooke's law. State of plane stresses, analytical dependences, Mohr's circle. Simple bending, normal stresses in bending bars, designing of bending bars. Shear stresses in beams with rectangular cross-section – Żurawski's formula. Torsion, stresses and deformations in torsion bars with circle section. Strength hypothesis, classification, principle definitions and dependences

### **Environmental law and protection of intellectual property**

Basic sources of environmental law in the internal legal order of Poland and in the EU. Legal norms of environmental law and intellectual property protection. Basic institutions of intellectual property law, both related to copyright, as well as with industrial property law and distinguishes between different systems in the field of protection of the rights of copyright and industrial property.

### **Hydrology and earth sciences**

Place of earth sciences in the natural sciences, the history of the earth. Factors affecting the surface of the land: ventilation, rivers activity, wind and glaciers. Hydrogeology – basis. Influence of geological conditions on the formation of the natural environment. Hydrology – general issues, sharing, application in environmental engineering and water management. The hydrological cycle as a physical system. Catchment and its characteristics. Characteristics and distribution of courses. Division of watercourse of the river cross-section, the concept of zero gage. Characteristic of states and flow of water. Determination of flow characteristic controlled rivers, hydrological information and move to places uncontrollable. The curves on the hydrological of states and water flow. River debris – characteristics. Hydrometry – methods of measurement of states and flows of water velocity, depth and river sediment. Likely flows – classification, the method of calculation. Precipitation – types, measurement, rainfall intensity distribution. Outflow - characteristics. Pairing and retention – characteristics. The river and its regime. Determination of usable capacity and flood storage reservoirs. Mathematical modelling of hydrological processes. Statistical methods for forecasting hydrological phenomena.

### **Foreign language**

English, German, French or Russian.

### **Soil mechanics and geotechnics**

Origins of rock and soil and physico-chemical properties. Igneous, sedimentary and metamorphic rocks. Glacial grounds. Granulation. Conditions. Water in the soil, groundwater flow, filtration, Darcy's law, pore pressure, a phenomenon suffosion, the calculation of the criterion of critical flow condition. The basic properties of soils. The recognizing of the ground for the construction of environmental engineering. The stresses and settlements in the ground. Design of foundation engineering environment. Rules of conduct earthmoving works. The stability of slopes and walls of excavations. The use of geosynthetics. Geotechnical aspects of landfill construction, construction principles, protection for the infiltration of pollutants into groundwater.

### **Fluid mechanics**

Basic properties of fluids. Hydrostatic pressure. Devices for measuring the pressure. The law of Euler. The equation of equilibrium liquids. Pascal's law. Hydrostatic pressure on flat and curved surfaces. Determination of the centre of pressure. Equilibrium of bodies submerged. Kinematics of fluid Lagrangian method, Euler's method, the traffic potential. The dynamics of a perfect fluid. Euler's differential equation of motion. Bernoulli's equation for a perfect fluid. Velocity measurements using the Bernoulli equation. Outflow through the holes and weirs. Fluid dynamics, Bernoulli's equation for real fluids, flow in pipelines, laminar and turbulent flow, resistance calculation, calculation of hydraulic systems and pipelines, reservoirs and pumping stations cooperation with pipelines. The fluid flow in open channels, subcritical and supercritical flow, hydraulic jump. Basics of groundwater filtration. Darcy's law. The differential equation of groundwater filtration. The water supply to wells and ditch. Gas flows through the holes and nozzles, gas flows in pipelines. Bernoulli's equation for gas in the adiabatic process.

### **Building and engineering structures**

The purpose of this subject is to achieve the learning outcomes in terms of: application of the criteria of selection of structural elements and insulation in buildings constructed in the traditional technology, The preliminary design of structural elements of the building, determination by the Eurocodes: dead load, imposed loads, snow and wind loads acting on buildings.

