**Module/Course Syllabus**
*Civil Engineering*
*Specialization: Civil Engineering Structures and Ecological Engineering*
Master-degree programme

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|---|---|
| **Course:** | *Politics of equal of opportunities in practice* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIP1A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *60* |
| Lecture | *30* |
| Classes | *-* |
| Laboratory | *30* |
| Project | *-* |
| **Number of ECTS credits:** | *3* |
| **Form of assessment:** | *Course completion assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Acquaint students with the basic principles of human management and teamwork.* |
| **CO2** | *Raise awareness of social inequality and sensitivity to effects of stereotypes and prejudice.* |
| **CO3** | *Acquaint students with the basic ideas of psychology of communication and utilizing them with teamwork* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Ability to communicate effectively in English at a basic level* |
| **2** | *Students have some experience with working in a group* |
| **3** | *Students are conscious of changes in modern society and increase multicultural* |

| **Learning outcomes (LO)** | |
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| | In terms of knowledge: |
| **LO 1** | *Students have knowledge concerning teams, role of individuals in groups, and styles of leadership* |
| **LO 2** | *Students have knowledge about biological sex and gender, stereotypes and effects of using stereotypes in everyday life* |
| **LO 3** | *Students have basic knowledge concern the subject of culture* |
| | In terms of skills: |

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| **LO4** | *Students learn how to work and cooperate with others regardless of their sex, race, or culture.* |
| **LO5** | *Students are able to accept people from different cultures* |
| **LO6** | *Students can communicate their needs and emotion without provoking conflicts and aggression* |
| | In terms of social competence: |
| **LO7** | *Students can take decision individually and being a member of group can take a part in common decision in group* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Nature and features of teamwork: numbers of members, shared goals, cooperation, splitting tasks, abilities and cooperation. Assignment of roles according to abilities and other differences. How to maintain and develop the team. Team motivation: sources of motivation (internal and external), role of leader in motivation. Competition or cooperation? Why cooperation is more effective than competition.* |
| **L2** | *The climate in an organization authoritarian, bureaucratic, friendly, and innovative. Changes in an organization how to introduce and make changes in the company. Team effectiveness and barriers to effectiveness. Methods of stimulating team work effectiveness: "brainstorming" and "crushing the object" Question check-lists, "Fish-bone diagram" Pareto Chart", participation.* |
| **L3** | *Material and non-material aspects of culture: values and norms, diversity of culture (subcultures), ethnocentrism. Socialization: social role and identity (social and individual). Cultural and biological features of gender. Socialization for gender identity and gender roles. Types of femininity and masculinity. Social formation of gender. Homosexuality and attitudes toward homosexuals. Law and the campaign for gay rights.* |
| **L4** | *Stereotypes and stereotyping: prejudice. Formation and development of stereotypes: what is social stereotype, mechanisms in the development of stereotypes.* |
| **L5** | *Stereotype and prejudices: External appearance as a basis of stereotyping: e.g. stereotypes of sex, weight, height, nationality, race, and criminality. What to do when I am stereotyped?* |
| **L6** | *Stereotypes of women and stereotypes of men. Consequences of stereotypes of sex.* |
| **L7** | *Women's rights in modern world. Opinions and facts regarding gender equality in Europe. Data on the comparative earnings of men and women. The principle of equal standard of living of both spouses in Polish law. Women working in precarious jobs. Women's work in the era of globalization- selected issues.* |
| **L8** | *The basics of the psychology of communication: the perception of people, their acceptance and approval, listening to somebody or pretending to listen to* |

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| | *somebody; structure of a simple sentence, e.g., four ways of perception and four meanings of sentences.* |
| **L9** | *The hierarchy of the needs of people; barriers to communications and how to break them down.* |
| **L10** | *The cultural differences in non-verbal communication; Non-verbal communication: gesture of possession, gesture of love, power of smile, types of shaking hands, personal space.* |
| **L11** | *Manipulation: what is it? Types of manipulation: social, emotional, and intellectual. Techniques of persuasion. Ethical and psychological aspects of manipulation. Ways to guard against manipulation.* |
| **L12** | *Solving a problem using the Gordon Method; Introducing the Gordon Method by giving examples and some practical solutions.* |
| **L13** | *Conformity: Factors influencing conformity. Psychological reactions to external authority. Stanley Milgram's experiment as a case study in obedience.* |
| **L14** | *Stanford Prison Experiment, documentary movie "Quiet Rage" of the experiment done by Philip Zimbardo. How situational and individual factors influence our decisions.* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Building relations between people in the group. Introducing in unusual way: 1. I wish to be name here as…, I like and dislike, 2. If I see the wizard I give him three my wishes. 3. My three features for my fist letter of my name. 4. All people born in summer (drawing flower).* |
| **Lab2** | *Human differences and similarities by culture. Variations in behavior in different nations with some examples. Different ways to be beautiful. Accepting and building positive images of people from different cultures.* |
| **Lab3** | *Me and my stereotypes and prejudices. Analyze of my stereotypes of sex, nationality, ethnics, jobs, religious, homosexuality, unemployment. Constructing idea of tolerance. Examples of tolerance.* |
| **Lab4** | *Stereotypes of sex. Language: proverbs concerning attitude to woman- from Poland and others countries. Analyzing meanings of the proverb; advertisement and image of women and men, old and young, Poles and foreigners.* |
| **Lab5** | *How to learn and teach tolerance? Building of conscious tolerance through role-playing. Discussion of the feelings, reactions and behavior of role-playing participants.* |
| **Lab6** | *Emotions: are emotions good or bad? Types of emotions; Expression of emotions, verbal and non-verbal; What does it mean to control emotions; "Reading" my emotions and those of others.* |
| **Lab7** | *Why we feel misunderstood in personal contact? Expression and full expression of oneself: observations, thoughts, emotions and needs. Examples and exercises done by students in different situations chosen by teacher and by students.* |
| **Lab8** | *Communications and barriers. Paraphrasing. Participants develop ability to paraphrase. This exercise helps participants to avoid misunderstanding.* |

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| | *Performing exercises in pairs. Each pair receives a task e.g. "Find a new model of a desk that motivates people to sit longer and longer." Or "How to protect your car from thieves. Your car is parked in front of a block of flats". Apart from the development of skills in paraphrasing, the exercise gives opportunities to think in more creative ways.* |
| **Lab9** | *Solving an problem in a small group consisting of students from different nationalities. Tasks receiving by students concern stereotypes, tolerance or intellectual task what needs untypical solution. Recording the process of solving the problem in one of the groups.* |
| **Lab10** | *Analyzing the recorded material (solving intellectual material) from these viewpoints: who became the leader during the problem-solving process, what kind of position was taken by participants (e.g. leader, adviser, not interested) how students felt during the problem solving. My behavior towards others.* |
| **Lab11** | *Training session in creativity; Exercises with building blocks as a method to overcome typical (common) ways of thinking; Analyzing individual/group behavior in a situation when a person/people cannot find a solution.* |
| **Lab12** | *Conflicts of opinions and conflicts of interests; Solving a problem using the Gordon Method in the examples given by students; Practice in small groups Analyzing participants' behavior recorded by camera.* |

| **Required textbooks and other course materials** | |
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| **1** | *Ambrosewicz-Jacobs J. Me us Them. Ethic prejudices Among Youth and Alternative Methods of Education. The Case of Poland. Towarzystwo i Wydawnictwo Prac Naukowych UNIVERSITAS. Cracow, 2003.* |


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| **The author of the programme:** | *Dr Anna Szafranek* |
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| **Organisational unit:** | *Independent Architectural Design Studio* |

**Module/Course Syllabus**
*Civil Engineering*
*Specialization: Civil Engineering Structures and Ecological Engineering*
Master-degree programme

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|---|---|
| **Course:** | *Recycling of Building Materials* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIP2A* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *60* |
| Lecture | *30* |
| Classes | - |
| Laboratory | - |
| Project | *30* |
| **Number of ECTS credits:** | *3* |
| **Form of assessment:** | *Lecture – exam, project - Summary reports* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Understanding the sources of waste materials and recycling technologies of building materials* |
| **CO2** | *Understanding and skillful use of methods for the determination of: mineral and chemical composition, physical, mechanical and surface properties of waste and building materials made from them.* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having a knowledge of construction materials manufacturing technology* |
| **2** | *Having a basic knowledge of chemistry, mineralogy, environmental protection* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Has the basic knowledge of the material recycling* |
| **LO 2** | *Knows modern materials and technologies in construction industry* |
| **LO 3** | *Knows the theoretical basics of standards and other regulations applied in European Union* |
| **LO4** | *Has the knowledge of sustainable development in the economic, social and environmental aspects* |

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| | In terms of skills: |
| **LO5** | *Is able to plan and conduct empirical research* |
| **LO6** | *Is able to, in compliance with the scientific principles and using the scientific workshop, formulate and conduct preliminary research works leading to the solution of engineering issues* |
| **LO7** | *Is able to use legal acts related to sustainable development* |
| **LO8** | *Is able to plan the components and processes meeting the construction and ecological requirements, anticipate the consequences of the activities related to natural environment, optimize the project by the sustainable resource use* |
| | In terms of social competence: |
| **LO9** | *Independently supplements and expands knowledge in terms of modern solutions, technologies and processes in construction industry* |
| **LO10** | *Is aware of the necessity to improve professional and personal skills* |
| **LO11** | *Is aware of the necessity of sustainable development* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Waste management - definitions and legal basis* |
| **L2** | *Methods of determining the physical and surface properties of waste materials. Testing methods for investigation of physical and mechanical properties of building materials from recycling.* |
| **L3** | *Basic methods of testing the chemical composition of the waste materials and building materials produced from them (XRF, ICP-MS, AAS).* |
| **L4** | *Basic methods of testing the mineral composition of the waste materials and building materials produced from them (SEM, XRD, optical microscopy, TGA).* |
| **L5** | *Industrial waste - Legal basis. Rules on disposal of recyclable materials. The major sources of by-products that may be used in building materials.* |
| **L6** | *Characteristics of waste generated in the production of building materials, energetic, mining, metallurgy and other fields of the economy.* |
| **L7** | *Directions of development of fly ash, silica fumes and slags from power plants in the production of binding materials, aggregates and concrete.* |
| **L8** | *The use of fly ash and slag from power plants in the production processes of ceramic building materials. Byproducts from the industry of insulation materials. The use of municipal waste in the production of building materials.* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Testing of physical properties of waste* |
| **P2** | *Testing of the mineral composition of waste* |
| **P3** | *Testing of the chemical composition of waste* |
| **P4** | *Production of aggregates and concrete with the addition of waste* |
| **P5** | *Testing of the physical and mechanical properties of the building materials containing wastes* |

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| **The author of the programme:** | *Dr hab. inż. Wojciech Franus, Prof. PL* |
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| **Organisational unit:** | *Department of Geotechnical Engineering* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

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|---|---|
| **Course:** | *European legislation* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIP3Aa* |
| **Year:** | *II* |
| **Semester:** | *3* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *30* |
| Classes | - |
| Laboratory | - |
| Project | - |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining basic knowledge about the European Union, its structure and legislation* |
| **CO2** | *Gaining basic knowledge about the directions of development of transport in the European Union* |
| **CO3** | *Gaining basic knowledge about standardization* |
| **CO4** | *Gaining basic knowledge about standards and other standardization documents in civil engineering* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Has a basic knowledge about the country, the system, the European Union* |

