Study programme

Civil engineering
first degree study

Cycle of education: 2023/2024
The profile of studing: general academic

P R K VI

1. Basic information about the course

The name of the field of study	**Civil engineering**
The level of study	**first degree study**
The profile of studing	**general academic**
Indication of the fields of science and scientific disciplines or fields of art and artistic disciplines to which the course of study was assigned	**civil engineering, geodesy and transport**
Number of semesters	full time study: **7**
Number of ECTS credit points required to complete the studies	**210**
Total number of class hours	full time study: **2395**
Recruitment requirements	Requirements annually determined by the Senate of Rzeszów University of Technology
After graduation, the graduate obtains a professional title	engineer

2. Learning outcomes

Symbol	Contents	References to PRK
K_W01	Has knowledge of selected branches of mathematics, physics, which is the basis of subjects in the field of mechanics, theory of construction, durability and technology of building materials.	**P6S_WG**
K_W02	Knows the rules of descriptive geometry and technical drawing regarding the recording and reading of architectural, construction and geodetic drawings, as well as their drawing using CAD.	**P6S_WG**
K_W03	Knows how cartographic mapping is defined and what the basic geodetic works in construction are.	**P6S_WG**
K_W04	Has knowledge of general mechanics, durability of materials, modeling of materials and principles of general construction shaping.	**P6S_WG**
K_W05	Knows the principles of mechanics and bar structure analysis in terms of statics, dynamics and stability.	**P6S_WG**
K_W06	Knows the standards and guidelines for the design of construction works and their components.	**P6S_WG**
K_W07	Knows the principles of dimensioning and construction of building elements and structures: metal, reinforced concrete, composite, wooden and masonry.	**P6S_WG**
K_W08	Knows the principles of foundation of construction works.	**P6S_WG**
K_W09	Knows the principles of construction and analysis of selected objects of general utility buildings, industrial and communication / bridge construction.	**P6S_WG**
K_W10	Has basic knowledge of the design of road transport infrastructure facilities.	**P6S_WG**
K_W11	Knows selected computer programmes supporting the calculation and design of structures and the organization of construction works.	**P6S_WG**
K_W12	Knows the basics of building physics regarding heat and moisture migration in building objects.	**P6S_WG**
K_W13	Knows the most commonly used building materials and basic technologies of their production.	**P6S_WG**
K_W14	Has knowledge about creating the procedures for quality management of construction works. Knows the norms and labour standards in construction as well as the organization and principles of construction management.	**P6S_WG**
K_W15	Has basic knowledge of economic, legal and other non-technical conditions of engineering activities in the construction industry.	**P6S_WK**
K_W16	Has knowledge about the impact of building investments on the environment.	**P6S_WK**
K_W17	Has basic knowledge about the construction and principles of functioning of internal installations in construction.	**P6S_WG**
K_W18	Knows the rules for conducting surveys of building plots.	**P6S_WG**
K_W19	Has basic knowledge about hazards occurring at the workplace and their impact on human health.	**P6S_WG**
K_W20	Understands the basics of computational methods used in structural mechanics and knows the basic concepts of Finite Element Method in the field of bar structures and heat transfer.	**P6S_WG**
K_W21	Has basic knowledge of information technology, including knowledge of office and statistical packages, engineering calculations, data visualization and engineering graphics.	**P6S_WG**
K_W22	Has basic knowledge of programming, computer aided design and artificial inteligence methods.	**P6S_WG**
K_W23	Demonstrates ability to use ergonomic knowledge to design the spatial structure of the workplace and to shape safe working conditions.	**P6S_WG**
K_W24	The student has a basic knowledge of human functioning to help work effectively as an engineer.	**P6S_WK**
K_W25	Knows and understands the basics of propriety as a necessity related to professional qualifications.	**P6S_WK**
K_U01	Can classify simple construction objects.	**P6S_UW**
K_U02	Can evaluate and make a statement of loads acting on building objects.	**P6S_UW**
K_U03	Demonstrates ability to correctly define computational models of computer structure analysis.	**P6S_UW**
K_U04	Demonstrates ability to perform static analysis of statically determinate and indeterminate bar structures. Can determine the frequency of natural vibrations for simple rod structures.	**P6S_UW**
K_U05	Demonstrates ability to correctly choose tools (analytical or numerical) to solve problems of analysis and design of building objects and conducting construction works.	**P6S_UW**
K_U06	Demonstrates ability to use selected computer programs supporting design decisions in construction. Demonstrates ability to critically evaluate the results of numerical analysis of building structures.	**P6S_UW**
K_U07	Can design selected elements and simple structures: steel, reinforced concrete, composite, wooden and masonry in general utility buildings and bridge construction.	**P6S_UW**
K_U08	Can design simple foundations for general utility buildings.	**P6S_UW**

K_U09	Demonstrates ability to perform stability analysis and graphical carrying capacity of simple bar systems in the area of the assessment of limit states of the structure.	**P6S_UW**
K_U10	Can draw up the energy balance of a building.	**P6S_UW**
K_U11	Demonstrates ability to perform simple laboratory experiments leading to the assessment of the quality of building materials used.	**P6S_UW**
K_U12	Demonstrates ability to read architectural, constructional and geodetic drawings and demonstrates ability to prepare graphic documentation of elements and simple general utility buildings in the environment of selected CAD programmes.	**P6S_UW**
K_U13	Can make a simple estimate and schedule of construction works.	**P6S_UW**
K_U14	Demonstrates ability to assess the risks in the implementation of construction works and implement appropriate safety rules.	**P6S_UW**
K_U15	Demonstrates ability to use information technologies, internet resources and other sources to search for general information, communication and acquiring software supporting the work of a designer and organizer of construction works.	**P6S_UU**
K_U16	Mastered the ability to communicate in a modern language other than the mother tongue at B2 level, including knowledge of technical language in the field of Civil Engineering.	**P6S_UW**
K_U17	Knows and applies the provisions of construction law.	**P6S_UW**
K_U18	Knows the rules for the production and use of building materials. Can make their selection and design their composition.	**P6S_UW**
K_U19	Can organize work on the construction site in accordance with the principles of construction technology and organization.	**P6S_UO**
K_U20	Can design pipelines for liquid transport and typical building installations for residential buildings.	**P6S_UW**
K_U21	Has the ability to work in a network environment and can work using online and group tools.	**P6S_UW**
K_U22	Can handle typical MES computational systems.	**P6S_UW**
K_U23	Demonstrates ability to plan and carry out experiments, experiments, measurements, calculations and interpret the obtained results and draw conclusions.	**P6S_UW**
K_U24	Can take care of his own health and physical fitness.	**P6S_UU**
K_U25	The student is able to apply psychological knowledge to improve efficiency in professional work.	**P6S_UW**
K_U26	Potrafi ocenić przydatność kompetencji miękkich w środowisku akademickim i naukowym.	**P6S_UW**
K_K01	Demonstrates ability to work independently and collaborate in a team over a designated task. is responsible for the safety of his own work and the team.	**P6S_KK**
K_K02	s responsible for the reliability and quality of the results of his/her work and their interpretation.	**P6S_KR**
K_K03	Independently completes and expands knowledge in the field of modern processes and technologies.	**P6S_KK**
K_K04	Is aware of his/her knowledge and skills and understands the need to constantly improve his/her professional and personal competences.	**P6S_KK**
K_K05	Can form opinions on technical and technological processes in construction, formulate conclusions and describe the results of his/ her own work.	**P6S_KK**
K_K06	Understands the need to provide the public with knowledge about the construction industry and communicates it in a generally understandable way. is communicative in media presentations.	**P6S_KO**
K_K07	Is aware of the need to comply with the principles of professional ethics, proper social relations and respect for the law, including copyrights.	**P6S_KR**
K_K08	Is aware of the advantages, limitations and threats resulting from the use of modern digital tools supporting the design and implementation of construction investments.	**P6S_UO** **P6S_KK**
K_K09	Correctly identifies and resolves dilemmas related to the profession of a civil engineer.	**P6S_UO**

The description of learning outcomes includes learning outcomes referred to in the Act of 22 December 2015 on the Integrated Qualification System and takes into account universal characteristics of the first degree cycle specified in this Act and the characteristics of the second degree cycle specified in the regulations issued on the basis of Article 7, section 3 of this Act..

Detailed information about:

1. the relationship between learning outcomes and modular learning outcomes;
2. key learning outcomes in terms of knowledge, skills and social competences, demonstrating their relation to the discipline / disciplines to which the course is assigned;
3. the development of learning outcomes at the level of classes or group of classes, in particular related to the scientific activity conducted at the university;
4. learning outcomes in terms of knowledge, skills and social competences leading to the acquisition of engineering competences, in the case of study programmes on completion of which the student is awarded a professional title of engineer / Master of Engineering;

can be found in the Module Activity Sheets, available on the website of the faculty. Module Activity Sheets are integral part of the study programme.