### **Basics of mechanical construction**

Division machinery and criteria for the selection of design solutions - optimization. Unification and standardization. Precision of machine parts. Basis for calculating the components and assemblies with static loads and fatigue. Connections inseparable. Classification of technical connections. The cohesion Connection: welded, glued, soldered, welded. General characteristics, calculation models, examples of design solutions. Connections opened and pressure. Fastenings. Types, shaping, calculation models. Dovetail and splined connections, pin and bolt. Screw connections. Calculation of strength bolts and nuts. Sensitive elements. The characteristics of the springs. The computational model. Pipes. Types of material connections. Calculation of the pipeline. Armature. Characteristics and distribution of valves. Design features of different types of valves. Shafts and axles. Features shafts and axles. Determination of external loads. Computational models of shafts and axles. Developing strength shafts. Bearings. Types of bearings. The design and calculation of plain bearings. Bearings, types and application, selection. Position Solutions bearings. Clutch. Tasks and classification of couplings. The design and selection of couplings. Gears. Tooth geometry and calculation of main dimensions. Gear types. Load distribution in spur. Belt drives. Types and Applications. Loads in the transmission belt. Machine Elements sanitation. Pressure equipment in the factory and on the plant. Vehicles and tractors in use for sanitary engineering and special equipment like mixers, scrapers, grinding machines, separators, presses, centrifuges for sewage and waste.

### **Basic of technical thermodynamic**

Basic principles and description of state system. Thermodynamic equilibrium. Heat and work – calculation and interpretation. First thermodynamic rule. Balancing energy systems open and closed. Ideal and real gas transformation and gas mixture. Real gas behaviour. Two phase area – water vapour. Wet gases – Molier chart. The second rule of thermodynamic. Energy. Heat circuits – Carnot. Technical fuel burning description. Basic of heat transfer and exchangers.

### **Technology and equipment for water treatment**

The module is related to the issue of water purification and treatment in the context of technology devices. The students will gain knowledge and skills necessary for the design of water treatment systems. The reagents used in water treatment, rules of use and storage. Apparatus for the preparation and dosage of reagents. Flash mixers and flocculation chambers. Grids, sieves, strainers and microstrainers, purpose and types. Clarifiers. Rapid and slow filters. Devices for iron and manganese removal. Apparatus for aerating water. Equipment for water disinfection Container water treatment. Devices with active carbon. Equipment for water ozonation. Design a underground water purification system using the equipment for aeration and removal of iron and manganese. Design a surface water purification system using the device for coagulation, sedimentation, filtration, adsorption and disinfection

### **Waste management**

Knowledge of the principles of waste management and waste utilization technologies. The acquisition of skills to perform and analyse laboratory tests of waste and design of waste management facilities. The legal bases of waste management. Characteristics of the main groups and physico-chemical analysis of the waste. Methods for collection and transportation of waste. Methods for the recovery and treatment of waste. Methods of waste treatment: biological, thermal and chemical. Storage of waste. Hazardous waste. Industrial waste. Physico-chemical and technological tests of waste.

### **Air protection**

The purpose of education is to familiarize students with the problems of the spread of contamination in the field and ways to minimize pollution. Basic information about the atmospheric air. Legislation on environmental protection - Environmental Law and Regulations. Sources of air pollution and their characteristics. Methods for calculating emissions from various sources. Factors influencing the spread of pollutants in ambient air. Criteria for evaluation of air pollution. Terms meet the allowable concentrations

of pollutants. Model point source emissions. Line and surface sources. Calculation formulas, Pasquille's model. Dust removal-methods used in heating and industrial installations. Desulfurization of flue-gas desulfurization methods.

### **Water supply systems**

The tasks of water supply systems and its components, schemes of water supply systems. Methods for calculating and forecasting the demand for water, the unit rates of water consumption, water consumption characteristics of inequality, fire water demand. Equity and demand for water. Designing water intakes - the necessary studies to design approaches, calculations and designing of various types of water intakes, water protection zones. Storage water tanks: principles of location, function, design and operation. Designing of water network. Hydraulic calculation of the water network, water pipelines fittings, materials used for construction of water pipelines, location of pipelines. Basic maintenance operations water supply. Design and operation of the pumping station and the hydrophores. Hydraulic cooperation of the system components. Hydraulic calculation of whole water supply system using analytical and graphic methods.