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| **2** | *Has a basic knowledge about the legal regulations* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows the standards and guidelines of the design of building facilities and their parts. He/she knows and applies the provisions of construction law.* |
| **LO 2** | *Has knowledge in scope of sustainable development in economic, social and environmental aspects* |
| | In terms of skills: |
| **LO 3** | *Is able to select tools to solve the engineering problems in terms of civil engineering.* |
| **LO 4** | *Is able to identify, examine and assess materials and road and bridge structures including for the protection of the environment.* |
| | In terms of social competence: |
| **LO 5** | *Independently supplements and expands knowledge in terms of modern solutions, technologies and processes in construction industry.* |
| **LO 6** | *Is aware of non-technical aspects of the civil engineering activity.* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *European integration, European Union as an international organization.* |
| **L2** | *The structure and institutions of the European Union. Economic and Monetary Union.* |
| **L3** | *Law in the European Union - sources, lawmaking process and rules of application.* |
| **L4** | *Financing the European Union. Freedom of the internal market.* |
| **L5** | *Directions of transport development - Transport White Paper.* |
| **L6** | *European standardization and objectives for standardization. Standardisation system.* |
| **L7** | *European standardization organizations, national standardization bodies.* |
| **L8** | *Technical specifications and standards, harmonized standards, European standards, PN and ISO standards, Eurocodes in civil engineering.* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *White Paper Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system (COM/2011/0144 final)* |

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| **The author of the programme:** | *Dr inż. Janusz Bohatkiewicz* |
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| **Organisational unit:** | *Department of Roads and Bridges* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

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|---|---|
| **Course:** | *Introduction into the European labour market* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIP3Ab* |
| **Year:** | *II* |
| **Semester:** | *3* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *30* |
| Classes | - |
| Laboratory | - |
| Project | - |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – examination* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Effective preparation of students for entering labour market. Improving their competitiveness and chances for finding work fit to their abilities.* |
| **CO2** | *Acquisition of skills for utilising all available means for job-seeking, drafting applications, effective self-presentation and establishing an own company by students.* |
| **CO3** | *Enabling acquisition of skills for making decisions regarding the selection of career path by students.* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Has the basic knowledge related to management, including quality management and conducting a business.* |
| **LO 2** | *Knows the issues related to good team management and the cooperation in a team, while respecting gender and cultures* |
| **LO 3** | *Knows the theoretical basics of standards and other regulations applied in European Union* |
| | In terms of skills: |
| **LO 4** | *Is able to manage building projects* |
| **LO 5** | *Is able to plan and conduct empirical research* |

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| | In terms of social competence: |
| **LO 6** | *Is able to – implementing particular tasks – work independently, cooperate in a team and to manage a team* |
| **LO7** | *Has a sense of responsibility for the reliability of the obtained results of his/her works and the works of the team in charge.* |
| **LO 8** | *Is aware of the necessity to improve professional and personal skills* |
| **LO 9** | *Is able to formulate conclusions and describe the results of own research* |
| **LO 10** | *Is able to respect economic/financial principles of the enterprises' activities* |
| **LO 11** | *Understands the necessity to abide by the ethical standards* |
| **LO 12** | *Is aware of non-technical aspects in construction activity* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *The European labour market – change, development, globalization* |
| **L2** | *Civil Engineering graduates on labour market* |
| **L3** | *Lublin University of Technology and its offer* |
| **L4** | *How companies recruit employees?* |
| **L5** | *Effective self-presentation in employee-employer interaction* |
| **L6** | *Employee-employer cooperation. Types of contracts* |
| **L7** | *Adaptation to new work environment* |
| **L8** | *Being your own boss - how to become an entrepreneur* |


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| **Organisational unit:** | *UMCS, Faculty of Economics, Institute of Management, Chair of Management* |

**Module/Course Syllabus**
*Civil Engineering*
*Specialization: Civil Engineering Structures and Ecological Engineering*
Master-degree programme

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|---|---|
| **Course:** | *Theory of Elasticity and Plasticity* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIK1A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *60* |
| Lecture | *30* |
| Classes | *30* |
| Laboratory | *-* |
| Project | *-* |
| **Number of ECTS credits:** | *4* |
| **Form of assessment:** | *Lecture – examination, classes – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Obtaining knowledge and skills in the analysis of stress and strain* |
| **CO2** | *Obtaining knowledge and skills in the analysis and formulation of constitutive equations for different materials* |
| **CO3** | *Obtaining the ability to apply theory to solving engineering problems* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having knowledge and skills in mathematics and in particular mathematical analysis and calculus* |
| **2** | *Having knowledge of theoretical mechanics* |
| **3** | *Having knowledge of the strength of materials* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows the basics of tensor calculus and the theoretical basis of the deformation and stress state analysis* |
| **LO 2** | *Knows the basics of the constitutive equations* |
| **LO 3** | *Knows the theoretical basis and methods of solving 2D problems in theory of elasticity* |

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| | In terms of skills: |
| **LO 4** | *Know how to write the equations of motion, determine the displacement vector, strain tensor, rotation tensor, velocity and acceleration vectors, strain rate tensor in the description of Euler and Lagrange. Know how to determine the invariants, values and principal directions of second order symmetric tensor* |
| **LO 5** | *Know how to determine the components of the stress tensor, normal and shear stresses, elastic energy* |
| **LO 6** | *Know how to formulate and analyze constitutive equations for linear, thermo-elastic, visco-elastic, elastic-plastic materials* |
| **LO 7** | *Able to solve engineering problems associated with solid mechanics* |
| | In terms of social competence: |
| **LO 8** | *It is responsible for the accuracy of their work results and their interpretation* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Tensor calculus* |
| **L2** | *Strain state* |
| **L3** | *Stress state* |
| **L4** | *Conservation laws* |
| **L5** | *Linear thermo-elasticity* |
| **L6** | *Basic theorems, simple problems of theory of elasticity* |
| **L7** | *2D problems* |
| **L8** | *Mechanical models of the solid, visco-elasticity* |
| **L9** | *Elasto-plasticity* |
| **Form of classes – classes (C)** | |
| | Course content |
| **C1** | *Index notations, summation convention, tensor operations, notations of differentiation, basic operators: gradient, divergence, curl, Laplacian* |
| **C2** | *Displacement, strain measurement, material derivative, speed and acceleration, values and main directions of second order symmetric tensor* |
| **C3** | *Cauchy's theorem, stress vector, normal and shear stress* |
| **C4** | *2D problems, the solution with polynomials* |
| **C5** | *2D problems, solutions using Fourier series* |
| **C6** | *Mechanical models of the solids* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *S.P. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw-Hill Book Company, 1951* |
| **2** | *Fung Y.C., First Course in Continuum Mechanics, Prentice Hall, 1993* |
| **3** | *Mase G., Schaum's Outline of Continuum Mechanics, McGraw-Hill, 1969* |
| **Recommended textbooks and other course materials** | |
| **1** | *Fung Y. C., Foundations of Solid Mechanics, Prentice Hall, 1965* |

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| **2** | *A. E. Green, W. Zerna, Theoretical Elasticity, Dover Civil and Mechanical Engineering, 2012* |

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| **The author of the programme:** | *Dr hab. inż. Jerzy Podgórski, prof. PL* |
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| **Organisational unit:** | *Departament of Structural Mechanics* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

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|---|---|
| **Course:** | *Computer Methods* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK2A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *60* |
| Lecture | *30* |
| Classes | *-* |
| Laboratory | *30* |
| Project | *-* |
| **Number of ECTS credits:** | *3* |
| **Form of assessment:** | *Lecture – examination, laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Obtaining a knowledge of the FEM modeling principles of any geometry systems in static and dynamic analysis of structures* |
| **CO2** | *Obtaining a knowledge of FEM algorithms used to solve advanced linear and nonlinear structural mechanics problems* |
| **CO3** | *Understanding the possibilities of using of computer programs to assist in the analysis and design of structures* |

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| **CO4** | *Obtaining a FEM modeling skills of any geometry systems in static and dynamic analysis of structures* |
| **CO5** | *Obtaining a the ability to solve advanced problems of linear and nonlinear structural mechanics with selected computer programs* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having a knowledge of structural mechanics and strength of materials* |
| **2** | *Having a basic knowledge of computational methods used to solve problems in civil engineering* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Has knowledge of the FEM modeling principles of engineering structures of any geometry in static and dynamic analysis* |
| **LO 2** | *He knows FEM algorithms used to solve advanced linear and nonlinear structural mechanics problems* |
| | In terms of skills: |
| **LO 3** | *Able to use FEM algorithms in static and dynamic calculations of simple parts of the structure* |
| **LO 4** | *Able to accept a static scheme and develop a FEM model of engineering structures* |
| **LO 5** | *Able to perform static and dynamic analysis of the structure using the selected computer program* |
| **LO 6** | *Able to critically evaluate the results of computer calculations* |
| | In terms of social competence: |
| **LO 7** | *It is aware of the necessity to raise professional and personal competences* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Mathematical and physical background of the finite element method (FEM)* |
| **L2** | *The FEM algorithm in static analysis of trusses* |
| **L3** | *Overview of methods of modeling material properties* |
| **L4** | *Overview of the type of FEM analyzes, used in civil engineering (analysis of linear and nonlinear static, eigenvalue problems in dynamics and buckling, integration the equations of motion)* |
| **L5** | *FEM modeling of beam structures* |
| **L6** | *Scope and mathematical description of the 2D slab elements* |
| **L7** | *Scope and mathematical description of plate elements* |
| **L8** | *Scope and mathematical description of shell elements* |
| **L9** | *Shape functions* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Static and dynamic analysis of the truss structure* |
| **Lab2** | *Static analysis, stability analysis and dynamic analysis of 3D frame structure* |

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| **Lab3** | *Analysis of the influence of FE mesh and element type on the accuracy solutions for static and dynamic analysis on the example of the slab structure* |
| **Lab4** | *Static and dynamic analysis of the structure using solid elements* |
| **Lab5** | *Static and dynamic analysis of the structure using shell elements* |
| **Lab6** | *Non-linear static calculation of the structure* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *Zienkiewicz O.C., Taylor R.L., Zhu J.Z., Finite Elements Metod, Butterworth-Heinemann, 2013* |
| **2** | *Cook R.D., Malkus D.S., Plesha M.E., Concepts and Applications of Finite Element Analysis, Wiley, 2001* |
| **3** | *Podgórski J., Błazik-Borowa E.: The Finite Element Method In Static Problems for Engineering Structures, IZT, Lublin 2001* |