3. List of classes, parameters of the study program, methods of verification of learning outcomes and program content

3.1 Common subjects for the field of study, independent of the students' choice

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/ Seminar	Sum of hours	ECTS	Exam	Mand.	Type
1	BB	Building materials	15	0	30	0	45	3	N		A
1	BP	Computer aided engineering graphics	20	0	30	0	50	4	N		A
1	BP	Engineering geometry	25	0	0	30	55	5	T		A
1	FM	Engineering Mathematics	60	45	0	0	105	9	T	🚩	A
1	FF	Engineering Physics	15	15	0	0	30	3	N	🚩	A
1	DJ	Foreign language	0	30	0	0	30	2	N	🚩	B

1	BM	Information technology	15	0	30	0	45	4	N		A
1	DL	Physical education	0	30	0	0	30	0	N	🚩	A
2	BM	Building Information Modelling	15	0	45	0	60	5	N		A
2	B	Elective module-1	15	0	0	0	15	2	N		B
2	FM	Engineering Mathematics	30	45	0	0	75	6	T		A
2	FF	Engineering Physics	15	0	15	0	30	3	T		A
2	DJ	Foreign language	0	30	0	0	30	2	N	🚩	B
2	BG	Geodesy	30	0	45	0	75	6	T		A
2	DL	Physical education	0	30	0	0	30	0	N		A
2	BM	Theoretical mechanics	45	30	0	0	75	6	T		A
3	BB	Building engineering	30	0	0	30	60	5	N	🚩	A
3	BB	Building physics	15	15	30	0	60	5	N		A
3	BS	Concrete technology	15	0	30	0	45	3	N		A
3	DJ	Foreign language	0	30	0	0	30	2	N	🚩	B
3	BG	Soil mechanics and foundations	15	0	30	0	45	3	N	🚩	A
3	BM	Strength of materials	45	30	15	15	105	8	T		A
3	BM	Structural mechanics	15	15	0	15	45	4	N	🚩	A
4	BB	Building engineering	15	0	0	30	45	4	T		A
4	BK	Concrete structures	30	15	15	30	90	6	N	🚩	A
4	B	Elective module-3	15	0	0	0	15	2	N		B
4	DJ	Foreign language	0	30	0	0	30	3	T		B
4	BG	Soil mechanics and foundations	30	0	0	30	60	5	T		A
4	BM	Structural mechanics	60	30	15	30	135	10	T		A
5	BM	Computational methods	30	0	30	0	60	4	N		A
5	BK	Concrete structures	30	0	0	30	60	5	T		A
5	BS	Construction technology	30	15	0	30	75	6	T		A
5	BK	Steel structures	30	15	15	30	90	6	N	🚩	A
5	BP	Visual programming	0	0	30	0	30	3	N		A
6	BM	Introduction to programming	15	0	30	0	45	3	N		A
6	BM	Machine Learning	15	0	15	0	30	2	N		A
6	BI	Sanitary installations	15	0	15	15	45	2	N		A
6	BK	Steel structures	30	0	0	30	60	4	T		A
7	B	Construction practice	0	0	0	0	0	5	N		B
7	B	Diploma seminar	0	30	0	0	30	3	N		B
7	B	Diploma thesis	0	0	0	0	0	15	T		B
7	BS	Elective module-2	15	0	15	15	45	4	N		B

Legend, types of subjects

A - mandatory for teaching programme
B - mandatory for teaching programme with the posibility of choice
C - chosen for teaching programme
D - mandatory for the speciality
E - chosen for the speciality
F - optional

Note that not being granted credits from the modules marked with a red flag makes it impossible to make an entry for the next semester (even if the total number of ECTS credits is lower than the permissible debt), these are modules continued in the next semester or modules in which failure to achieve all assumed learning outcomes does not allow one to continue studies in the modules included in the next semester's study programme

3.2 List of thematic blocks

- Civil and bridge engineering
- Civil and road engineering

3.2.1. Thematic block: Civil and bridge engineering

Subjects implemented after the selection of the thematic block

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/Seminar	Sum of hours	ECTS	Exam	Mand.	Type
5	BC	Bridge construction	15	15	0	15	45	6	N	🚩	C
6	BC	Bridge construction	15	15	0	15	45	6	T		C
6	BS	Construction organization and costs	15	15	15	0	45	4	N		C
6	BB	Energy efficient construction	30	0	0	15	45	3	N		C
6	BC	Fundamentals of road engineering	20	0	0	15	35	3	N		C
6	BK	Masonry structures	20	0	0	15	35	3	N		C
7	BK	Structural detailing	0	0	30	0	30	3	N		C

Legend, types of subjects

    A - mandatory for teaching programme
    B - mandatory for teaching programme with the posibility of choice
    C - chosen for teaching programme
    D - mandatory for the speciality
    E - chosen for the speciality
    F - optional

Parameters of the study program

The total number of ECTS credits that a student must obtain in the course of classes conducted with direct participation of academic teachers or other persons conducting classes.	106 ECTS
The total number of ECTS credits allocated to classes related to scientific activity conducted at the university in a given discipline or disciplines to which the course of study is assigned.	140 ECTS
The total number of ECTS credits required to be obtained by a student in the humanities or social sciences for the courses of study assigned to disciplines within the fields of study other than the humanities or social sciences respectively.	8 ECTS
The total number of ECTS credits allocated to elective courses.	68 ECTS
Total number of ECTS credits allocated to work placements, internships (if the study program includes work placements or internships).	5 ECTS
Hours of apprenticeships, internships (if the study program provides for internships or apprenticeships).	160 h.
The total number of ECTS points that a student must obtain as part of a foreign language course.	9 ECTS
Number of hours of physical education classes.	60 h.

Verification methods of learning outcomes

Detailed rules and methods for the verification and assessment of learning outcomes that allow all learning outcomes to be verified and assessed are described in the Module Activity Sheets. Within the framework of a programme, verification of learning outcomes is carried out in particular by means of the following methods: written, exam part practical, exam part oral, written pass, pass a part practical, oral pass, essay, colloquium, written test, observation of performance, portfolio, project presentation, written report, oral report, project report, written test. Detailed information about the verification of learning outcomes achieved by students can be found in the Module Activity Sheets on the website of the faculty. Parameters of selected methods of verification of learning outcomes are presented in the table below.

Number of classes where the exam is required	16
Number of classes where a written exam is required	10
Number of classes where an oral exam is required	1
Number of hours devoted to the written exam	22
Number of hours devoted to oral exam	1
Estimated number of hours students should spend preparing for exams and credits	692
Number of classes which result in a pass without an exam	33
Number of hours to be completed in writing	23
Oral number of hours to complete	6
Estimated number of hours that students should spend on preparing for credits during semesters during classes (no final credits)	115
Number of classes in which the verification of the achieved learning outcomes is carried out on the basis of observation of performance (laboratories)	21
Number of laboratories where the achieved learning outcomes are checked on the basis of tests during the semester	3
Estimated number of hours students should spend in preparing for laboratory tests	40
Number of project classes in which the learning outcomes achieved are checked on the basis of a project presentation, a written report, a written report, an oral report or a project report	19
Estimated number of hours students should spend on design / documentation / report preparation and preparation for presentation	427
Number of lecture classes that require separate credit in writing or orally, regardless of the requirements of other forms of classes in this module	15
Estimated number of hours students should spend in preparing for lecture tests	86

3.2.2. Thematic block: Civil and road engineering

Subjects implemented after the selection of the thematic block

Semester	Org.Unit	name of the subject	Lecture	Class	Laboratory	Project/ Seminar	Sum of hours	ECTS	Exam	Mand.	Type
5	BC	Road construction	15	15	0	15	45	6	N		C
6	BC	Fundamentals of bridges	20	0	0	15	35	3	N		C
6	BS	Organization of building production	15	15	15	0	45	4	N		C
6	BB	Renewable energy sources	30	0	0	15	45	3	N		C
6	BC	Road construction	15	15	0	15	45	6	T		C

6	BK	Timber structures	20	0	0	15	35	3	N		C
7	BK	Computer aided design of building structures	0	0	30	0	30	3	N		C

Legend, types of subjects

    A - mandatory for teaching programme
    B - mandatory for teaching programme with the posibility of choice
    C - chosen for teaching programme
    D - mandatory for the speciality
    E - chosen for the speciality
    F - optional

Parameters of the study program

The total number of ECTS credits that a student must obtain in the course of classes conducted with direct participation of academic teachers or other persons conducting classes.	106 ECTS
The total number of ECTS credits allocated to classes related to scientific activity conducted at the university in a given discipline or disciplines to which the course of study is assigned.	140 ECTS
The total number of ECTS credits required to be obtained by a student in the humanities or social sciences for the courses of study assigned to disciplines within the fields of study other than the humanities or social sciences respectively.	8 ECTS
The total number of ECTS credits allocated to elective courses.	68 ECTS
Total number of ECTS credits allocated to work placements, internships (if the study program includes work placements or internships).	5 ECTS
Hours of apprenticeships, internships (if the study program provides for internships or apprenticeships).	160 h.
The total number of ECTS points that a student must obtain as part of a foreign language course.	9 ECTS
Number of hours of physical education classes.	60 h.

Verification methods of learning outcomes

Detailed rules and methods for the verification and assessment of learning outcomes that allow all learning outcomes to be verified and assessed are described in the Module Activity Sheets. Within the framework of a programme, verification of learning outcomes is carried out in particular by means of the following methods: written, exam part practical, exam part oral, written pass, pass a part practical, oral pass, essay, colloquium, written test, observation of performance, portfolio, project presentation, written report, oral report, project report, written test. Detailed information about the verification of learning outcomes achieved by students can be found in the Module Activity Sheets on the website of the faculty. Parameters of selected methods of verification of learning outcomes are presented in the table below.