### **Melioration**

Definition of land reclamation. Land reclamation as a tool of shaping the environment. The basic and detailed objectives of the land drainage. Factors affecting of soil water relations. Acceptable levels of ground water - the causes of flooding and water shortages. Types of melioration works. Water meliorations, agricultural meliorations, land reclamation of urban areas. Legal aspects of land reclamation. Facilities used in land reclamation. Basics of drainage and irrigation. The operating rules of melioration devices. Impact of the land drainage on the status of surface waters. The importance of land reclamation in sustainable development and environmental protection.

### **Wastewater discharge and sewage systems**

Sewage networks and different types of discharged sewage. Technical methods of discharging sanitary sewage, trade effluent and precipitation wastewater from urban catchments. Different types of gravitational sewage systems – combined, separate, partially separate and mixed sewage systems and forced methods of sanitary sewage discharge with pressure and vacuum sewage systems. Construction and principles of designing of sewage network elements such as storm overflows, pumping stations, channel flushing systems, etc. Influence of sewage systems on efficiency of sewage treatment plants operation and water quality of the receiver. Materials, construction and exploitation of network and sewage network facilities. Introduction to the issue of regulation and control of sewage transport in the network to the sewage treatment plant. Storage reservoirs hydraulically unloading the sewage network.

### **Heating and heat engineering**

Thermal comfort requirements. The microclimate of the room – the parameters. Designed temperatures inside and outside. The rules of calculating heat transfer coefficients. Heat losses by infiltration and ventilation. Heat load calculations. Classification, characteristics and criteria for the selection of radiators. Classification and characteristics of heating systems. Graphic imaging of central heating installation. Hydraulic calculations of central heating installation. Classification and characterization of heat sources. Overview of types of boilers. Safety of central heating installations open and closed systems. Underfloor heating - the parameters, requirements, design principles. Characteristic of technology and fittings used in central heating systems. Requirements for boiler rooms . The quality of water for heating purposes. Flue and fuel supply systems. Computer-aided designing of heating systems. Installation and commissioning research of heating systems.

Types of heat. Characteristics of the nodes of the hot water service. Characteristics of nodes exchanger. Heating combi systems. Selection of heat exchangers, pumps, regulatory systems, measuring systems. The desirability of centralized heat supply. Centralized systems of heat supply. Determine the nature and amount of the heat. Structured graph heat loads. Heating control systems – qualitative and quantitative regulation.

Chart control. Control systems. Choosing the type and parameters of the heating medium. Selecting the location of heat. Integrated heating technology. Protection of water sealed heating systems. Overview of types of boilers for heating. Selection of circulation pumps, stabilizing and supporting. Water treatment technology requirements for the heating system. The properties of solid, liquid and gas. Criteria for the selection of fuel. Fuel demand for heating season. Power supply to solid fuel. Calculation of the composition of the fuel and slag. Environmental pollution from heating. Requirements for boiler built. District heating systems. Types, construction of heating systems. Fixed points and sliding. Compensation expansion. Design and construction of pre-insulated networks. Hydraulic calculations network. Performing diagram the pressure.

### **Pumps and ventilators in heating and ventilation systems**

Classification of pumps. Positive displacement pumps. Centrifugal pumps – construction and application. Special pumps and vacuum pumps – the scope of applicability. Fans and blowers – construction, distribution and selection. The compressors in air conditioning and refrigeration. Positive displacement compressors. Orbital centrifugal compressors – application. The multi-system project of refrigeration unit for the environmental engineering sector.