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|---|---|
| **The author of the programme:** | *Dr hab. inż. Jerzy Podgórski, prof. PL* |
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| **Organisational unit:** | *Department of Structural Mechanics* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Complex Concrete Structures* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIK3A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *60* |
| Lecture | *30* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *30* |
| **Number of ECTS credits:** | *4* |
| **Form of assessment:** | *Lecture – examination, project – assessment* |
| **Course language:** | *English* |

| Course objective (CO) | |
|---|---|
| **CO1** | *Gaining knowledge and skills in designing complex reinforced concrete structures* |
| **CO2** | *Obtaining knowledge about forced strains and rheological phenomena affecting the distribution of internal forces in reinforced concrete structure* |

| Prerequisites in terms of knowledge, skills and other competencies | |
|---|---|
| **1** | *Having knowledge and skills in the field of reinforced concrete structures included in the syllabus of first-cycle studies* |
| **2** | *Having knowledge and skills in structural mechanics allowing to solve complex static systems* |

| Learning outcomes (LO) | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows the rules of static behaviour of reinforced concrete deep beams* |
| **LO 2** | *Has the knowledge in the design of retaining walls of different types* |
| **LO 3** | *Has the knowledge in designing liquid retaining and containment structures* |
| **LO 4** | *Has the knowledge of forced strains, rheological phenomena and knows the rules of internal forces redistribution* |
| | In terms of skills: |
| **LO 5** | *Is able to design liquid retaining and containment structures* |
| | In terms of social competence: |
| **LO 6** | *Is able to independently design and formulate conclusions* |
| **LO 7** | *Is aware of the responsibility that the design of engineering structures carries and the necessity of continuous deepening of knowledge* |

| Course content | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Reinforced concrete deep beams – structural analysis and design* |
| **L2** | *Retaining walls – structural analysis and design* |
| **L3** | *Liquid retaining and containment structures – structural analysis and design* |
| **L4** | *Forced strains, rheological phenomena and the rules of redistribution of internal forces* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Loads on silos and tanks* |
| **P2** | *Structural analysis of liquid retaining and containment structures* |
| **P3** | *Ultimate and serviceability limit states* |
| **P4** | *Silo and tank construction drawing* |

| Required textbooks and other course materials | |
|---|---|
| **1** | *EN 1992-1-1 Eurocode 2. Design of concrete structures. Part 1-1: General rules and rules for buildings* |

| | |
|---|---|
| **2** | *EN 1992-3 Eurocode 2. Design of concrete structures. Part 3: Liquid retaining and containment structures* |
| **3** | *EN 1991-4 Eurocode 1. Actions on structures. Part 4: Silos and tanks* |
| **Recommended textbooks and other course materials** | |
| **1** | *Kong F.K., Reinforced Concrete Deep Beams. Taylor & Francis Books, Inc. 2003* |
| **2** | *MacGinley T.J., Choo B.S., Reinforced Concrete. Design Theory and Examples. Second edition. E & FN Spon, London & New York 1990* |

| | |
|---|---|
| **The author of the programme:** | *PhD, Eng. Piotr Smarzewski* |
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| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Complex Metal Structures* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIK4A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *60* |
| Lecture | *30* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *30* |
| **Number of ECTS credits:** | *4* |
| **Form of assessment:** | *Lecture – examination, project – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** |
|---|

| | |
|---|---|
| **CO1** | *Gaining knowledge of the basic functions of load-bearing elements in complex steel structures* |
| **CO2** | *Gaining knowledge and skills in terms of defining loads acting on complex steel structures* |
| **CO3** | *Acquainting students with principles of selecting the cross-section and connections of the complex steel structures elements.* |
| **CO4** | *Gaining skills in the design of complex steel structures and assessment of the ultimate and serviceability limit states.* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Has necessary and advanced knowledge of mathematics in order to solve engineering problems.* |
| **2** | *Has knowledge of structural mechanics and strength of materials.* |
| **3** | *Has knowledge on the fundamentals of section dimensioning and steelwork connections.* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows the design principles for the complex steel structures, is able to explain the behaviour of structural elements being the part of bar type supporting systems and is capable of choosing the optimal connection type between these elements.* |
| **LO 2** | *Knows the rules of transferring the loads onto the structural elements and their connections.* |
| **LO 3** | *Knows the rules on verifying ultimate limit states and serviceability limit states in terms of load-bearing elements and their connections.* |
| | In terms of skills: |
| **LO 4** | *Is able to define and combine the loads acting on the steel framed buildings.* |
| **LO 5** | *Can choose the proper static schemes and determine the internal forces in the elements of a bar type structure.* |
| **LO 6** | *Can define and design the connections and load-bearing elements of steel frameworks in terms of the ultimate and serviceability limit states.* |
| | In terms of social competence: |
| **LO 7** | *Is responsible for the reliability of results obtained in the course of individual work, as well as for their interpretation.* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *The construction of single story industrial buildings - principles for the selection of dimensions and shape due to the function; portal-, truss-, single and multi-bay frames; basic structural elements and static schemes of steel framed buildings.* |

| | |
|---|---|
| **L2** | *Permanent and variable loads acting on the structure, rules of determining the load combinations, principles of transferring the actions onto the structural elements of single story buildings.* |
| **L3** | *Framing options - truss and portal frames. Non purlins constructions. Purlins - principles of design and determining of the cross section. Purlins static schemes. Verification of purlins in terms of the ultimate and serviceability limit state. Bolt assembly connections and purlins support. Roof bracings.* |
| **L4** | *Roof trusses – types of trusses depending on the shape, function, type of bracing. Rules for structural design of steel trusses. Buckling length of truss members. Determining the members cross sections and types of connections. Members ultimate limit state. Load capacity of nodes (gusset plates and welded connections).* |
| **L5** | *Bracings in the single storey framed buildings – wall bracings (longitudinal bracings and wind girders), roof bracings (transverse and longitudinal bracings in the roof plane, vertical bracings). Rules for bracings design and location of bracing in single story industrial buildings. Bracings in non-purlins systems. Approach of optimal choice of bracing cross sections and assembly connections.* |
| **L6** | *Crane runway beams and girders - classification because of the cross-section; rules for determining loads. The beams impact onto the columns. Support of crane runway girders on columns of uniform section or on stepped or built-up columns. Ultimate and serviceability limit state of crane runway girders.* |
| **L7** | *Columns in single story industrial buildings – solid or built up members. Loads acting on columns. Columns static schemes and cross sections. Ultimate and serviceability limit states of columns in bending and compression. Design of built-up columns with lacings and battens.* |
| **L8** | *Beam to column and truss to column joints. Column basics – pinned or fixed. Design of column basics (elastic or plastic global analysis). Type of holding down bolts and anchors. Ultimate limit state of holding down bolts and anchors.* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Determination of the dead, live and environmental loads acting on the roof structure.* |
| **P2** | *Determination of internal forces in the roof purlins. Verification of ultimate and serviceability limit state of purlin.* |
| **P3** | *Determination of internal forces from permanent and variable loads in the truss nodes. Calculation of internal forces in truss chords and members.* |
| **P4** | *Calculation of buckling lengths of truss members. Design of truss chords and internal members.* |
| **P5** | *Design of connections between truss members – direct connections and connections with gusset plates. Arrangement and design of bracings.* |
| **P6** | *Discuss on the project's drawings – a general drawing presenting the truss scheme and detailed drawings with nodes and connections.* |

| Required textbooks and other course materials | |
|---|---|
| **1** | *EN 1993-1-1:2006 Eurocode 3: Design of steel structures. Part 1-1: General rules and rules for buildings* |
| **2** | *EN 1993-1-5:2008 Eurocode 3: Design of steel structures. Part 1-5: General rules - Plated structural elements* |
| **3** | *EN 1993-1-8:2006 Eurocode 3: Design of steel structures. Part 1-8: Design of joints* |
| **4** | *Steel Buildings in Europe. Single-storey steel buildings. Part 1-11.* |
| **5** | *Access Steel. NCCI: Design of roof trusses SN027a-EN-EU* |
| **6** | *Access Steel. Scheme Development: Conceptual design of truss and column solutions SS050a-EN-EU* |
| **7** | *Access Steel. Example: Single span truss and post frame for a low pitch roof using battened section chords SX017a-EN-EU* |
| **8** | *Steel Designers' Manual 7th Edition, The Steel Construction Institute, 2012* |
| **Recommended textbooks and other course materials** | |
| **1** | *Gaylord E.H., Gaylord Ch.N., Stallmeyr J.E., Design of steel structures, Mc Graw-Hill, Inc., 1992* |
| **2** | *Trahair N.S. and others, The behaviour and design of steel structures to EC3, Fourth edition,Taylor & Francis Group, London and New York 2008* |

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|---|---|
| **The author of the programme:** | *Dr inż. Wiesława Banachewicz* |
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| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Construction project management with regard to the environmental aspects* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIK5A* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *60* |
| Lecture | *30* |

| | |
|---|---|
| Classes | - |
| Laboratory | - |
| Project | *30* |
| **Number of ECTS credits:** | *3* |
| **Form of assessment:** | *Lecture – examination, project – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *To provide the student with understanding of project management methodology* |
| **CO2** | *To develop the learners understanding of typical decision problems and suitable decision support methods in managing project* |
| **CO3** | *To introduce the concept of risk management* |
| **CO4** | *To raise student awareness on the environmental impact of construction and civil engineering projects* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Completed courses in construction technology, construction methods, construction planning and management, and construction documentation* |
| **2** | *Ability to prepare construction cost estimates* |
| **3** | *Computer skills: text editing, technical drawing, engineering calculations* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows methodological bases of project management in construction* |
| **LO 2** | *Has theoretical background for modelling and solving decision problems typical for construction project management* |
| **LO 3** | *Identifies sources of risks and describes methods of risk management in the course of construction projects* |
| | In terms of skills: |
| **LO 4** | *Prepares project schedule allowing for a variety of constraints and particular project conditions* |
| **LO 5** | *Conducts risk analysis and assessment on the basis of project information* |
| | In terms of social competence: |
| **LO 6** | *Is able to consider economic/financial principles in project management* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Introduction to project management in construction* |
| **L2** | *Project management methodology* |
| **L3** | *Basics of decision theory and decision support methods* |
| **L4** | *Decision problems in managing construction projects* |
| **L5** | *Risk management in construction* |
| **L6** | *Ecological issues in construction project management* |

| Form of classes – project (P) | |
|---|---|
| | Course content |
| **P1** | *Scheduling construction project with various conditions and constraints (e.g. limited availability of resources, random process durations)* |

| Required textbooks and other course materials | |
|---|---|
| **1** | *Walker A., Project management in construction, Blackwell Publishing, 2007* |
| **2** | *Code of practice for project management for construction and development. Chartered Institute of Building, Wiley-Blackwell, 2014* |
| **3** | *Smith N.J., Merna T., Jobling P., Managing Risk in Construction Projects, Wiley Blackwell, 2014* |
| **Recommended textbooks and other course materials** | |
| **1** | *Mubarak S.A., Construction Project Scheduling and Control, Wiley, 2015* |
| **2** | *Hilier F.S., Lieberman G.J., Introduction to Operations Research, McGraw-Hill International Edition, 2014* |
| **3** | *Glasson J., Therivel R., Chadwick A., Introduction to environmental impact assessment, Routledge, 2011* |

| | |
|---|---|
| **The author of the programme:** | *Dr inż. Agata Czarnigowska* |
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| **Organisational unit:** | *Department of Construction Methods and Management* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Chemistry of Construction Materials* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIK6A* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *45* |
| Lecture | *30* |
| Classes | - |