Number of classes where the exam is required	16
Number of classes where a written exam is required	10
Number of classes where an oral exam is required	1
Number of hours devoted to the written exam	23
Number of hours devoted to oral exam	1
Estimated number of hours students should spend preparing for exams and credits	695
Number of classes which result in a pass without an exam	33
Number of hours to be completed in writing	24
Oral number of hours to complete	4
Estimated number of hours that students should spend on preparing for credits during semesters during classes (no final credits)	121
Number of classes in which the verification of the achieved learning outcomes is carried out on the basis of observation of performance (laboratories)	21
Number of laboratories where the achieved learning outcomes are checked on the basis of tests during the semester	3
Estimated number of hours students should spend in preparing for laboratory tests	40
Number of project classes in which the learning outcomes achieved are checked on the basis of a project presentation, a written report, a written report, an oral report or a project report	19
Estimated number of hours students should spend on design / documentation / report preparation and preparation for presentation	477.50
Number of lecture classes that require separate credit in writing or orally, regardless of the requirements of other forms of classes in this module	18
Estimated number of hours students should spend in preparing for lecture tests	114

3.3 Programme content

Programme content (educational content) is consistent with the learning outcomes and takes into account, in particular, the current state of knowledge and research methodology in the discipline or disciplines to which the course of study is assigned, as well as the results of scientific activity in this discipline or disciplines. A detailed description of the program content is available in the Module Activity Sheets on the website of the faculty.

Bridge construction	K_W04, K_W06, K_W09, K_W10, K_W11, K_W13, K_W15, K_W16, K_U01, K_U02, K_U06, K_U07,

	K_U09, K_U12, K_U13, K_K01, K_K02, K_K03, K_K04, K_K06, K_K07

• Basic definitions, examples • The history of bridge construction • Classification of bridges • The modern types of beam, frame, arch, suspension and cable stayed bridges. The modern solutions of pedestrian bridges. • Basic parts of bridges and their function • The technology of bridge construction • Shaping of bridge span cross section • Types of foundations and supports of bridges • Loadings of road and railway bridges • Clearances • The rules of dividing of barrier for spans

Building engineering	K_W06, K_W07, K_W13, K_U01, K_U02, K_U12, K_U15, K_U18, K_K01, K_K03, K_K04

• General concepts: building construction, building, construction engineering, landscape architecture. The technical conditions to be met by buildings and their location on the basis of implementing provisions of the Building Act. • Integrated design - terminology, parts of buildings and structures, buildings implementation stages • Solutions foundations of buildings, foundation walls, earthworks at the foundation of buildings • The walls of buildings, elements shaping the surface of the walls • Communication in the building, construction and principles of forming stairs, rules for the selection and implementation of the chimney in buildings. • Organizational activities, design of buildings, the stages of design, construction documentation. Definitions related to buildings and rooms functions. Forming the building. Entrances to buildings and dwellings. Lighting and sunlight inside the building. Room arrangement relative to parts of the world. • Issuance of design assumptions. Dimension lines. Rules of dimensioning the drawings. Layout of the staircase. The ramps in buildings. The location of the building on the plot. Distance of building from the plot. Rules of locating field devices on the plot. • Fence parcel, parking spaces, communication routes. Drawing a building plot. Technical description. Crediting the design part. • General Information, Grid Load Capacities - classification, the rules for determining load combinations • Construction of ceilings in buildings, Ceilings - principles of design and construction, criteria for selecting items. Roofs and flat roofs as well as balconies and terraces of the buildings made in traditional technology - the types of construction, development of roofs, roofing, drainage of rainwater. • Basic dimensioning of timber structures. • General Information, Grid Load Capacities - classification, the rules for determining load combinations, examples designation loads on structural elements of the building • Exercise and verification of project billings according to individual assumptions • Wooden roof structures, basic dimensioning examples of structural wood roof • Exercise and verification of the wooden roof structure design according to individual assumptions

Building Information Modelling	K_W11, K_W22, K_U15, K_U21, K_K01, K_K02, K_K03, K_K04, K_K05, K_K06, K_K08

• Introduction to issues related to the implementation of construction projects using BIM technology. Standardization and documentation of the BIM process. Dimensions and levels of details. Common Data Envirnment platforms (CDE). VDC coordination meetings. • Introduction to work in the Revit environment, issue and approval of individual project topics. • Loading foundations, creating a construction grid and levels, defining and modeling walls. • Loading families of windows and doors and inserting them into the model. Creating an exemplary parametric family for window. • Defining ceilings and stairs. • Terrain and foundations modeling. Exporting views to DWG. • Modeling of the roof slope and the structure elements (using beams system). • Variant of the project. Modeling of a room equipment and surroundings. • Dimensioning of projections and sections. • Labels creation and rooms description. Lists of rooms and roof truss elements. • Creating drawing sheets and documentation. • References and details detailing. Documentation printout and preparation of project implementation reports.

Building materials	K_W06, K_W13, K_U11, K_U15, K_U18, K_K01, K_K03

• General information on the classification, test methods and the normalization of materials and construction products. The technical characteristics of materials and selected aspects of construction chemicals. • Classification, raw materials and production technology, general characteristics, properties and possible applications in the construction of selected building materials such as construction ceramics, stone and aggregate materials, adhesives and mortar, wood, metal, glass, plastic materials, thermo-and hydro-insulation and sound insulation. • Discussion of issues related to the subject: presentation of issues involving the subject, the requirements and conditions of of assessment, rules of procedure in the lab, cleaning, health and safety regulations. • The study of selected physical and mechanical properties of basic building materials such as: selected wall components, stone materials, aggregates, construction adhesives, wood, asphalt, metal. • The use of chemical methods for testing the selected materials of construction.

Building physics	K_W06, K_W12, K_W13, K_U10, K_U15, K_U23, K_K01, K_K02

• Indoor climate. The parameters of humid air. Condensation on the surface of the partition. Characteristics of Polish climate. Discussion of climate data in the heating season. Physical properties of construction materials. • Dampness in building envelopes. Forms of occurrence of dampness in materials and building envelope. Diffusion and condensation in materials. Calculation of humidity building partitions. Heat transfer through building partitions in the one-dimensional. Conduction. Convection. Radiation. Heat transfer through the transparent barrier. • Thermal insulation of barrier and building elements. Principles of design of building partitions. Rules for designing of building partitions. Thermal bridges in building envelopes. Profits and heat loss through the building envelope. Heat balance of the building. Thermal performance of the building. Interior lighting works. Basic concepts of building acoustics. Sound insulation of airborne and impact sound. • calculation to avoid condensation of water vapor on the surface of the barrier construction, air data and partitions, resulting in condensation of water vapor surface • calculation of heat transfer coefficients of various building partitions, in contact with air and soil, building components. Thermal and humidity calculations of building partitions • Calculation of the energy balance of the building partitions and the building • Testining of humidity, water absorption, humidity sorption, hygroscopic and capillary water in building materials. Specifying the relative humidity in the Assman psychrometer (test method) • Specifying the air temperature and surface building partitions temperature (types of measuring instruments). Specifying the heat transfer coefficient U of building partitions method for measuring the temperature and heat flux. The measurement of light intensity areas. Measurement of noise in the room.

Computational methods	K_W01, K_W04, K_W11, K_W20, K_U03, K_U05, K_U06, K_U15, K_U22, K_U23, K_K02, K_K04

• Introduction - mathematical modelling. Mathematical and numerical models of physical problems. Discrete systems. Mathematical modelling of structure - global and local formulation of boundary value problems. • Interpolation - Lagrange, Hermite, trigonometric. Approximation - least-squares, points. • Classical finite difference method (FDM). Introduction, difference operators, FDM meshes. • Approximations methods for solving mechanics problems - Ritz method, Galerkin methods. • Introduction - Finite Element Method (FEM). Geometrical and physical assumptions. Local approximation. Shape functions for finite elements. One-dimensional, two-dimensional finite elements. 3D finite elements. The finite element algorithm and procedures. Convergence and errors of the finite element method. Analysis of bars structures, 2D solids.

Computer aided design of building structures	K_W02, K_W04, K_W07, K_W11, K_W21, K_U01, K_U02, K_U03, K_U04, K_U05, K_U06, K_U07,

	K_U15, K_U22, K_K02, K_K04, K_K05, K_K08, K_K09

• Computer model of the process of creating reinforced concrete structures. Modeling and computational analysis of reinforced concrete plane member structures in various programs Robot Axis MV and ATENA, material models, authoritative values of internal forces - averaging of results, cracking analysis, deflection, 3D modeling and calculation of reinforced concrete structures in CAD - analysis of structures in Robot and Axis MV. Modeling of masonry structures. • Model of the process of creating steel structures Modeling and analysis of steel plane member structures in Robot and Consteel programs, node models, stability analysis, dimensioning 3D modeling of steel structures in Robot and ConSteel programs Modeling of connections (e.g., in Idea Statica) • Modeling and computational analysis of reinforced concrete plane member structures in Robot and Axis MV software, using a reinforced concrete frame as an example 3D modeling and computational analysis of structures in CAD - analysis of structures in Robot and Axis MV system, using the example of a reinforced concrete floor with two-way bending based on intermediate beams and columns. Automatic creation of reinforcement drawings of reinforced concrete structures, automatic creation of descriptions, dimension lines and list of reinforcing steel - use of CAD overlays (e.g. Bik reinforced concrete, RCAD reinforced concrete, etc.). • Modeling and analysis of steel plane member structures in Autodesk Robot and ConSteel, using a steel frame as an example. Modeling and analysis of space member structures and shell structures in Robot and ConSteel, using a steel tank as an example. Familiarization and use of tools that allow the creation and calculation of connections in steel structures (e.g. Idea Statica). Ability to automatically generate drawings of shipping elements and assembly details of steel structures.