### **Reclamation and revitalization of water ecosystems**

Water management in Poland and EU. Elementary adjustment law in protection of waters and soils. Eutrophication of superficial waters, the role of biogens. Trophic conditions of polish lakes and rivers, reclamation of lakes. Self-purification of waters. Lentic waters, temperature-oxygen profiles. Forecasting of natural water quality

### **Water supply systems**

The tasks of water supply and its components, schemes of water supply systems. Methods for calculating and forecasting the demand for water, the unit rates of water consumption, water consumption characteristics of inequality, fire water demand. Equity and demand for water, groundwater, surface water. Designing water supplies - the necessary studies to design approaches, calculations and designs for various types of water supplies, water protection zones. Storage water mains water supply tanks: Principles location, function, design and operation. Transfer water, basic concepts of water flow, flow resistance, cooperation pumping, water supply and expansion tanks. Design and operation of the pumping station and the hydrophore. Types of water supply and the hydraulic calculation. Policy routing water supply, network equipment, materials used for construction of water supply, location of pipes and water supply fittings in cross section of the street. Basic maintenance operations water supply. Health and safety conditions in the performance of water supply. Requirements and acceptance tests performed water supply. Methods for trenchless renovation of the water supply system. Rules draw up guidelines instrumentation and monitoring system of water supply, the use of modern techniques in the design and operation of water supply systems. Cooperation of hydraulic system components. The characteristics of piping serially connected and parallel. Calculation of pipework with by ties. Hydrogeology of intakes and drainage. Sources of surface water and groundwater. Imported characteristics of water sources. Study of water supply in spatial planning. Pump selection of pump units, control pumping station. Analytical calculation and diagram of water supply systems, interoperability reservoirs and pumping stations. Complete Hydraulic calculation of water supply systems and analytical-graphic methods . Comprehensive system hydraulic calculation of single and multi-zone a few sources of power.

### **Physical education**

The main aim of studying: shaping the habits and improving the physical agility, as well as stimulating active participation in physical education classes. Developing pro-health behaviour, perfecting physical condition and coordination. Preparation for participation in various forms of sport and recreational activities. Developing cooperation and collaboration skills.

## **Gas and electrical installations**

Basic definitions in the field of electrical installations. Low voltage power networks. Selection of electrical equipment. Methods of laying wires and cables. Selection and installation of switchgear and control equipment. Determining the power demand and electricity. Surge Protection. Protection against electric shock. Lightning protection. The current legislation, regulations and standards in power. Gas installations: Properties and applications of the gaseous fuels. Ways of supply buildings in gas. Interaction of gas network and internal gas installation. Technical solution, designing, construction and commissioning of the gas installation in residential buildings. Calculation of gas installations. Domestic gas appliances - classification and construction. The measurement of gas, adjustment devices, fittings and gas pipes. Tightness tests. Ventilation and flue systems in residential buildings with gas appliances - theoretical fundamentals. Operational safety gas systems. Current legal acts. Regulations and standards in gas installations. Gas installations: Practical exercise of design the gas installation in residential building or other building.

## **Sanitary installations**

Water supply and sewage discharge systems. Tasks and distribution of cold water. Water supply installations fed by municipal water supply networks. Zoning, water reservoirs. Water supply installations fed by individual water sources. Sanitary technician. Elements of water supply installations. The functional water installation. Armature and materials used in water supply systems. Protection of water in water supply systems against pollution. Hydraulic calculations water installations  
Fire protection systems. Domestic hot water systems. Basic schemes of district heating systems. Hydraulic calculations of hot tap water Tasks and method of calculation of circulation. Elements of sewage systems. Division of tasks and sewage systems. Components of the drains. Drainage systems - running and dimensioning of pipes. Develop and sanitary sewer profiles. Rules sewage drains external and individual receiving water. Drainage system. Sewer technology. Testing and commissioning of sanitary