| | |
|---|---|
| Laboratory | *15* |
| Project | - |
| **Number of ECTS credits:** | *3* |
| **Form of assessment:** | *Lecture – examination, laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Understanding the chemical structure and chemical processes in building materials* |
| **CO2** | *Gaining knowledge of protection against corrosion of building materials* |
| **CO3** | *Gaining the ability to evaluate the suitability of water* |
| **CO4** | *Systematic habit of self-education, self-reliance, learning skills, learn new techniques and experimental methods* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having basic knowledge in chemistry* |
| **2** | *Having the ability to understand the basic physicochemical changes in construction materials* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows what is happening there and chemical changes that affect the properties of materials* |
| **LO 2** | *Has expertise in corrosion processes of building materials and know how to protect them* |
| **LO 3** | *Knows the basis of physical and chemical processes of binding materials and is familiar with modern materials and technologies in construction* |
| | In terms of skills: |
| **LO 4** | *Describe properties of important chemical compounds and types of corrosions associated with them* |
| **LO 5** | *Recognize and interpret physicochemical processes taking place during exploitation of building constructions* |
| **LO 6** | *On the basis of chemistry able to explain the phenomena that threaten widespread building materials in the surrounding environment* |
| **LO 7** | *Can use the results of chemical analysis to determine the suitability of raw materials, for example, mixing water* |
| | In terms of social competence: |
| **LO 8** | *Responsible for providing obtained results, interpretation and creative during solving important problems of modern civilization* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |

| | |
|---|---|
| **L1** | *Structure of matter. Construction of solid-body lattice, crystal systems, crystal lattice defects, the binding of atoms in the crystal, glass, ceramics* |
| **L2** | *Chemical bonds and types of building materials - cohesive forces* |
| **L3** | *Mineral chemistry building materials, adhesive-bonding materials. Components and properties of concrete* |
| **L4** | *Introduction to the Chemistry of silicates, organosilicon compounds, the structure and chemical composition of materials* |
| **L5** | *Physical chemistry of water and processes of chemical technology for natural water treatment, the effect of water quality in engineering materials* |
| **L6** | *Chemistry of polymeric materials important in construction, modification of polymer materials and their practical application* |
| **L7** | *Corrosion of materials, processes and the environment. Protection against corrosion, security techniques-of mineral materials (sealing of concrete mechanical and chemical) protection of materials, inhibitors* |
| **L8** | *Road materials, asphalt- tarmac. The chemistry of the rock-forming materials and their occurrence* |
| **L9** | *Physicochemical methods of materials. Advanced technologies in surface engineering of materials* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Safety and preparation for laboratory work, knowledge of equipment and research positions* |
| **Lab2** | *Concrete corrosion - vulnerability assessment acid corrosion of concrete* |
| **Lab3** | *Evaluate the usefulness of mixing water for concrete (in accordance with standard construction)* |
| **Lab4** | *The effect of inhibitors on the steel corrosion* |
| **Lab5** | *Determination of the calcium hydroxide in the concrete* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *W. Kurdowski, Cement and Concrete Chemistry, Springer Science+Busines Media B.V. 2014* |
| **2** | *Anthony R. West, John Wiley & Sons, Solid State Chemistry 1989* |
| **3** | *Lawrence S. Brown, Thomas A. Holme, Chemistry for Engineering students II Edition, Cengage Learning 2009* |
| **Recommended textbooks and other course materials** | |
| **1** | *E. Cartmell, Chemistry for Engineers, An Introductory Course, Butterworth's Scientific Publications,1989* |


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|---|---|
| **The author of the programme:** | *Dr hab. Justyna Jaroszyńska-Wolińska, Prof. PL* |
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| **Organisational unit:** | *Department of Geotechnical Engineering* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

| | |
|---|---|
| **Course:** | *Architectural and Urban Planning Aspects in Civil Engineering* |
| **Type of the course:** | *Core* |
| **Course code:** | *IIK7A* |
| **Year:** | *II* |
| **Semester:** | *3* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *30* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *-* |
| **Number of ECTS credits:** | *1* |
| **Form of assessment:** | *Lecture – examination* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining knowledge in the field of knowledge and understanding of the principles of architectural design and urban planning including the needs of disabled people* |
| **CO2** | *Gaining knowledge of the world history of architecture and urban planning* |
| **CO3** | *Obtaining knowledge of contemporary trends in the design of architectural and urban planning* |
| **CO4** | *Gaining knowledge of the legal requirements architectural and urban planning* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Requires basic knowledge of architectural and urban design and the basis of the history of architecture and urban planning* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *The student has knowledge of architectural design and urban facilities polyfunctional-of utilities including the needs of disabled people* |
| **LO 2** | *The student has knowledge of the world history of architecture and urban planning* |

| | |
|---|---|
| **LO 3** | *The student has knowledge of the rules applied in architectural design and urban planning* |
| | In terms of social competence: |
| **LO 4** | *The student is aware of the importance of the work of the architect in shaping the environment* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Principles of architectural design and urban facilities multifunction the needs of people with disabilities* |
| **L2** | *The history of the world architecture and urbanism* |
| **L3** | *Legal aspects of architectural design and urban planning* |
| **L4** | *Contemporary trends in contemporary architectural design multi-functional buildings* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *Edwards B., Libraries and learning resource centers, Chicago 2002* |
| **Recommended textbooks and other course materials** | |
| **1** | *Serraino P., Shulman J.: Modernism Rediscovered. Taschen, Köln 2000* |

| | |
|---|---|
| **The author of the programme:** | *Dr inż. arch. Bartłomiej Kwiatkowski* |
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| **Organisational unit:** | *Department of Architecture, Urban and Spatial Planning* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *BIM in General Construction* |
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK1A* |
| **Year:** | *II* |
| **Semester:** | *3* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *75* |

| | |
|---|---|
| Lecture | *30* |
| Classes | *-* |
| Laboratory | *45* |
| Project | *-* |
| **Number of ECTS credits:** | *3* |
| **Form of assessment:** | *Lecture – assessment, laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining knowledge about the possibilities of using BIM technology in the design and erection of buildings* |
| **CO2** | *Understanding the possible use of computer programs based on BIM technology for supporting the design of buildings* |
| **CO3** | *Gaining the ability to design simple buildings objects with selected computer software compatible with BIM technology* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having knowledge and skills of general construction, steel construction and reinforced concrete structures covered by the first-cycle studies* |
| **2** | *Having knowledge in the field of information technology and practical computer skills* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Has knowledge in the design of buildings using BIM technology* |
| **LO 2** | *Know the benefits and risks of the practical use of BIM technology* |
| | In terms of skills: |
| **LO 3** | *Is able to design simple building object with selected computer software based on BIM technology* |
| **LO 4** | *Is able to make drawing documentation of the simple building object with selected computer software based on BIM technology* |
| **LO 5** | *Can prepare reports and material bills of the simple building object with selected computer software based on BIM technology* |
| | In terms of social competence: |
| **LO 6** | *Is aware of the responsibility that brings design of engineering structures and the need for permanent improvement of knowledge and skills* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *The essence of the BIM technology* |
| **L2** | *Parametric modeling - methodology and the possibilities* |
| **L3** | *Integration and data exchange between applications* |

| | |
|---|---|
| **L4** | *Use of BIM in the design and erection of buildings (from the point of view of investor, construction manager, engineer, architect, contractor, subcontractor and manufacturer)* |
| **L5** | *Case studies - examples of practical use of BIM technology* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Creating grids and sketches, basic operations on objects* |
| **Lab2** | *Modeling of steel elements, manually creating connections between them and by components* |
| **Lab3** | *Modeling of concrete and reinforced concrete elements, manual execution of the reinforcement and by components* |
| **Lab4** | *Control and model numbering* |
| **Lab5** | *Creating and editing of drawings: summarized, single component, assembly and formwork* |
| **Lab6** | *Generating of reports and bills* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *Szeląg M., Szewczak A., Brzyski P., BIM in General Construction, 2016* |
| **2** | *Eastman C., Teicholz P., Sacks R., Liston K., BIM Handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons, 2011* |
| **3** | *Krygiel E., Nies B., Green BIM: Successful sustainable design with building information modeling. Wiley Publishing, 2008* |
| **4** | *Garber R., BIM design: realizing the creative potential of building information modeling, John Wiley & Sons, 2014* |
| **Recommended textbooks and other course materials** | |
| **1** | *Kensek K.M., Noble D., Building Information modeling: BIM in current and future practice, John Wiley & Sons, 2014* |
| **2** | *Olbina S., Building Information Modeling, 2015* |

| | |
|---|---|
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| **Organisational unit:** | *Department of General Construction* |

| | |
|---|---|
| **Course:** | *Fire Protection in Construction* |
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK2A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – exam, project – assessment and test* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Acquisition of knowledge of classification of structural elements concerning the fire resistance* |
| **CO2** | *Acquisition of knowledge and abilities in scope of designing of reinforced concrete, steel, masonry and wooden structures concerning the safety in fire conditions* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Knowledge and abilities in the scope of reinforced concrete, steel, masonry and wooden structures being the subject of the BSc and MSc courses* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Student knows the classification of structural elements concerning the fire resistance and reactions imposed to structure in the case of fire* |
| **LO 2** | *Student has knowledge about the structural materials parameters in high temperatures* |
| **LO 3** | *Student knows the rules of designing of the reinforced concrete, steel, masonry and wooden structures regarding the safety in fire conditions* |
| | In terms of skills: |
| **LO 4** | *Student can design fire protected structural elements* |
| | In terms of social competence: |
| **LO 5** | *Student can himself solve the design exercise and draw the conclusions* |
| **LO 6** | *Student is conscious of reliability of designer for safety of people* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Classification of structural elements concerning the fire resistance* |

| | |
|---|---|
| **L2** | *The reactions imposed onto structures in fire conditions* |
| **L3** | *The main rules for structures designing for fire conditions* |
| **L4** | *Characteristics of steel in high temperatures and method of designing of fire protected steel structures* |
| **L5** | *Characteristics of concrete and reinforcing steel in high temperatures and method of designing of fire protected reinforced concrete structures* |
| **L6** | *Characteristics of masonry in high temperatures and method of designing of fire protected masonry structures* |
| **L7** | *Characteristic of wooden elements in high temperatures and method of designing of fire protected wooden structures* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Design of exemplary steel structure for fire conditions* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *EN 1992-1 – 2 2004 Eurocode 2: Design of Concrete Structures. General rules and rules for buildings and structural fire design* |
| **2** | *EN 1993-1--2:2005. Eurocode 3 Design of steel structures. General rules and rules for buildings and structural fire design* |
| **3** | *EN 1995-1--2:2004. Eurocode 5 Design of timber structures. General rules and rules for buildings and structural fire design* |
| **4** | *EN 1996-1--2:2005. Eurocode 6 Design of masonry structures. General rules and rules for buildings and structural fire design* |
| **5** | *EN 13791 Assessment of in-situ compressive strength in structures and precast concrete components* |
| **Recommended textbooks and other course materials** | |
| **1** | *R S Narayanan and A Beeby: Designers' Guide to EN 1992-1-1 and EN 1992-1-2 Eurocode 2: Design of Concrete Structures. General rules and rules for buildings and structural fire design* |
| **2** | *Jürgen König: Structural fire design according to Eurocode 5 – design rules and their background, Fire and Materials Volume 29, Issue 3, pages 147–163, May/June 2005* |