Computer aided engineering graphics	K_W02, K_W11, K_U12, K_U15, K_K01, K_K02, K_K04, K_K08

• AutoCAD as a basic program in the field of computer-aided design. Drawing 2D geometric objects. Precise drawing tools. Modifying objects. Properties of objects. Describing and dimensioning of drawings. Model and paper space. Printing drawings. Basics of 3D modeling. • General rules for the technical drawings and their dimensioning • General principles of making technical building drawings. • Types of architectural and building drawings and designations and rules of dimensioning used in these drawings. • Rules governing exercise of drawings of building structures. Drawings of concrete, metal and timber structures.

Concrete structures	K_W01, K_W02, K_W06, K_W07, K_W11, K_U01, K_U02, K_U06, K_U07, K_U09, K_U12, K_K02, K_K04

• Lecture: 1. Concept, historical development and classification of conctere structures. 2. Concrete: strength, elastic deformations, creep and shrinkage, physical and chemical properties. 3. Properties of reinforcing steel: strength, ductility characteristics, welding, fatigue. 4. Basis of design: basic requirements, design situations, limit states, partial factor method, actions, combinations of actions. 5. Mechanism of bond transfer, reinforcing bars anchoring. 6. Durability: environmental classes, bond, concrete cover. 7. Structural analysis: general requrements, idealization of structural respose, geometric data and imperfections, methods of structural analysis. 8. Ultimate limit states: bending with or without axail force, shear, torsion, punching. General principles of verification, procedures and algorithms, working examples. 9. Serviceability limit states: general, stress limitation, crack control, deflection control. 10. Detailing of reinforcement: general, spacing of bars, permissible mandrel diameters, anchorage of longitudinal reinforcement, stirrups and shear reinforcement, splices of reinforcement, details. CLASSES (exercise) 1. Working examples of RC membres dimensioning, calculation of load bearing capacity and verification of limit states. PROJECT 1. Project of RC one-way slab-and-beam floor structure in industrial building. LABORATORY 1. Basis of measurements and data analysis for testing of cocrete members. 2. Non destructive testing of cocrete structures, localization and identification of reinforcement in RC members. 3. Destructive testing of RC beams. • LECTURE: 1. Designing and detailing of reinforcement in RC members: beams, one-way and two-way slabs, columns, deep beams, brackets and corbels, walls, footings. 2. Principles of calculation, shaping, dimensioning and deatailng of reinforcement in RC floor structures, stairs, building and industrial hall superstructures. 3. Design of selected RC special structures (silos, tanks, etc.). 4. Concept and classification of prestresse cocrete structures: prestressing steel and devices, systems of prestressing, basis of design, worked examples. PROJECT: Project of industrial hall with beam-and-column RC precast structure

Concrete technology	K_W01, K_W06, K_W13, K_U11, K_U15, K_U18, K_U23, K_K01, K_K02

• The basic definition and classification . Specifications of concrete. Concrete ingredients: cement , aggregate , water, admixtures , additives, types of components , the standard requirements . Properties of the concrete mix . The mechanical properties of the concrete. Design of normal concrete - methods of design , selection of qualitative and quantitative components, control of the properties of concrete and concrete at the design stage. Preparation of concrete. High performance concretes. Durability of concrete. • Types of binders for concrete and mortar. Classification of cements. Tests cement - determination according to standard consistency, time of bonding reaction, volume change of bending strength and compressive strength. Classification of aggregates. Requirements for mineral aggregates for concrete. Determination of particle size distribution, apparent density, bulk density and voids. - Types of mortar. Materials for mortar. Determining the composition of mortars. Studies of fresh mortar: the mortar, volumetric density, amounts of ingredients for 1 m3 of mortar. Research on hardened mortar - marking flexural and compressive strength. • The basic terms. Classification of ordinary concrete. Requirements for components of concrete and concrete composition. Designing the composition of the concrete. - Types of technical research of concrete mix and ordinary concrete. The study of consistency of concrete mix. Determination of the air content of the concrete mix. The test of compressive strength of concrete. - The types of additives and concrete admixtures. Study of the effect of additives and admixtures on the properties of concrete and concrete.

Construction organization and costs	K_W11, K_W14, K_W15, K_U13, K_U15, K_K02, K_K03, K_K05

• Basic definitions. • Investment process – participants and stages. • Analysis of costs in different phases of investment process. • Kinds of cost calculation. Bases of cost calculation. • Cost calculation, formulas of calculation • Calculation methods – detailed and simplified method. • Computer methods in cost calculation • Public orders – kinds of concurs. • Forms of remuneration and clearing works • BIM in cost estimation and investment time management • Rules for calculating the amount of works

Construction practice	K_U12, K_U19, K_K01, K_K04

• Construction investment process from design, through construction to obtain a permit to use a building

Construction technology	K_W06, K_W11, K_W13, K_W19, K_U13, K_U14, K_U15, K_U19, K_K01, K_K02, K_K03

• BASICS OF TECHNOLOGY AND MECHANIZATION OF CONSTRUCTION WORKS: Specificity of construction production technology, Characteristics and structure of basic construction production. Partial and comprehensive mechanization of construction production. Characteristics and classification of construction machines. Theoretical, technical and operational capacity of construction machines. Synchronization of machines in the set, leading machine, principle of mass service. Calculation of the efficiency of machine sets. Cataloged expenditures of construction machines. CONSTRUCTION TRANSPORT: Importance of

transport in construction production. Types of transport. Internal and external transport. Horizontal and vertical transport. • EARTH WORKS: Properties of grounds - classification into categories due to separation and dislocation difficulties, primary and final loosening, grounds compaction. Permanent and temporary earthworks - stability of slopes of excavations and embankments, housing of slopes of temporary excavations. Surface and depth drainage of excavations. Calculation of the volume and size of earthworks. Calculation of the level of works. Balance of earthworks. Calculation of the average length of the earth mass transport path in the profiling works and leveling works. Classification and criteria for the selection of earthmoving machinery. Determination of earthworks, geodetic control network, execution accuracy. • CARPENTER WORKS: Traditional and systemic formwork, small size and large size. Adjustable and sliding formwork. Horizontal and vertical loads of formwork. Stripping conditions. CONCRETE AND REINFORCED CONCRETE: Technologicity of concrete mix - workability, resistance to segregation, wear time, heat of hydration, time of achieving operational parameters, etc. Conditions for concreting - the minimum rate of concreting. The concept and the essence of the working break, the arrangement of work gaps, the conditions for the resumption of concreting at the place of the working break. Machines and devices for making, transport, laying and compacting concrete mix - basic parameters, selection rules, performance calculation. The maximum rate of concreting. Concrete works in the period of reduced temperatures - modification of the composition of the concrete mix, heating of ingredients, method of heat preservation, the method of hothouses, the concept of critical temperature, full and conditional resistance of concrete to frost attacks. Principles of concreting monolitic structures. Machines and devices for preparing reinforcement. Concreting by spraying. Compaction of the mixture by vacuum dehydration. CORROSION OF A STEEL: The importance of the quality of concrete works for the reinforced concrete's durability. Corrosive factors and their classification. Conditions for passive steel. Carbonization and durability of reinforced concrete. Effect of chlorides on the durability of reinforcement. Degrees of corrosion damage to reinforced concrete structures and methods of repair. • MOUNTING WORKS: Assembly methods - forced and arbitrary, comprehensive and resolving. Assembly machines and devices. Determining the working parameters of assembly machines - overhang, capacity, working torque, lifting height. Selected assembly methods of reinforced concrete and steel structures.

Diploma seminar	K_W11, K_U06, K_U12, K_U15, K_K03, K_K04, K_K05, K_K06, K_K07

• 1. Requirements for the substantive and formal engineering diploma thesis (design engineering) for the construction. 2. Characteristics of the basic types of theses: Design, Research, Study. 3. Overview of theses subjects performed by students of the seminar group. 4. The standard part of the work of nature: the design, research and studialnym. 5. The method of selection and use of sources related to the topic of diploma thesis. 6. Basic methods and computational tools or research used during execution of work. 7. Methodology for the development and presentation of the results of the design, research, studies and surveys. 8. Rules for parts of the text, graphics and editing work correctly. 9. Discussion of preparation for the presentation, discussion and the final exam. 10. Presentation of their graduates. Discussion of the adopted solutions, methods, results and conclusions presented works.

Diploma thesis	K_W02, K_W05, K_W08, K_W14, K_U01, K_U05, K_U06, K_K01, K_K02, K_K05, K_K06, K_K07

• Preparation of a study or engineering project (in English). Participation in the discussion on projects. Presentation of individual stages and final results.