## **Protection against noise and vibration**

Physical characteristics of noise and vibration. Properties of acoustic waves (reflection, absorption, refraction). Acoustic signal and the vibration. Sources of vibration and noise in the environment. Effect of noise and vibration on man. The methods of measurement, acquisition and analysis of vibro-acoustic signals. Sound propagation in the open air. Methods for measuring and predicting the distribution of sound pressure level in the environment. Methods for reducing vibration and noise. Measurement and evaluation of vibration in the environment. Methods of preparation of environmental impact assessments in the field of noise and vibration impacts. Acts. Plans Acoustic cities. Noise monitoring - account technical and legal formalities. Acoustics noise sources, the distribution half-acoustic efficiency protections. Laws for the protection against noise and vibration.

## **Practical training**

Practice in industrial enterprises in the field of environmental engineering (4 weeks, 40 hours per week).

## **Sludge utilization**

Composition and properties of the sludge, rules of law concerning sludge. Conditioning and disintegration of sludge. Thickening sludge. Dewatering and drying the sludge. Stabilization of sludge: anaerobic digestion, aerobic stabilization, chemical stabilization, composting. Thermal methods of sludge degradation. Hygienisation. Sludge disposal. Storage of sludge. Technological research of sludge.

## **Ventilation and air conditioning**

The microclimate of the room, the microclimate parameters and rules for its evaluation. Measurements of microclimate. Humid air, its characteristics. Molier chart and its use in ventilation. Rules for calculating air requirements. Methods for simplified and accurate types of ventilation and ventilation methods. Supply air streams. The components of ventilation: ducts and their accessories. Fans, filters, heaters, air handling units. Selection of ducts and ventilators. Hydraulic calculation of the ventilation system and air distribution control in the installation. Acoustics ventilation, silencers. Heat recovery in the ventilation. Technical

acceptance, commissioning, measurement and control in ventilation systems. Balancing rules the profit and loss of heat, moisture and other contaminants. Selection of the air conditioning system depending on the nature of premises. Individual air conditioning. Ceilings and chilled beams. Central air conditioning and zone. Air conditioning of 2-3-4 pipes. Air conditioning using fan coil units. Two ducts air conditioning systems. Air conditioning with variable volume flow. Automatic adjustment of air conditioning. The development of the technical design of ventilation or air conditioning for the room with making drawings and selection of equipment. Measurements of basic size used in air conditioning with measurements of microclimates in room.

### **Water-engineering**

Tasks and distribution of hydraulic engineering. Types of hydraulic structures and their application. Dams: dams and dam, hydroelectric installations. Storage reservoirs for municipal, industrial and agricultural. The role of reservoirs in the country's water management system. The management of water in the storage reservoir. Failures of dams throughout history. Installation mountain streams. Characteristics of rivers. Adjusting the rivers. Flood protection: embankments of rivers, canals relief, flood control reservoirs. Implementation of the conceptual design of water passing over the instep across the stream. Design of selected conceptual structure of water.

### **Technological water in industrial plants**

Classification of water pollutants industry. Types and purpose of water in industrial plants. Characteristics of heat cycles, boilers, cooling. Requirements for circulating waters. Characteristics and preventing corrosion and boilers stone. Equipment and technology of circulating and technological water treatment. Water balance in selected industrial plants, developing the technological concept of water treatment and calculations of basic equipment. Analysis and technical description of the solution.

### **History of art and architecture**

General information about artistic techniques and iconography. The art and architecture of ancient civilizations (Mesopotamia, Egypt). The art and architecture of ancient Greece. Etruscan and Roman architecture and art. Early Christian and Byzantine architecture and art. Romanesque and Gothic architecture and art. The art and architecture of the Renaissance and Mannerism. Baroque architecture and art. Polish architecture and art of the 10th-18th centuries.

### **Diploma thesis**

#### **Diploma seminar**

Presentation of the rules of writing scientific papers. Using the literature in scientific texts and rule of citations. Preparation of the presentation, principles and presentation the results. Individual preparation of written papers and their presentation, using multimedia tools.