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| **The author of the programme:** | *Dr hab. inż. Anna Halicka, prof. PL* |
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| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**
*Civil Engineering*
*Specialization: Civil Engineering Structures and Ecological Engineering*
Master-degree programme

| | |
|---|---|
| **Course:** | *Scaffolds* |
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK3A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *15* |
| Project | *-* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture and laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Obtaining knowledge of the rules of design and exploitation of scaffolds according to actual standards and law acts* |
| **CO2** | *Obtaining knowledge of methods of the technical assessment of scaffold structures and the analysis of their statics work* |
| **CO3** | *Gaining the ability to make the statics-strength analysis of scaffold structures* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having knowledge of structural mechanics and strength of materials* |
| **2** | *Having a basic knowledge of computational methods applied in building engineering* |
| **3** | *Having knowledge of steel structures* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *A student has knowledge of the rules of scaffolds exploitation on building sites and knows law acts concerning the design and exploitation of scaffolds* |
| **LO 2** | *A student has knowledge of the rules of scaffolds design according to actual standards and law acts* |
| | In terms of skills: |
| **LO 3** | *A student is able to make the technical project of scaffolds* |

| | |
|---|---|
| **LO 4** | *A student is able to assess technical condition of scaffolding and effects of load action on the scaffold structures* |
| | In terms of social competence: |
| **LO 5** | *A student is aware of the civil engineering responsibility for safety of scaffolds users* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Getting to know the definitions and legislation, scaffolds systems and rules of scaffolds design* |
| **L2** | *The overview of the preparation process of scaffolding for the production and marketing* |
| **L3** | *The overview of the scaffolding operating on building sites, including the necessary documentation, rules of erection, exploitation and dismantling* |
| **L4** | *The overview of laboratory tests of scaffolds and methods of statistical analyses of their results* |
| **L5** | *The design of untypical scaffolds* |
| **L6** | *The presentation of implementation of scaffolds* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Assembly of the scaffolds* |
| **Lab2** | *The creation of scaffold models with using AUTOCAD programme* |
| **Lab3** | *The statics-strength analyses for exemplary scaffolds* |
| **Lab4** | *The measurements of strains for facade frame with using Zwick strength machine* |
| **Lab5** | *The measurements of the bearing capacity for scaffold modular node with using VBai strength machine* |
| **Lab6** | *The measurements of the bearing capacity for scaffold modular node with using MTS strength machine* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *EN 12811-1:2007 Temporary works equipment - Part 1: Scaffolds – Performance requirements and general design* |
| **2** | *EN 12811-3:2003 Temporary works equipment. Part 3: Load Testing* |
| **3** | *EN 12810-1:2010 Façade scaffolds made of prefabricated components. Part 1: Product specifications.* |
| **4** | *EN 12810-2:2010 Façade scaffolds made of prefabricated components. Part 2: Particular methods of structural design* |
| **Recommended textbooks and other course materials** | |
| **1** | *Zienkiewicz O.C., Taylor R.L., Finite Element Method. Volume 1, McGraw-Hill, London 1989* |

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| **The author of the programme:** | *Dr hab. inż. Ewa Błazik-Borowa, prof. PL; mgr inż. Michał Pieńko* |

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| **Organisational unit:** | *Department of Structural Mechanics* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Masonry structures* |
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK4A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – assessment, project – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Getting of knowledge and competences in range of forming and calculation of unreinforced masonry structures* |
| **CO2** | *Getting of knowledge and competences in range of forming and calculation of reinforced masonry structures* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having of knowledge from building materials connected with mortars and masonry elements* |
| **2** | *Having of knowledge from basics of civil engineering, structural mechanics and strength of materials to solve engineering problems* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Selects proper classes of mortars and masonry elements to calculated internal forces* |

| | |
|---|---|
| **LO 2** | *Knows theoretical basics of calculation of unreinforced masonry structures and calculation models* |
| **LO 3** | *Knows calculation ways of mostly vertically loaded walls, stiffening walls and reinforced masonry* |
| | In terms of skills: |
| **LO 4** | *Knows how to calculate the strength of unreinforced masonry depending on kind and class of masonry element and mortar* |
| **LO 5** | *Can calculate masonry pillar in selected cross-sections on calculated floor* |
| **LO 6** | *Can propose effective way to increase capacity of masonry structure without enlargement of cross-section* |
| **LO 7** | *Knows how to calculate the strength of reinforced masonry with taking into account the limitations of its strength* |
| | In terms of social competence: |
| **LO 8** | *Is thorough and always on time in solving tasks* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Classes of mortars and masonry elements, masonry strengths* |
| **L2** | *Effective height, reduction coefficients of capacity* |
| **L3** | *Checking of ultimate limit state of masonry pillar in outer wall* |
| **L4** | *Calculations of inner walls on both sides loaded by floor slabs* |
| **L5** | *Calculation models of stiffening walls (horizontally loaded)* |
| **L6** | *Reinforced masonry with vertical and horizontal bars (bars in joints)* |
| **L7** | *Composite masonry-concrete and masonry-reinforced concrete structures* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Calculation of masonry strength and effective height of walls* |
| **P2** | *Capacity checking of outer wall pillar in selected cross-sections on calculated floors* |
| **P3** | *Capacity of inner walls on both sides loaded by floor slabs* |
| **P4** | *Modelling of stiffening walls and capacity checking with taking into account horizontal load caused by wind* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *Eurocode 6: Design of masonry structures. Part 1-1: General rules for buildings – Rules for reinforced and unreinforced masonry* |
| **2** | *Eurocode 6: Design of masonry structures. Part 1-2: General rules for buildings – Structural fire design* |
| **3** | *Eurocode 6: Design of masonry structures. Part 2: Design, selection of materials and execution of masonry* |
| **4** | *Eurocode 6: Design of masonry structures. Part 3: Simplified calculation methods and simple rules for masonry* |
| **Recommended textbooks and other course materials** | |

| | |
|---|---|
| **1** | *Beall C., Jaffe R., Concrete and Masonry Databook, The McGraw-Hill Companies 2003* |
| **2** | *Hendry A.W., Sinha B.P., Davies S.R., Design of Masonry Structures, E & FN SPON 2004* |

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|---|---|
| **The author of the programme:** | *Dr inż. Marek Grabias* |
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| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Wooden Engineering Constructions* |
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK5A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | - |
| Laboratory | - |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – test, project – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Obtaining knowledge about the structural properties of wood, applications of wood in structures and methods of their shaping* |
| **CO2** | *Obtaining skills in solving specific engineering problems arising in the designing of complex wooden structures* |

| **Prerequisites in terms of knowledge, skills and other competencies** |
|---|

| | |
|---|---|
| **1** | *Knowledge and skills in the field of Structural Mechanics allowing for solving engineering problems* |
| **2** | *Knowledge and skills in the field of Strength of Materials allowing for solving engineering problems* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knowledge of the properties of wood as a construction material, and methods of its protecting* |
| **LO 2** | *Knowledge about the designing of traditional and modern roof rafters, frame structures* |
| **LO 3** | *Basic knowledge about the modern structures made of glued laminated timber* |
| **LO 4** | *Knowledge about joining wooden elements in structures* |
| | In terms of skills: |
| **LO 5** | *Ability of calculating and shaping elements from solid wood and glued laminated wood* |
| **LO 6** | *Ability of selecting mechanical fasteners and designing joints with their use* |
| **LO 7** | *Ability of optimizing the cross-sections of structural elements taking into account the economic conditions* |
| | In terms of social competence: |
| **LO 8** | *Concern for the economic designing of building structures* |
| **LO 9** | *Concern for the reliability of the results of own work* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Properties of wood as a construction material* |
| **L2** | *Traditional and modern solid wood constructions* |
| **L3** | *Manufacture of glued laminated wood and its application in engineering structures* |
| **L4** | *Joints of the wooden elements* |
| **L5** | *Methods of checking of the limit states conditions applied to the wooden structures* |
| **L6** | *Protection of the wooden structures against biological corrosion and against fire* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *The calculations of the wooden element in terms of the ultimate and serviceability limit state on the example of composite double T beam with nailed joints, selecting mechanical fasteners, protecting against biological corrosion. Making of construction drawings* |
| **P2** | *Shaping the cross section and calculating of the glued laminated element* |

| **Required textbooks and other course materials** |
|---|

| | |
|---|---|
| **1** | *Breyer D.E., Fridley K.J., Cobeen K.E. Design of wood structures, 1999* |
| **2** | *Kermani A., Structural timber design, 1999* |
| **Recommended textbooks and other course materials** | |
| **1** | *Wood handbook. Wood as the engineering material* |

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|---|---|
| **The author of the programme:** | *Dr inż. Jerzy Szerafin* |
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| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Prestressed structures* |
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK6A* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – examination, project – assessment and test* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Acquisition of knowledge of prestressed concrete structures and their specific features* |
| **CO2** | *Acquisition of abilities for designing of prestressed concrete structures* |

| **Prerequisites in terms of knowledge, skills and other competencies** |
|---|

| | |
|---|---|
| **1** | *Knowledge and abilities in the scope of reinforced concrete structures being the subject of the BSc course and complex concrete structures being the subject of MSc courses* |
| **2** | *Knowledge and abilities in the scope of strength of materials and mechanics being the subject of the BSc course* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knowledge about prestressed concrete structures, especially the idea of prestressing, the technology of pre-tensioning and post-tensioning, materials used for prestressed structures and their characteristics* |
| **LO 2** | *Knowledge concerning the arrangement of the prestressed beams cross-sections, calculations of prestressing force losses, checking the ultimate and serviceability limit states during and before usage of prestressed beams* |
| **LO 3** | *Knowledge concerning the technology of prestressing circular tanks and silos and knowledge about the calculations rules of them* |
| | In terms of skills: |
| **LO 4** | *Student can assess the losses of prestressing force* |
| **LO 5** | *Student can calculate pre-stressed beam in all stages of its life. He can prepare its drawings* |
| | In terms of social competence: |
| **LO 6** | *Student can solve by himself the design work and draw the conclusions* |
| **LO 7** | *Student is conscious of the responsibility for the designing of engineering big-span structures* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *The idea of prestressing* |
| **L2** | *Pre-tensioning and post-tensioning technologies* |
| **L3** | *Materials for presstressed structures and their characteristics* |
| **L4** | *Losses of prestressing force* |
| **L5** | *Establishment of prestressing level due to demands of deflection and cracking limit states* |
| **L6** | *Ultimate limit states in exploitation and realization stages* |
| **L7** | *Arrangement of cross-sections of prestressed beams* |
| **L8** | *Technology of prestressing of cylindrical tanks and rules of calculation of such structures* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Establishment of necessary level of prestressing basing on the serviceability conditions and assessment of prestressing force losses* |
| **P2** | *Checking of limit state conditions concerning the beam* |
| **P3** | *Preparation of the realization drawings of the beams* |

| Required textbooks and other course materials | |
|---|---|
| **1** | *EN 1992-1-1 Eurocode 2. Design of concrete structures, Part 1-1 Main rules and rules for buildings* |