Energy efficient construction	K_W06, K_W15, K_W16, K_U10, K_U12, K_U15, K_K02, K_K03, K_K04, K_K05

• Principles of design of energy efficient buildings. • The heat demand for heating buildings. • Standard requirements related to energy-saving construction. • The possibilities of using alternative energy sources in buildings. • Construction of buildings energy-efficient technologies, energy efficient finishing materials. • Solar construction. • Economic issues in energy-efficient construction. • Optimizing building solutions for the criterion of the least energy consumption. • Analysis of buildings in terms of their thermal characteristics. The possibilities of using alternative energy sources in energy-efficient construction. • Dimensioning of active and passive systems using solar and other non-conventional energy systems in buildings energy efficient. • Calculating the economic efficiency of the implementation of cost-effective building. • Exercise project of energy-efficient building.

Engineering geometry	K_W02, K_U12, K_K02

• Properties of parallel and orthogonal projections. • Monge's method and the applications of it • Geometric shaping of multi-slope roofs • Geometric shaping of shell roofs • Rules for the preparation of illustrative drawings using axonometry • Method of map projection and applications of it

Engineering Mathematics	K_W01, K_U23, K_K02, K_K04

• Intuition and logic. Sets (actions on sets, recurrence, non-recalcitability, mappings). Mathematical induction. • Complex numbers. Exponentiation and roots of complex numbers. Roots of polynomials. • Matrices and determinants. Matrix inversion, matrix row. Cramer's theorem. Kronecker - Capelli theorem. • Vectors on the plane and in space. Plane and straight in space. Mutual position of the straight line and plane in space. Conical curves on the plane. • Selected properties of numeric functions. Metric space, the limit of the numerical sequence. The number e and rules determining the limits of sequences. Numeric series. Limit of a function, continuous functions and their properties. Derivative of the real variable function. L'Hospital's theorem. Application of a derivative account. Taylor's theorem, sequences and series of functions. • Indefinite integral. Integration of selected types of functions. Riemann integral. Improper integrals. The use of the integral calculus. • Functions of several variables. Extremes of functions of two variables. • Double integral. Double integral as an iterated integral. Selected applications of double integral. • Issues leading to differential equations. Ordinary differential equations with separated variables. Selected types of first order, second order differential equations. Bernoulli's differential equation. Euler's differential equation of the second order.

Engineering Physics	K_W01, K_U23, K_K01, K_K02, K_K04

• Introduction. Physical quantities. Vectors and scalars. • Functions of one and many variables. Derivatives in physics. • Kinematics of a material point. Kinematics of rotary motion. • Dynamics of a material point. Dynamics of a rigid body. Moment of inertia. • Conservation laws in physics. Elastic and inelastic collisions. • Harmonic oscillations. Simple oscillator, damped oscillator, forced oscillator. Resonance phenomenon. • Physical measurements. Methods for the development of measurement results. • Mechanical waves in elastic media. Elements of acoustics. • Elements of hydrostatics and hydrodynamics. The basic laws of fluid mechanics. • Elements of thermodynamics. The first law of thermodynamics, gas transformations. Equations of state • Electrostatic field. Electric charges, the principle of preservation of electric charges, Coulomb's law. Gaus's law. The values describing the electrostatic field. • DC and AC. Ohm's law, Kirchhoff's law. Magnetic field.

Fundamentals of bridges	K_W08, K_W09, K_W10, K_W11, K_W13, K_W16, K_U01, K_U02, K_U06, K_U12, K_U15, K_K01, K_K02, K_K03

• Basic definitions, examples • Classification of bridges • Basic parts of bridges and their function • Shaping of bridge span cross section • Types of foundations and supports of bridges • Loadings of road and railway bridges • Clearances • The rules of dividing of barrier for spans	
Fundamentals of road engineering	K_W09, K_W10, K_W11, K_W13, K_W16, K_U01, K_U02, K_U06, K_U12, K_U15, K_K01, K_K02, K_K03, K_K04, K_K06
• The components of the road. Distribution, classification and characteristics of the roads in Poland. Bike paths, sidewalks.The car-speed in road design. Traffic and road capacity. Horizontal and vertical arcs. Road ramps. The human factor in traffic. Surface or pit drainage. Methods of making and earthmoving equipment. The construction and classification of the surface. Subsoil natural and artific. Classes are conducted in a stationary or remote form, depending on the current orders of the Rector. • Simple design project of road	
Geodesy	K_W01, K_W02, K_W03, K_U12, K_U15, K_U23, K_K01, K_K02
• 1.Introduction to the course, spatial reference systems, coordinate systems in geodesy, geodetic networks, GNSS satellite measurements. 2.Maps, maps classification, cartographic projections, digital map, digital terrain model. 3.The organization of geodetic services, technical regulations and standards. 4.The theory of errors in engineering measurements. 5.Horizontal measurements. 6.Vertical and 3D measurements, leveling, topographic model of the surface. 7.Geodetic stakeout, surveying in civil engineering, control measurements. 8.Displacements and deformations measurements. 9.General information of geographical environment monitoring. 10.Remote sensing and photogrammetric measurements for civil engineering. • 1.Coordinate systems and basic geodetic calculations. 2.Working with the map. 3.Construction and using of theodolite, angles measurements. 4.Horizonlat measurements. 5.Construction and using of leveling instrument, vertical measurements.	
Information technology	K_W21, K_U15, K_U21, K_K01, K_K02, K_K03, K_K04, K_K05
• Work rules in the Intranet and Internet network environment. E-mail. Work and security in a wide area network. Remote work tools. • Mathematical programs for engineering calculations • Spreadsheet in engineering calculations • Word processor program in engineering applications • Rules for creating and presenting public presentations • Bitmap and vector graphics • MATLAB • Obligatory tests • Additional tests • Second chance tests	
Introduction to programming	K_W01, K_W11, K_W22, K_U15, K_K01, K_K02, K_K04
• Algorithmic problem solving, using algorithms and data structures to solve problems, analyzing the time complexity of algorithms, and selected algorithmic techniques • IDE and running your own program. Functions and scripts. Basic calculations using conditional instructions with complex logical conditions, loops, array operations, input/output operations and working with text files (reading data, writing results).	
Machine Learning	K_W01, K_W04, K_W22, K_U06, K_U23, K_K01, K_K02, K_K04, K_K06, K_K08
• A review of the use of artificial intelligence methods in civil engineering. • Basic of Artificial Neural Netoworks and Machine Learning. • Evolutionary/genetic algorithms and generative design. • Review of exemplary optimization tasks using soft computing methods. • Implementation of exemplary projects in the field of regression and classification tasks.	
Masonry structures	K_W02, K_W06, K_W07, K_W11, K_U01, K_U02, K_U07, K_U12, K_U15, K_K02, K_K03
• masonry units, types and grouping of masonry units, strength of masonry units, mortar, types of masonry mortar, properties of mortar • Durability of masonry, characteristic compressive strength of masonry, characteristic flexural strength of masonry, deformation properties of masonry • Calculation of unreinforced masonry structural and verification of ultimate limit state and serviceability limit state • Calculation of reinforced masonry structural and verification of ultimate limit state and serviceability limit state • Bonding of masonry, mortal joints, connection of walls, expansion joint,	
Organization of building production	K_W11, K_W14, K_W15, K_W16, K_U13, K_U14, K_U15, K_U17, K_U19, K_K01, K_K03, K_K05, K_K07
• Basics of organization and planning in construction. Organization of construction in time - schedules. Criterion for division of labor - classification of construction processes. Standards of labor intensity. Composition of work teams and their working time. Working plots, rhythm and continuity of work teams. Efficiency and time of the leading machine. • General schedule of construction and derivative schedules (employment, equipment work, material supply, financing of works). Analysis and modification of schedules in terms of turnaround time, employment size, equipment work and material supplies. Traditional and network methods of scheduling works in construction - comparative analyzes. The concept of a critical path. Computer programs in the construction organization - Planista program. General assumptions of the critical chain method. • Organization of construction in space - development of the construction site; design and implementation guidelines, review of selected projects. BIOZ plan. • Design documentation as the basis for the organization of works. Organizational function of the cost estimate. The contract and the organization of works. Construction documentation. Simplified registration and detailed progress of works, applied measures. The basic tasks of participants in the construction process related to the organization and progress of works. Disruptions in the implementation of construction processes. • Calculation of sets of work teams and their working time based on catalog work standards. Determining the duration of mechanized works; performance and running time of the leading machine. Synchronization of machines in the set. Establishing assumptions, preparing and calculating a network model of technological and organizational connections - calculating time inventories and determining the critical path. Making schedules using a computer program. Introducing technological and organizational connections and their analysis. Modification of the general construction schedule without change and with the change of the project implementation time. Determining the organizational quantities of plots. Analyzing the possibilities of introducing work rhythmicity. Analysis and modification of schedules in terms of the size and continuity of employment, equipment work, material supplies and project financing.	
Physical education	K_U24, K_K01, K_K04
• Acquainting with the rules of participation in classes and the conditions for obtaining a pass. Discussion of the principles of safe use of sports facilities and equipment and safety rules in force during the course. • Acquainting with the rules of participation in classes and credit conditions. Discussion of swimming pool conditions and safety rules applicable during exercise in the aquatic environment. • Implementation of various sets of warm-up exercises and exercises focused on developing the student's basic motor skills. • Initial adaptation to the aquatic environment: - face dipping, eye opening and orientation under the surface of the water, - mastery of breathing in the aquatic environment, familiarization with the buoyancy of water, - control of lying on the breast and back, - plays and games in water. Warm-up exercises, preparing for	

exercises in water. Learning how to behave in water in difficult and unusual situations: choking, shrinkage, sinking, etc. • Shaping general physical fitness, motor coordination, endurance, flexibility, speed through individual selection of sports activities (eg: football, volleyball, basketball, table tennis) or recreational physical activity (eg: badminton, gym exercises). • Learning backstroke style: lying on the back, slipping, correct leg work with a board on the hips and without a board, proper work of the arms. Improvement of proper coordination of lower and upper limbs. Learning free style: slipping on the chest, proper leg work combined with breathing, exercise with a board and without a board. Learning the proper work of the arms (swimming with a proper body with a proper breath and exhalation). Learning how to coordinate the work of lower and upper limbs with the determination of proper breathing. Learning breaststroke style: proper work of legs with a board and without boards on the chest and on the back, correct work of arms in a classic style. Coordination of lower and upper limbs and breathing in a classic style. Learning to jump on the legs and on the head. • Physical fitness test: Multistage 20 m Shuttle Run (Beep test). • Fitness test: a 25-meter swimming trial chosen by the student. • Shaping general physical fitness, motor coordination, endurance, flexibility, speed through individual selection of sports activities (eg: football, volleyball, basketball, table tennis) or recreational physical activity (eg: badminton, gym exercises).