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|---|---|
| **The author of the programme:** | *Dr hab. inż. Anna Halicka, prof. PL* |
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| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

| | |
|---|---|
| **Course:** | *Industrial steel structures* |
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK7A* |
| **Year:** | *II* |
| **Semester:** | *3* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – examination, project – assessment* |
| **Course language:** | *English* |

| Course objective (CO) | |
|---|---|
| **CO1** | *Gaining knowledge on structures and forming load-bearing elements in advanced steel constructions like crane trestles, chimneys, and tanks.* |
| **CO2** | *Gaining knowledge on loads and load capacity of industrial steel structures of the bar type and steel shell and plate structures.* |
| **CO3** | *Acquiring skills on forming load-bearing elements and estimating ultimate limit states and serviceability limit states of advanced, industrial steel structures.* |

| Prerequisites in terms of knowledge, skills and other competencies | |
|---|---|
| **1** | *Has necessary and advanced knowledge of mathematics in order to solve engineering problems.* |
| **2** | *Has knowledge of structural mechanics and strength of materials.* |
| **3** | *Has knowledge on the fundamentals of section dimensioning and steelwork connections.* |

| Learning outcomes (LO) | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows the design rules on forming load bearing structure of different industrial structures, is able to explain the behaviour of main load-bearing elements in advanced bar type or shell structures; is able to choose the optimal connection type between the load-bearing elements depending on the nature of work and employed technology.* |
| **LO 2** | *Is able to describe loads and knows the principles of its transmission to individual construction elements and their connections* |
| **LO 3** | *Knows the rules on verifying ultimate limit states and serviceability limit states in terms of load-bearing elements and their connections.* |
| | In terms of skills: |
| **LO 4** | *Is able to form a complex load-bearing structure of an industrial object. Is able to define and combine static and dynamic loads of a steel bar and shell structure.* |
| **LO 5** | *Is able to determine internal forces, after choosing a correct static scheme, for the main load-bearing elements and connections of an advanced bar or shell structures.* |
| **LO 6** | *Is able to design connections and load-bearing elements of the bar or shell structures in terms of ultimate limit states for load capacity and serviceability.* |
| | In terms of social competence: |
| **LO 7** | *Is responsible for the reliability of results obtained in the course of individual work, as well as for their interpretation.* |

| Course content | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Steel chimneys – classification according to construction type and static scheme. Loads in steel chimneys. Corrosion. Design of cross-sections and connections.* |
| **L2** | *Ultimate limit states for load capacity and serviceability of a chimney construction and sectional connections. Stability of chimneys. Material fatigue in chimneys.* |
| **L3** | *Steel crane trestles – principles of forming load-bearing elements. Sections of crane runway beams. Columns design. Loads in trestles – principles of taking into account loads from crane beams and wind.* |
| **L4** | *Ultimate limit states of load capacity and serviceability of crane beams and supporting columns. Anchorage of columns. Bracing in steel trestles.* |

| | |
|---|---|
| **L5** | *Steel tanks. Classification according to function and type. Tanks for loose materials: silos and bunkers. Principles of determining load and internal forces in silos and bunkers. Stability of coating on silos and bunkers.* |
| **L6** | *Ultimate limit states of load capacity and serviceability for silos and bunkers. Tanks for liquids – classification according to function. Determining load and internal forces. Criteria for ultimate limit states of load capacity and serviceability. Methods of assembling tanks for liquids.* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *The project of a steel load-bearing construction of a crane beam with a brace. Analysis of dead and live load affecting load-bearing elements.* |
| **P2** | *Determination of internal forces in a crane beam and brace for different patterns of dynamic load.* |
| **P3** | *Design of a cross-section of a plate crane girder, a cross-section of a brace, and a cross-section of angle braces.* |
| **P4** | *Design of connections between beams, rail, beams and columns. Testing the construction against fatigue.* |
| **P5** | *Discussion on the project's drawings – a general drawing presenting the construction and detailed drawings with connections.* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *EN 1993-1-1:2006 Eurocode 3: Design of steel structures. Part 1-1: General rules and rules for buildings* |
| **2** | *EN 1993-1-5:2008 Eurocode 3: Design of steel structures. Part 1-5: General rules - Plated structural elements* |
| **3** | *EN 1993-1-8:2006 Eurocode 3: Design of steel structures. Part 1-8: Design of joints* |
| **4** | *EN 1993-1-9:2005 Eurocode 3: Design of steel structures - Part 1-9: Fatigue* |
| **5** | *EN 1993-3-2:2006 Eurocode 3: Design of steel structures. Part 3-2: Towers, masts and chimneys – Chimneys* |
| **6** | *EN 1993-4-1:2007 Eurocode 3: Design of steel structures - Part 4-1: Silos* |
| **7** | *EN 1993-4-2:2007 Eurocode 3: Design of steel structures - Part 4-2: Tanks* |
| **8** | *EN 1993-6:2007 Eurocode 3: Design of steel structures - Part 6: Crane supporting structures* |
| **9** | *EN 1991-3:2006 Eurocode 1: Actions on structures. Part 3: Actions induced by cranes and machinery* |
| **10** | *C.J. Brown, J. Nielsen: Silos: Fundamentals of Theory, Behaviour and Design, E&FN Spon, London, 1998* |
| **Recommended textbooks and other course materials** | |
| **1** | *Guide for the Design of Crane-Supporting Steel Structures 2nd Edition, CISC, Canada 2009* |
| **2** | *Meier S.: Steel Water Storage Tanks: Design, Construction, Maintenance, and Repair, AWWA, 2010* |

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|---|---|
| **The author of the programme:** | *Dr inż. Wiesława Banachewicz* |

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|---|---|
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| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

| | |
|---|---|
| **Course:** | *Failures and Building Diagnostics* |
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK8A* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *15* |
| Project | *-* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – exam, laboratory - assessment and test* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Acquisition of knowledge of building structures diagnostics* |
| **CO2** | *Learning the reasons of building structure failures* |
| **CO3** | *Learning the main repair methods of structural elements repairs after damage* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Knowledge and abilities in the scope of reinforced concrete, steel, masonry and wooden structures being the subject of the BSc and MSc courses* |

| Learning outcomes (LO) | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Student know the aim and rules of building structures diagnostics* |
| **LO 2** | *Student know the methods of testing of existing reinforced concrete, steel, masonry and wooden structures* |
| **LO 3** | *Student knows the most frequent reasons of building structures failures, the prevention methods and repair methods of structural elements after failure* |
| | In terms of skills: |
| **LO 4** | *Student can find the reasons of cracking of reinforced concrete structures on the basis of crack patterns* |
| **LO 5** | *Student can draw up the inventory of structure damages, establish the schedule of diagnostics tests and propose the repair method* |
| | In terms of social competence: |
| **LO 6** | *Student is reliable and conscious of the responsibility for the correctness of diagnosis of damaged structures* |
| **LO 7** | *Student is conscious of the necessity of looking for information of structures damages and new diagnostic equipment in professional journals* |

| Course content | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *The aim and rules of building structures diagnostics* |
| **L2** | *Methods of testing of testing of existing reinforced concrete, steel, masonry and wooden structures* |
| **L3** | *The most frequent reasons of failures of building structures* |
| **L4** | *The methods of repair of structural elements after failure* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Demonstration of testing of reinforced concrete beam under four-point bending* |
| **Lab2** | *Demonstration of diagnostics equipment* |
| **Lab3** | *Drawing up the destruction inventory of building structure, working out the schedule of its diagnostic testing and proposing the repair method* |

| Required textbooks and other course materials | |
|---|---|
| **1** | *EN12504-2:2002. Testing concrete in structures. Part 2: Non-destructive testing. Determination of rebound number* |
| **2** | *EN12504-4:2005 Testing concrete in structures. Part 4: Determination of ultrasonic pulse velocity* |
| **3** | *EN 12504-3:2006 Testing concrete in structures. Part 3: Determination of pull-out force* |
| **4** | *EN 12504-1:2011 Testing concrete in structures. Part 1: Cored specimens. Taking, examining and testing in compression* |

| | |
|---|---|
| **5** | *EN 13791 Assessment of in-situ compressive strength in structures and precast concrete components* |

| | |
|---|---|
| **The author of the programme:** | *Dr hab. inż. Anna Halicka, prof. PL* |
| **E-mail address:** | *a.halicka @pollub.pl* |
| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Industrial Reinforced Concrete Structures* |
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK9A* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – test, designed exercise – completed project* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Obtaining knowledge of the design of industrial concrete chimneys and industrial floors* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having knowledge of structural mechanics and strength of materials* |
| **2** | *Having a basic knowledge of designing concrete structures* |

| | |
|---|---|
| **3** | *Having the ability to make constructional drawings* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Has knowledge about specific condition of the work of industrial chimneys and industrial floors* |
| **LO 2** | *Has knowledge of the rules of designing concrete chimneys* |
| | In terms of skills: |
| **LO 3** | *Is able to design concrete chimneys* |
| | In terms of social competence: |
| **LO 4** | *Is responsible for the reality of performed calculations and projects* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Specific rules of the work of industrial chimneys and characteristic of industrial floors* |
| **L2** | *Actions applied on high concrete chimneys* |
| **L3** | *The rules of designing concrete chimneys* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Selection of chimney geometry layers of the shall wall* |
| **P2** | *Founding the load combination and determining internal forces* |
| **P3** | *Design calculations for the limit state* |
| **P4** | *Design calculations for serviceability conditions* |
| **P5** | *Making the constructional drawings* |

| | |
|---|---|
| **The author of the programme:** | *Dr inż. Marta Słowik* |
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| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Special Foundations* |

| | |
|---|---|
| **Type of the course:** | *Obligatory* |
| **Course code:** | *IISK10A* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *45* |
| Lecture | *30* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *15* |
| **Number of ECTS credits:** | *3* |
| **Form of assessment:** | *Lecture – assessment, project – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Obtaining knowledge about ways of foundation engineering in complex geotechnical conditions and exceptional structural solutions of buildings* |
| **CO2** | *Gaining skills and competences regarding the selection of special foundation engineering techniques under the conditions of geotechnical category* |
| **CO3** | *Gaining knowledge and skills regarding advanced models of the ground* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Demonstrating knowledge and skills in engineering geology and hydrogeology, soil mechanics, foundation engineering and the earthworks, concrete structures, MES modeling to the extent that enables solving problems in geotechnical engineering* |
| **2** | *Demonstrating knowledge and skills to navigate the environment of operating system and application software* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows the methods of research and the assessment of the subsoil in relation the current state of knowledge and the applicable regulatory framework* |
| **LO 2** | *Knows the rules of selecting the correct model of the subsoil in numerical analysis* |
| **LO 3** | *Knows the rules of selection applicable to specific ground conditions and the geotechnical category of special foundation of a building* |
| | In terms of skills: |
| **LO 4** | *Can develop a complete foundation design of objects belonging to the II and III geotechnical category* |
| | In terms of social competence: |
| **LO 5** | *Is responsible for the reliability of obtained results of his/her work and its interpretation* |
| **LO 6** | *Notices the necessity to continue the replenishment of knowledge* |

| Course content | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Laboratory and field study of the soil for the purpose of numerical analyses* |
| **L2** | *Advanced models of the subsoil* |
| **L3** | *Deep excavation and supporting structures of walls. Methods of implementing the deep excavations and designing of their enclosures* |
| **L4** | *Constructions of reinforced soil. Methods of implementing a composite structure and the principles of dimensioning* |
| **L5** | *Designing of building objects foundations on the reinforced substrate* |
| **L6** | *Geotechnical impact in building hydraulic engineering. Functional and structural solutions* |
| **L7** | *Soil as a building material. Earthen structures, hydraulic engineering: location criteria, dimensioning of constructions including stability, sealing and drainage* |
| **L8** | *Foundation Engineering in the areas of mining damage. The substrate deformations of and their impact on designed construction objects* |
| **L9** | *Lowered wells and counterframes as an example of deep excavation and the indirect foundation* |
| **L10** | *Design and technology execution of reinforcements of existing foundations engineering* |
| **L11** | *Examples of errors in geotechnical solutions* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Laboratory tests on soil for the characteristics of the constitutive soil model* |
| **P2** | *Modeling of subsoil, along with the design of a building* |
| **P3** | *Analysis of substrate work and sensitivity of a model to different parameters* |
| **P4** | *Analysis of an own model and the defense of project* |