Renewable energy sources	K_W06, K_W15, K_W16, K_U10, K_U12, K_U15, K_K02, K_K03, K_K04, K_K05

• Introduction: sources of energy and their consumption, sustainable development. Selected aspects of the European Directives and National Set of Technical Conditions (which should be met by buildings and their location), consumed for energy efficiency in buildings. • The methodology for calculating the energy performance of the building. Calculation of energy demand for heating, ventilation and hot water preparation. Shaping the heat balance of the building. The structure of heat loss. Rules for designing buildings with low energy consumption. • Using renewable energy sources in buildings. Active and passive solar systems, photovoltaics, heat pumps, ground heat exchangers. Energy-efficient equipment and systems used in buildings. Construction of buildings energy efficient technologies. Energy-efficient construction materials, insulation and finishing. • Renovation project single family building. Preparing data for the calculations, the state of the existing building envelope. The calculation of heat transfer coefficients defining the shell of the house a heated zone and heat loss coefficients transmission and ventilation. Calculation of profits and losses of heat for the building. Calculation of the building's usable energy for heating and ventilation. Calculation of usable energy demand for hot water. Calculation of the annual energy: consumption of the building in use, the final and original. • Description of variant the thermal renovation of the building. Comparison of the EU, EK and EP before and after thermal renovation. Analysis of energy saving renovation projects.

Road construction	K_W06, K_W09, K_W10, K_W11, K_W13, K_W15, K_W16, K_U01, K_U02, K_U06, K_U07, K_U09, K_U12, K_U13, K_K02, K_K03, K_K04, K_K06, K_K07

• The main rules of the road geometry designing. The types crossings and roads connections. Modern paving. New methods of testing materials for road paving. The functional approach to the material properties and pavement. The human factor in road engineering. Classes are conducted in a stationary or remote form, depending on the current orders of the Rector. • Outline of measurement and control traffic The parking policy and the preference of public transport Transportation hubs in the cities Modern diagnostics of roads and road network management systems. Classes are conducted in a stationary or remote form, depending on the current orders of the Rector.

Sanitary installations	K_W17, K_U15, K_U20, K_K03

• Water supply and sewage discharge systems • Water supply installations fed by municipal water supply networks • Water supply installations fed by individual water sources • Elements of water supply installations – characteristics, calculations and selection. Drawing the installation. • Hot water installations – parameters and classification • Hot water sources characteristics • Sanitary sewerage system • Stormwater drainage • Elements of sewerage installations – characteristics, calculations and selection. • Thermal comfort requirements. Calculating the coefficients of heat transfer, requirements, standards, methods of calculating the heat demand. • Heating systems – classification, characteristics, installations' configurations • Heating installations – elements, materials, selection, heat pipes laying. Drawing the heating installations. • Requirements concerning boiler- rooms, gas passes, gravitational ventilation • Gas installations - classification and characteristics. • Gas installations - requirements and drawings. Final test.

Soil mechanics and foundations	K_W06, K_W07, K_W08, K_W11, K_U02, K_U08, K_U09, K_U12, K_U15, K_K01, K_K02, K_K04

• Phisico - chemical occurrences in the soil. Electrocinetical occurrences in the soil and their practical applications. Ticsotrophy occurrens. Soil structures. • Phisical parameters of soils. Grain diameter soil fractions, grin curve. • Consistensy limits and cohesive soil states. Density index and states of granular soils. compactibility of soils. • Water in soil. Filtration and Darcy Formula. Insite soil occurrences induced by filtracion, protection agaist influence of harmful water filtration. • The phenomenon iquefying and hydraulic breakdown • Mechanical properties of soils: compressibility, shear strenght. • The stresses and their distribution in the subsoil, the primary stress, Boussinesq formula, the method of partial concentrated forces • The stress distribution at the foundation level. • Resistance and formability of the ground, the stress limit (issue Terzaghi'ego). • Practical determination of the stresses in the foundation of the building. • Determination of geotechnical parameters. Geotechnical categories • The impact soil for buildings • Slope stability • General terminology. Law rules and geotechnical norms. Geotechnical categories and soil conditions. • Geotechnical eleborations. Principles of geotechnical recognition. • Ground conditions. General rules for determining the bearing capacity. • Foundations - a historical outline. • Direct foundations. Bearing capacity of shallow foundations. • Settlement of shallow foundations. • Deep foundations. • Technologies execution of piles. • Bearing capacity of foundation piles. • Earth pressure. Stability of retaining walls. • Retaining structures. • Protection of deep excavations. Landslides. • Earthworks. • Problems of groundwater..

Steel structures	K_W02, K_W06, K_W07, K_W11, K_U01, K_U02, K_U06, K_U07, K_U09, K_U12, K_K02, K_K04

• Materials and hot rolled products. Mechanical properties of steel and metals used in construction. Idealisation of geometry, loads and methods of analysis. Connections: types, characteristic and application. Welded connections: technology and quality requirements for welding. Bolted connections: types, technology and quality requirements. Design and detailing of connections. Elements, joints and structures. Behaviour of elements, plastic hinge. Global stability and local stability of elements. Imperfections in steel structures. Classification of cross sections. Ultimate limit states of elements in tension, axial compression and bending. Columns and beams. Joints in structures. CLASESS (exercise): Design and detailing of welded and bolted connections. PROJECT: Project of floor structure in industrial building. LABORATORY: Examination of geometrical imperfections of hot rolled sections, destructive testing of welded connections, destructive testing of end plate bolted connections (T-stub type), execution of bolted connection (C category), examination of hardness in welded connection • Design and detailing of welded and bolted connections. • Project of floor structure in industrial building. • Examination of geometrical imperfections of hot rolled sections, destructive testing of welded connections, destructive testing of end plate bolted connections (T-

stub type), execution of bolted connection (C category), examination of hardness in welded connection. • Single story industrial buildings. Actions, building envelope, trusses, types of primary steel structures. Beam-column elemnts. Overall stability of structure, roof and wall bracings. Fatigue. Corrosion and fire protection of steel elements. Execution of steel structures. Selected steel special structures: framed structures, structures with tension components, thin-walled structures, plated and shell structural elements. • Project of industrial single story building.

Strength of materials	K_W01, K_W04, K_W05, K_W07, K_W11, K_U01, K_U04, K_U06, K_U07, K_U23, K_K01, K_K02, K_K03, K_K04

• Introduction to the subject of "Strength of Materials" (SoM). Basic concepts and assumptions of SoM. • The concept of an internal force. Theorem on the equivalence of systems of internal and external forces. The concept of a bar. The concept of the section forces. Sign conventions for the section forces. Reduction of external forces to cross-sectional forces. • Members subjected to extension and compression. Basic definitions. Tensile test. Strain diagram and normal stress diagram • Diagrams of cross-sectional forces for beams. Characteristic points and characteristic intervals. Functions of normal force, shear force, bending moment. Presentation of variability of cross-sectional forces in the form of graphs. Differential equations for the equilibrium. Diagrams for section forces. Principle of superposition. Examples for beams. • Cross-Sectional Properties. First moments of area; centroid and normal centre. Second moments of area. Thin-walled cross-sections. • Members subjected to bending • Unsymmetrical bending • Deformation Due to Bending • Members subjected to bending and extension. The core of cross-section. • Shear Forces and Shear Stresses Due to Bending. Principal directions and principal values of the stresses. • Yield criterion for different stress conditions • Review before the exam

Structural detailing	K_W02, K_W04, K_W11, K_W15, K_W21, K_U01, K_U05, K_U06, K_U07, K_U12, K_U15, K_K02, K_K04, K_K05, K_K08, K_K09

• Knowing and using tools enable the creation of detailed drawings of any reinforced concrete structure (e.g. Bik , RCAD, etc.). Ability to automatically create drawings of reinforcement of reinforced concrete structures, i.e. bars of any shape, automatic creation of descriptions, dimension lines and lists of reinforcing steel on the basis of previously prepared formwork drawings. • Modeling and computational analysis of reinforced concrete plane member structures in Robot and Axis MV software, using a reinforced concrete frame as an example. • 3D modeling and calculation of structures in CAD - analysis of structures in Robot and Axis MV system, using an example of a reinforced concrete floor with two-way bending based on intermediate beams and columns. • Modeling and analysis of steel plane member structures in Autodesk Robot and ConSteel, using a steel frame as an example. • Modeling and analysis of spatial member and shell structures in Robot and ConSteel, using a steel tank as an example. • Knowing and using tools for creating and calculating connections in steel structures (e.g. Idea Statica). • Ability to automatically generate drawings of shipping elements and assembly details of steel structures.