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|---|---|
| **The author of the programme:** | *Dr inż. Jolanta Słoma* |
| **E-mail address:** | *j.sloma@pollub.pl* |
| **Organisational unit:** | *Department of Geotechnical Engineering* |

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|---|---|
| **Course:** | *Surface girders* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK1Aa* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *45* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *30* |
| **Number of ECTS credits:** | *3* |
| **Form of assessment:** | *Lecture – examination, project – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining knowledge on the classification of slabs, plates and surfaces used in civil engineering* |
| **CO2** | *Obtaining knowledge on theory of slabs, plates and surfaces* |
| **CO3** | *Obtaining the skill of displacements and internal forces calculation slabs, plates and surfaces* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having knowledge and skills in mathematics which allow solving engineering problems* |
| **2** | *Having knowledge in the range of theoretical mechanics* |
| **3** | *Having knowledge in the range of strength of materials* |
| **4** | *Having knowledge in the range of theory of elasticity* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Has knowledge on the problems of slabs, thin plates and surfaces used in civil engineering* |
| **LO 2** | *Names the methods used for solving problems of slabs, thin plates and surfaces* |
| **LO 3** | *Knows theoretical basics of methods used for calculation of displacements and internal forces in slabs, thin plates and surfaces* |
| | In terms of skills: |
| **LO 4** | *Can perform static analysis of surface structure* |
| **LO 5** | *Can critically evaluate results of calculations by using analytical and numerical methods of surface girders statics* |
| | In terms of social competence: |
| **LO 6** | *Is responsible for the reliability of the obtained results* |

| Course content | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Theory of slabs, thin plates and surfaces* |
| **L2** | *Selected analytical methods of determination of displacements and internal forces in slabs, thin plates and surfaces* |
| **L3** | *Selected numerical methods of determination of displacements and internal forces in slabs, thin plates and surfaces* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Rectangular slab loaded with any at the edge – determination of displacements and stress field* |
| **P2** | *Rectangular plate – determination of displacements and internal force with use of any analytical method* |
| **P3** | *Axially symmetrical surface loaded with pressure – determination of displacements and internal force with use of numerical method* |

| Required textbooks and other course materials | |
|---|---|
| **1** | *S.P. Timoshenko and J.N. Goodier "Theory of Elasticity" McGraw-Hill Comp., N.Y. 1951* |
| **2** | *S.P. Timoshenko and S. Woinowsky-Krieger. „Theory of Plates and Shells". McGraw-Hill Comp., N.Y. 1959* |
| **3** | *E. Ventsel, Th. Krauthammer „Thin Plates and Shells: Theory: Analysis, and Applications", CRC Press, 2001* |
| **Recommended textbooks and other course materials** | |
| **1** | *K. Girkmann "Flächentragwerke", Springer, 1959* |

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|---|---|
| **The author of the programme:** | *Dr hab. inż. Jerzy Podgórski* |
| **E-mail address:** | *j.podgorski@pollub.pl* |
| **Organisational unit:** | *Department of Structural Mechanics* |

**Module/Course Syllabus**
*Civil Engineering*
*Specialization: Civil Engineering Structures and Ecological Engineering*
Master-degree programme

| | |
|---|---|
| **Course:** | *Reinforced Concrete Structures Loaded Dynamically* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK1Ab* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *45* |
| Lecture | *15* |
| Classes | - |
| Laboratory | - |
| Project | *30* |
| **Number of ECTS credits:** | *3* |
| **Form of assessment:** | *Lecture – assessment, project – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining knowledge from the range of designing and dimensioning RC structures loaded dynamically* |
| **CO2** | *Gaining skills related to adoption of computational schemes, compilation of loads and dimensioning of crane beams loaded dynamically* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having knowledge and skills related to strength of materials and dynamics of structures, allowing for analysis of work of bar systems loaded statically and dynamically* |
| **2** | *Having knowledge from the range of concrete structures allowing for dimensioning of RC structures* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Has knowledge of types and specificity of work of RC structures loaded dynamically* |
| **LO 2** | *Has knowledge of major parameters characterising vibrations and knows how to evaluate the impact of vibrations on machines, structures and people* |
| **LO 3** | *Has knowledge of structural systems of foundations for machines, knows how to classify them and knows how to design reinforcement* |

| | |
|---|---|
| **LO 4** | *Has knowledge about dynamic loads acting on crane beams* |
| | In terms of skills: |
| **LO 5** | *Is able to design RC crane beam including the impact of dynamic loads* |
| | In terms of social competence: |
| **LO 6** | *Is responsible for correct and reliable execution of their works* |
| **LO 7** | *Is aware of the need to raise their professional and personal competences* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Introduction to RC structures loaded dynamically* |
| **L2** | *Harmful effects of vibrations* |
| **L3** | *Characteristics of foundations for construction of industrial facilities* |
| **L4** | *Static and dynamic loads in crane beams* |
| **L5** | *Construction and calculations of block foundations for non-impact machines and hammers* |
| **L6** | *Construction and calculations of frame foundations* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Determination of loads acting on crane beams* |
| **P2** | *Determination of internal forces in crane beams* |
| **P3** | *Dimensioning of crane beam for bending* |
| **P4** | *Dimensioning of crane beam for shearing* |
| **P5** | *Dimensioning of crane beam for torsion* |
| **P6** | *Verification of crane beam for transportation* |
| **P7** | *Calculation of transport handles in crane beam* |
| **P8** | *Verification of serviceability limit states in crane beam* |
| **P9** | *Principles of drawing of crane beam* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *Kappos A.J. (Ed.), Dynamic loading and design of structures, Spon Press, London and New York, 2002* |
| **Recommended textbooks and other course materials** | |
| **1** | *Meyer Ch., Modelling and analysis of reinforced concrete structures for dynamic loading, Springer, 1998* |

| | |
|---|---|
| **The author of the programme:** | *D.Sc. Ph.D. Eng. Grzegorz Golewski, prof. LUT* |
| **E-mail address:** | *g.golewski@pollub.pl* |
| **Organisational unit:** | *Department of Structural Engineering* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

| | |
|---|---|
| **Course:** | *Electrical installations in buildings* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK2Aa* |
| **Year:** | *II* |
| **Semester:** | *3* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | - |
| Laboratory | *15* |
| Project | - |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – assessment, laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Understanding the principles of power supply and distribution of electricity in buildings. Characteristics and role of the main elements of low voltage electrical installations and installation equipment* |
| **CO2** | *Gaining knowledge of the construction, operation and safety of low voltage electrical equipment use. Gaining knowledge of the standards and other regulations applied in low-voltage electrical installations* |
| **CO3** | *Understanding the rules of selection of installation cables, selection of electrical protections and means of protection against electric shock in low voltage electrical installations in buildings* |
| **CO4** | *Gaining knowledge about modern electrical installations and management systems of electrical equipment in buildings. Understanding principles of integration of control and supervision systems in buildings and the idea of intelligent building.* |
| **CO5** | *Gaining skills about electrical metrology and measurements of electrical quantities in electrical installations* |
| **CO6** | *Obtaining the skills correctly assess the functioning of the electrical system and knowledge about the risks of incorrect use of electrical equipment and electrical installations* |

| **Prerequisites in terms of knowledge, skills and other competencies** |
|---|

| | |
|---|---|
| **1** | *Having a knowledge of electrical engineering and electronics* |
| **2** | *Having basic skills related the operation measurement devices* |
| **3** | *Knowledge of OHS and rules of electrical equipment use* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Has a basic knowledge of the construction and functioning of electrical installations in buildings and control systems and building automation* |
| **LO 2** | *Knows the terminology and the standards applied in low-voltage electrical installations* |
| **LO 3** | *Knows the rules of safety in use of electrical equipment in low voltage electrical installations* |
| | In terms of skills: |
| **LO 4** | *Is able to select the control and measuring devices and perform basic measurements in low voltage electrical installations* |
| **LO 5** | *Is able to determine the conditions the power supply and costs of using for electrical equipment* |
| **LO 6** | *Knows how to properly interpret the information contained in the electrical schematics and electrical installation projects* |
| | In terms of social competence: |
| **LO 7** | *Is aware of the need to raise professional and personal competences* |
| **LO 8** | *Has a sense of responsibility for their decisions and understands the safety aspect in the use of electrical equipment* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Characteristics of the basic equipment and items of equipment of low voltage electrical installations in buildings. Determination of the conditions of installation and proper operation of the elements of low voltage electrical installations. The signs and the graphic symbols used in electrical technology on the diagrams and the technical documentations. Low-voltage systems. The selection and the methods of stacking cables in electrical installations.* |
| **L2** | *Electric devices and electrical equipment in buildings. Classification of the main groups of low voltage electrical equipment. Characteristics of electric light sources, electric engines and electrothermal equipments in low voltage electric installations used in buildings.* |
| **L3** | *Determination of feeding conditions for electricity devices. Reactive power compensation. The use of renewable energy sources in electrical installations in buildings.* |
| **L4** | *Characteristics and importance electrical protections. Rules for selection of short-circuit protection and circuit overload. Selectivity of protection devices.* |
| **L5** | *The effects of the flow of electric current through the human body. Means of protection against electric shock in low-voltage electrical equipment.* |