Structural mechanics	K_W01, K_W05, K_W11, K_U04, K_U09, K_U23, K_K01, K_K02, K_K04

• Introduction. Basic concepts and assumptions. Internal and cross-sectional force. Equivalence theorem for systems of internal and external forces. Concepts of a rod. Reduction of the system of external forces to cross-sectional forces. The convention of labeling cross-sectional forces. Representation of variation of cross-sectional forces in the form of diagrams. Differential relationships for a straight bar. Principles of construction of diagrams of cross-sectional forces with examples: simple beams, hinged beams. The method of superposition. Diagrams of cross-sectional forces for frames. • Calculationof sectional forces in the indicated sections for simple beams and frames. Equations describing cross-sectional forces. Diagrams of sectional forces for simple beams and frames. Beams with hinges, scheme of work, and method of superposition. Pinned frames. • Theoretical foundations of elastic, planar bar structures: superposition principle, generalized quantities, work of external and cross-sectional forces, virtual work principle and reciprocity theorems. Calculation of displacements in statically determinate structures: Maxwell-Mohr formula and graphical integration, displacements caused by mechanical and non-mechanical actions (temperature changes and supports movement). Method of forces: canonical equations. Calculation of displacements in indeterminate structures using the Maxwell-Mohr formula. Displacement method, transformation formulas, initial reactions, canonical equations, examples. Dynamics of flat bar structures. Dynamically applied loads, stiffness and flexibility matrices, mass and damping matrices, free and forced vibrations, resonance and effect of friction on the example of an oscillator with one degree of freedom. Dynamics of structures with concentrated masses. Free and forced vibrations of systems with multiple degrees of freedom. Calculation of inertia forces for harmonic excitations. Approximate calculation of fundamental natural frequency. Free vibration of a simply supported beam with uniformly distributed masses, evaluation of the accuracy of solutions for concentrated masses. Buckling of columns and planar frames. Introduction to the theory of stability of bar structures. force method and transformation formulas for buckling of members. Analysis of linear algebraic eigenproblem. Buckling of rectangular frames and use of system symmetry for calculating loads and critical buckling shapes. Algorithms for calculating influence lines in statically determinate systems. Examples of constructing influence lines for reactions and internal forces in simple beams. Extension and generalization of learned methods for solving statically determinate and non-determinate systems. Examples of solving complex problems in statics and dynamics of building structures. • Relationships between cross-sectional forces. Complex statically determinable bar systems (circular and parabolic arcs, frame-arc systems). Calculation of displacements in planar bar structures, construction of a deformation shape. Solving statically indeterminate systems by the method of forces. Solving statically indeterminate systems by displacement method. Calculation of natural frequencies of plane structures. Calculating and drawing the vibration mode shapes, checking the orthogonality condition. Calculating the value of the critical force, calculating and drawing the buckling shape. Influence lines in statically determinable trusses - construction, interpretation, application.

Theoretical mechanics	K_W01, K_W04, K_W11, K_U15, K_K02, K_K04

• Elements of vector calculus, basic concepts and definitions in mechanics, the axioms of statics. Moment of force to the point and axis, statements about pairs of forces. • The reduction of system of forces to any pole and the simplest form. Graphical methods of forces systems reduction. • Equilibrium of forces system, equilibrium equations in each case of the forces systems, models of constraints and their reactions. Calculation of the reaction in the statically determinated systems. • Degrees of freedom of the mechanical system of rigid bodies. Conditions of geometric invariability and static determinability. Calculation of reactions in statically determinate plane bar systems. • Trusses. The degrees of freedom of rigid bodies, conditions of geometrical stability and statically determinate systems. Zero bars. Calculation of forces in bars of flat trusses by balancing nodes, Ritter method, Cremona's method.. • The problem of friction. Mathematical description of the point motion. Progressive, rotary and flat movement of the rigid body. Calculation of the instantaneous velocity and acceleration in plane motion of a rigid body and theirs mechanisms. The method of instantaneous center of rotation. Complex motion. • Newton's law, d'Alembert principle and kinetostatic method. Free, forced and damped vibrations of systems with one degree of freedom. • Dynamics of point systems. Dynamics of translational, rotational and planar motion. Kinetic energy of the solid in translational, rotational and flat motion. Field of strength. Potential energy. The principle of conservation of mechanical energy.

Timber structures	K_W02, K_W06, K_W07, K_W11, K_U01, K_U02, K_U07, K_U12, K_U15, K_K02, K_K03

• History of timber structures, The structure of timber, Natural characteristics of timber Wood properties, Advantages and disadvantages of wood. Assortment of tmber and engineered wood products. Material and product properties. Characteristic and design values of material. Strength classes of timber. Serviceability limit states. Ultimate limit states - structural members. • Design of members subjected to axial actions. Members subjected to axial compression. Members subjected to combined bending and axial loading. Lateral torsional instability under the effect of bending about the major axis. • Design of roof truss. Design of stability bracing for beam and truss. • Design of metal dowel type connections and punched metal plate fastener. • The written test • Project of roof structure in store building.

Visual programming	K_W01, K_W02, K_W11, K_U06, K_U15, K_K01, K_K02, K_K04, K_K05, K_K08

• Gaining knowledge about the possibility of using the resources of various parametric design applications in building structures design • Acquisition of skills in using parametric modeling software • Acquisition of the ability to formulate design assumptions by defining parameter ranges and design constraints • Implementation of an individual design of a spatial structure using tools for parametric design

Construction law - Elective module	K_W15, K_U15, K_U17, K_K03, K_K07, K_K09

• In the field of construction law: Location of construction law in the general legal system. Basic issues of construction law. Independent technical functions in construction. Rights and obligations of participants in the construction process. Proceedings preceding the commencement of construction works. Construction and commissioning of buildings. Maintenance of buildings. Construction disaster. Bodies of architectural and construction administration and construction supervision. Criminal regulations in construction. Professional responsibility in construction In the field of intellectual property protection: The history of intellectual property protection. Sources of law in the field of intellectual property. Main principles of intellectual property protection Subject and subject of copyright. Copyright content. Personal and property rights. Fair Use of Protected Works. Duration of copyrights. Transfer of copyrights. Audiovisual works and computer programs. Protection of the image, addressee of correspondence and confidentiality of information sources. Neighboring rights. Right to artistic performances. Right to Phonograms and Videograms. Right to broadcast programmes. Right to first editions and scientific publications. Organizations for the collective management of copyright and related rights. Criminal liability for copyright infringement. Inventions and patents. Invention application. Consideration of an invention application. Patent. Additional protection right. License Agreements. Compulsory license. Invalidation and expiration of the patent. Utility models and protection rights for utility models. Industrial designs and rights from the registration of industrial designs. Trademarks. Collective Trademark and Collective Guarantee Trademark. Trademark application. Consideration of a trademark application. Proceedings in matters of international protection of trademarks. Trademark protection rights. Invalidation and expiration of the trademark protection right. Geographical indications. Filing and processing a geographical indication application. Geographical indication registration rights. Topographies of integrated circuits. Basic concepts and meaning of topography of integrated circuits in electronics. Reporting and consideration of topography. Topography registration rights. Patent Office of the Republic of Poland. Adjudication boards for disputes. Patent Attorneys. Criminal law protection of industrial property.

English	K_U16

• Level B2 lower: Organizations - roles and responsibilities within the organization; innovation in the company; • Level B2 lower: Communication during the first meeting; chat/breaking ice; brands and marketing; • Team communication; presentations; formal and semi-formal emails • Level B2 higher: Corporate culture; retention of employees in the company; Building a relationship • Self-presentation; training and development. • HR strategies; team communication; conducting meetings. • Level C1: Innovation in business; innovative thinking; persuasion. • Engaging during the presentation; Circular and linear economy. • Lifecircle of products; clarification of information; effective meetings. • Level B2 lower: Looking for a job. Job interview. • Covering letter; business strategies; analysis of factors when planning in business. • Problem solving; cause and effect reporting. • Level B2 higher: Finance and economic crises; competition in business; reacting to bad news. • Clarification of information; reporting; technology in business. • Dealing with a difficult interlocutor; negotiations; business proposals. • Level C1: Finance and financial investments; questioning the facts; consideration of options. • Budget analysis; innovators/precursors in business. • Problem solving; reporting and planning. • lower B2 level: Logistics; Internet sale; communication during cooperation. • Negotiations; complaints; entrepreneurship/running a business. • Influencing people; presentation of facts and data. • Level B2 higher: Corporate culture; retention of employees in the company; Building a relationship. • Presenting yourself; training and development. • HR strategies; team communication; leading meetings. • Level C1: Marketing strategies; persuasion; data presentation. • Building relationships based on trust; tourism industry. • Business contacts; diversifying the presentation with stories, business correspondence. • lower B2 level: Cultural differences; working abroad; decision-making. • Building relationships; recommendations/suggestions; leadership. • Feedback - giving and receiving; conducting meetings. • Level B2 higher: Time management; emergencies. • Difficult negotiations; email giving reason; change management. • Coaching and mentoring; brainstorming • Level C1: Workplace clashes; giving support; mediating conflict. • Reporting conflicts at work; enterpreneurial mindset. • Performance review; self-assesment.

French	K_U16

• Describing and reporting events in the past tense. • Paris - the center of fashion. • Pronouns COD/COI in various tenses. • Modern and dying professions. • A famous fashion designer - presentation. • Demonstrative and possessive substatival pronouns. • Simple and complex relative pronouns. • Jeans - a universal timeless outfit. • Complaints and solving problems, giving advice. • Expressing reason and result. • The „subjonctif" mood - expressing purpose. • Traffic regulations - obligations and prohibitions. • Reported questions. • Choosing profession, justifiyng. • Expressing the reason. • Living in homeland and abroad, giving arguments. • National symbols of Poland and France. • „Le passé simple - literary tense". • Comparisons - various living styles, the comparative of irregular adjectives. • Real estate market in France and in Poland. • Expressing acquiescence. • Emigration and mobility, expressing opinions. • „Le savoir-vivre" - good manners. • What is proper and improper - similarities and differences concerning Polish and French customs. • Negatives - summary. • Expressing prohibition. • Expressing hypothesis. • Passive voice in a newspaper article. • Climate changes - vocabulary related to ecology. • People's eco-friendly habits. • Plans for the future - time expressions. • Pensioners nowadays and in the past; changes in perceiving elderly people. • Setting up a company - development plans. • Inventions which revolutionized people's lives. • Expressing hypothesis and condition. • Eco-firendly solutions for the city, region and country. • Ideal friend; superlatives. • Modern idols. • Presenting the favourite character. • Passions in our lives. • Tense concordance in a short story. • Globalisation, positive and negative consequences. • Verb patterns with an infinitive. • Expressing disagreement towards proposals. • The art of giving arguments in a presentation. • A mobile phone: hell or paradise? • Where does Europe end? - information about the European Union. • Verbs useful for giving arguments. • Arguments cohesion - coherence linkers. • Sentence transformations - expressing coherence. • Higher education - facts and expectations. • Presenting a selected company.

German	K_U16

• New communication media. Establishing new contacts: Speed-dating. • Describing one's language skills - working with a video material. Declension of an adjective after definite, indefinite and no article. • Media competences, ability to creatively use internet assets in foreign language learning. Time adverbs. • Bisness meetings in a new environment, forms of greeting and introduction. • Strategies of learning language for special purposes. • Private and business meetings. Modal particles. • Planning and organizing official events. • Spoken and written invitations, establishing the date of the meeting. Rektion of the verb. Adverbial pronouns in questions and answers. • Working with a video material - 'Oktoberfest'. • Planning and preparation of a presentation. • Business lunch. Quiz about etiquette. • Features of a good presentation. • Preparing product presentation. • Planning a holiday, travel bureau's offers. Assumptions - 'werden + wohl' verbs + infinitive. • Accommodation - hotel rating, opinions on internet sites. Relative sentences, relative pronouns. • Public transport in German speaking countries. • Future vehicles and travels. Future tense 'Futur I'. • Working with a video material - dream travels. • Organizing a conference, choosing a hotel, business mail. • Flat market, different forms of accommodation. Complex nouns. • Living community, student's house. Looking for a flat - advertisements. Time prepositions. • A student room, flat appliances, description of functions of furniture and items of every day use. • Switching flats during holiday. Word order. • Multi generation house. • Office and its equipment, positive rapport. • Living business community, pros and cons. • Presenting a profession - working with a video material. • Ideal work place. Conditionals. • Job advertisements, writing a cv. • Different ways of job searching. Advice and tips for job applicants. Sentences with 'damit' and 'um...zu'. • Job applications, talking about your education and work experience. • Small-talk, expressing opinion about one's job - pros and cons. • Famous composers, a biography note. Negative sentences. • Music genres, music instruments, music bands. • Festivals and concerts in German speaking countries. A schedule of musical events. • Planning a shared evening, inviting to a concert, writing a private email. • 'Rammstein' band - presenting a band. Providing argument support one's choice. Sentences with „denn", „weil", „nämlich", „deshalb". • German rock music - working with a video material. • Creating a presentation about German rock music. • Board games, tele shows. Rules of favourite games. Passive voice. • E-commerce, internet shops. • Psychology of selling, interpreting the behaviour of the customer. Passive voice with modal verbs. • Consumers' typical behaviour during shopping. Identification of different behaviour. • Online shopping discussion - pros and cons. • Vocabulary related to finances. • Acquisition of new skills, upgrading one's qualifications, various course offers and certificates. Noun's genitive. • Advanced ways of information searching, remote ways of providing education, education platforms. • Facilities found in a moder language lab. Prepositions of place. • Education system in Germany - a discussion forum. • Technical occupations, handling and description of technical equipment, manuals. Prepositions with dative and accusative. • Malfunctions and technical faults. Imperative. • Complaints - exchaning emails.

History of building engineering - Elective module	K_W06, K_W09, K_W13, K_U01, K_U12, K_K04, K_K09

• General information about artistic techniques and iconography, Architecture of Ancient civilizations (Mesopotamia, Egypt), Architecture of Ancient Greece, Etruscan and Roman Architecture, Early Christian and Byzantine Architecture, Romanesque Architecture, Gothic Architecture, Architecture of the Renaissance and Mannerism, Baroque Architecture, Architecture of Poland (XVI - XVIII century) • The analysis of typical monumental structures from different periods discussed during the lectures

Human resources management - Elective module	K_W24, K_W25, K_U25, K_U26, K_K01, K_K07, K_K09

• Principles of work in the project team and lidership realization.

Investment economics - Elective module	K_W11, K_W15, K_U13, K_U15, K_K03, K_K05, K_K06

• Basic definitions. • Investment process – participants and stages. • Analysis of costs in different phases of investment process. • Kinds of cost calculation. Bases of cost calculation. • Cost calculation, formulas of calculation • Calculation methods – detailed and simplified method. • Computer methods in cost calculation • Public orders – kinds of concurs. • Forms of remuneration and clearing works • BIM in cost estimation and investment time management • Rules for calculating the amount of works

Management of the investment process - Elective module	K_W11, K_W15, K_U13, K_U15, K_K03, K_K05, K_K06

• The investment process in civil engineering: definitions, types of investments, stages in the investment process. Participants in the investment process: organisational structures of participants, organisational relationships between participants in the investment process, basic powers and obligations of the participants. Professional responsibility of civil engineers performing independent functions. Safety and health protection in building works. Environmental protection. • Public administration authorities in the building investment process. Administrative procedure of obtaining a building permit. Illegal constructions. Significant changes in construction project. Penalties and legalisation fees. • Procurement of building works financed by public funds. Public Procurement Law. Public-Private Partnership (PPP). Terms of Reference (ToRs). Public procurement modes. Criteria for selecting the best tender. Changing the object of procurement. Additional works and interchangeable works in public procurement. • Frames of organising and implementing construction projects. Project Management (PM) system. A "project manager" in a PM system. Conditions of contract FIDIC. A role of the "engineer of contract" in the FIDIC rules. Contracts in the investment process. Building contracts. Methods of securing proper execution of a contract. Warranty and mandatory warranty. Contractual penalties. Works acceptance. Handing a building over for occupancy. Economic analysis and control in the particular stages of the investment process. • Procedures and documentation in the preliminary, implementation and finishing stages of building works. Documentation: a building site logbook, a measurement of quantities logbook, hand over-acceptance reports, health and safety trainings register, medical examination certificates register and others. • Settlement of fees for construction works: invoicing, payment deadlines, Value Added Tax (VAT). Methods of monitoring costs and the progress of works using computer software. Systems of employees compensation. Motivating employees. • Commercial buildings investments. Directive schedules as the basis of economic effectiveness analysis. Static and dynamic methods of evaluating profitability of building projects. Cash-Flow: a plan of cash inflows and outflows. A function and basic components of a business plan. • BIM (building information modelling) technology in the investment process in civil engineering. Application of modern computer programs BIM: NavisWorks, Revit Architecture and BIMestiMate. Fields of usage of the programs, description of certain their functions, advantages and difficulties for participants in the investment process in civil engineering, avoiding improper even wrong decisions in application of these tools.

Psychological aspects of engineer work - Elective module	K_W24, K_W25, K_U24, K_U25, K_U26, K_K09

• Communication as the basis for building good relations with the environment. • Aspects of interpersonal communication • Factors influencing the effectiveness of self-presentation • Persuasion, eristics, rhetoric • Stress and time management • Basic group roles • Techniques of exerting influence • Social psychology • Stereotypes and prejudices • Sources of conflicts and problems in the group

4. Student work placement and internship

The basic aim of the professional practice is to acquire practical skills that complement and deepen the knowledge acquired by the student during the classes at the university. The implementation of the internship provides the opportunity to confirm and develop the student"s professional competences within the chosen field of study and, become familiar with advanced technical solutions as well as acquire professional knowledge and skills of their practical application.

Apprenticeship is treated as a separate module of education and it is mandatory to pass. The way of organizing professional practice is defined in the Rector"s Regulation on the principles of organizing internships for students of the Rzeszów University of Technology.

The number of student work placements and internships is presented in Chapter 3 and may vary in different variants of the study plan for a given course Civil engineering.

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