| | |
|---|---|
| **L6** | *Using the low-voltage electrical installations. Making measurements in low voltage electrical installations. Measurement instrumentation in low-voltage electrical installations.* |
| **L7** | *Determination of demand for power and electricity. Rules of billing for services related to the distribution of electricity - electricity tariffs.* |
| **L8** | *Control systems of the electrical equipment in buildings. Control systems and building automation. Intelligent electrical installation. Characteristics of control and surveillance systems in buildings. Processes of integration in controls and supervision systems.* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Introductory classes. OHS and instruction exercises* |
| **Lab2** | *Examination of 3-phase circuits of alternating current* |
| **Lab3** | *Examination of single phase transformer* |
| **Lab4** | *Examination of means of protection against electric shock* |
| **Lab5** | *Examination of light sources and electric lighting system* |
| **Lab6** | *Examinations of classical automatic control systems* |
| **Lab7** | *Examination of PLC controllers and automatic control systems* |
| **Lab8** | *Compensatory courses addressed. Assessment of the course* |

| | |
|---|---|
| **The author of the programme:** | *dr inż. Marcin Buczaj* |
| **E-mail address:** | *m.buczaj@pollub.pl* |
| **Organisational unit:** | *Department of Computer and Electrical Engineering*<br>*Institute of Electrical Engineering and Electrotechnologies, Lublin University of Technology* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Surveilance and control systems in buildings* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK2Ab* |
| **Year:** | *II* |
| **Semester:** | *3* |
| **Form of the degree programme:** | *Full-time* |

| | |
|---|---|
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *15* |
| Project | *-* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – assessment, laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining knowledge of the control systems, surveilance systems, alarm systems used in protection of buildings* |
| **CO2** | *Understanding the structure, characteristics and principles of functioning of security systems, alarm systems and communication systems.* |
| **CO3** | *Understanding the terms of cooperation between security systems and alarm systems with control and automation systems in buildings. The role of the detection systems, decision-making and actuators used in autonomic and integrated systems of surveilance and control.* |
| **CO4** | *Understanding the legal conditions to be met alarm systems, security and surveillance systems used in buildings. Gaining knowledge of the legal requirements relating to surveillance systems: intrusion and hold-up alarm systems (I&HAS), access control systems (ACS), video surveillance systems (CCTV).* |
| **CO5** | *Obtaining knowledge about the operating principle and structure of basic elements of alarm systems, access control systems and video surveillance systems and hazard identification systems used in buildings.* |
| **CO6** | *Gaining knowledge and skills related to the management processes that affect the operation and use of the building, in particular the execution of the lift function of comfort, the utility functions of the building and reduce the energy intensity of work processes.* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having a knowledge of electrical engineering and electronics* |
| **2** | *Having a basic knowledge of electrical installations and electrical equipment* |
| **3** | *Having of basic knowledge of automation systems and control systems* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows the structure, operating principle and role of particular elements of surveilance and control systems* |
| **LO 2** | *Knows the terminology and the standards applied in surveilance and control systems* |
| **LO 3** | *Has knowledge in the field of devices within electrical installations, security systems and control systems, knows their destiny* |
| | In terms of skills: |

| | |
|---|---|
| **LO 4** | *Is able to determine the structures of control and alarm systems and determine method of integrate particular system components* |
| **LO 5** | *Is able to configure and manage a work of control system or alarm system commonly used in protection of buildings* |
| **LO 6** | *Knows how to properly interpret the information contained in the electrical schematics and surveilance and control system projects* |
| | In terms of social competence: |
| **LO 7** | *Is aware of the need to raise their professional and personal competences* |
| **LO 8** | *Is aware of non-technical aspects in construction activity and responsibility for their decisions* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Characteristics of control and surveilance systems. Components, function blocks, principles of construction, installation and operation of control systems, signalling systems and supervision systems.* |
| **L2** | *The functions and tasks realized by alarm systems and supervisory systems in protected building. Autonomous control and surveilance systems and integrated control and surveilance systems in buildings. Zonal organization of security systems and surveillance systems.* |
| **L3** | *Integration of control and supervision systems with automation systems in buildings. Aspect of the functioning of integrated control and supervision systems in intelligent buildings.* |
| **L4** | *Characteristics, functioning and structure of alarm systems. Transmission information on the occurrence of hazard between cells of system in order to neutralize the threat. Detailed standards and regulations concerning of alarm systems in particular intruder and hold-up alarm systems (I&HAS).* |
| **L5** | *Characteristics, functioning and structure of access control systems (ACS). Opportunities for integration and interoperability of access control systems with other surveilance and control systems. Detailed standards and regulations concerning access control systems. The authentication processes of users in access control systems.* |
| **L6** | *Types and classification of biometric features. Characteristics of behavioral and phenotypic traits used in access control systems. The use of biometrics systems in access control systems. Presentation of techniques for reading and interpretation of individual biometric features.* |
| **L7** | *Characteristics, functioning and structure of video surveillance systems (CCTV). Construction and destiny of video monitoring system components CCTV. Detailed standards and regulations concerning video monitoring systems.* |
| **L8** | *Characteristics of control and surveilance systems in the building performing functions related to improving comfort, increasing the usefulness of the object and rational use of energy. BMS systems and intelligent electrical installations. Methods of manage electrical devices and climatic processes in* |

| | |
|---|---|
| | *facilities. Adaptive control systems for lighting, heating, ventilation and air-conditioning (HVAC) in the rooms.* |
| **L9** | *The role of modern means of transmission of information in surveilance and control systems. Current trends and concepts in surveilance and control systems.* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Introductory classes. OHS and instruction exercises* |
| **Lab2** | *Examination of alarm systems in different configurations* |
| **Lab3** | *Analysis of the possibility of a computer system for managing the alarm system* |
| **Lab4** | *Examination of cameras used in CCTV systems* |
| **Lab5** | *Analysis of the possibility of a computer system for managing the CCTV system* |
| **Lab6** | *Examination of control system for electrical devices in the facility* |
| **Lab7** | *Analysis of the possibility centralized BMS system* |
| **Lab8** | *Compensatory courses addressed. Assessment of the course* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *Cieszyński J., Close circuit television, Newnes, London, New York 2007* |
| **Recommended textbooks and other course materials** | |
| **1** | *Harwood E., Digital CCTV – A security professional's guide, Elsevier, London, New York 2008* |



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|---|---|
| **The author of the programme:** | *dr inż. Marcin Buczaj* |
| **E-mail address:** | *m.buczaj@pollub.pl* |
| **Organisational unit:** | *Department of Computer and Electrical Engineering*<br>*Institute of Electrical Engineering and Electrotechnologies, Lublin University of Technology* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

| | |
|---|---|
| **Course:** | *Building Materials in Energy-Efficient Construction* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK3Aa* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | - |
| Laboratory | - |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – examination, course project – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining knowledge of the energy efficiency criteria for building materials* |
| **CO2** | *Obtaining knowledge of the types and properties of building materials for energy-efficient construction* |
| **CO3** | *Acquiring the ability to rationally select building materials for energy-efficient construction* |
| **CO4** | *Understanding possible uses of different methods and tools for estimating the energy efficiency of buildings* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Knowledge of physics and chemistry of building materials* |
| **2** | *Basic knowledge of the methods applied in selecting building materials for energy-saving construction* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *The student has knowledge of the energy efficiency criteria of building materials* |

| | |
|---|---|
| **LO 2** | *The student has knowledge of the types and properties of building materials for energy-efficient construction* |
| | In terms of skills: |
| **LO 3** | *The student can rationally select building materials for energy-efficient construction* |
| **LO 4** | *The student can understand possible uses of different methods and tools for estimating the energy efficiency of buildings* |
| **LO 5** | *The student can critically evaluate the results of calculations* |
| | In terms of social competence: |
| **LO 6** | *The student is aware of the need to raise their professional and personal competences* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *General information on building materials in energy-effective buildings: key issues and terms* |
| **L2** | *Criteria for the selection of building materials for energy-efficient construction* |
| **L3** | *Life Cycle Assessment (LCA) of building materials* |
| **L4** | *Types of building materials for energy-efficient construction: an overview* |
| **L5** | *Building materials for thermal insulation (mineral and natural based composites, polymers, advanced materials, reflective materials)* |
| **L6** | *Prefabricated building products* |
| **L7** | *Advanced and smart materials for envelopes* |
| **L8** | *Case studies of the application of sustainable building materials in energy-efficient buildings* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Selection of energy-efficient ecological building materials for basic structural elements of single-family houses (or multi-family houses)* |
| **P2** | *Determination of thermal and energy parameters of basic structural elements* |
| **P3** | *Familiarization with open online tools for LCA of buildings depending on selected building materials (Athena Institute software)* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *Hall M. (ed.) Materials for Energy Efficiency and Thermal Comfort in Buildings. Woodhead Publishing Ltd, 2010, 760 p. Part II. Materials and sustainable technologies: improving energy efficiency and thermal comfort in built environment, pp. 175-504.* |
| **2** | *Berge B. The Ecology of Building Materials, 2009, 2nd ed. 448 p.* |
| **3** | *Sustainable Building Technical Manual: Green Building Design, Construction, and Operations. Public Technology, Inc, 1996, 292 p.* |
| **Recommended textbooks and other course materials** | |
| **1** | *Spegel R., Meadows D. Green building materials. A guide to product selection and specification. 2nd ed., John Wiley & Sons, 2006, 361p.* |

| | |
|---|---|
| **2** | *Laustsen J. Energy efficiency requirements in building codes, energy efficiency policies for new buildings. IEA, Information paper, March 2008, 85 p.* |
| **3** | *Bayer C. Gamble M. and Gentry R. AIA Guide to Building Life Cycle Assessment in Practice, The American Institute of Architects, 2010, 193 p.* |
| **4** | *Stanek R., Lipp B. Modeling of buildings using conventional and ecological materials. Evaluation of the eco-performance of buildings. Austrian Institute for Healthy and Ecological Building, 2010, 65 p.* |

| | |
|---|---|
| **The author of the programme:** | *Dr. Eng. Stanislaw Fic Prof. PL, Dr. Eng. Nataliya Lushnikova* |
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| **Organisational unit:** | *Department of Construction* |

**Module/Course Syllabus**

***Civil Engineering***

***Specialization: Civil Engineering Structures and Ecological Engineering***

Master-degree programme

| | |
|---|---|
| **Course:** | *Technologies in Sustainable Construction* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK3Ab* |
| **Year:** | *I* |
| **Semester:** | *1* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | *-* |
| Laboratory | *-* |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – examination, course project – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining knowledge of the key aspects of sustainable construction* |
| **CO2** | *Obtaining knowledge of the basic technologies used in sustainable construction* |

| | |
|---|---|
| **CO3** | *Acquiring the ability to rationally selecting energy-efficient ecological building materials for sustainable Construction* |
| **CO4** | *Understanding possible uses of different methods and tools for estimating the influence of buildings on the environment* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Basic knowledge of building physics* |
| **2** | *Basic knowledge of properties of building materials* |
| **3** | *Basic knowledge of the methods applied in sustainable construction* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *The student has knowledge of the principles and criteria of sustainable construction* |
| **LO 2** | *The student has knowledge of the basic technologies and basic materials used in sustainable construction* |
| | In terms of skills: |
| **LO 3** | *The student can rationally select building materials for sustainable construction* |
| **LO 4** | *The student can understand possible uses of different methods and tools, including computer programmes, for estimating the construction's influence on the environment* |
| **LO 5** | *The student can critically evaluate the results of calculations* |
| | In terms of social competence: |
| **LO 6** | *The student is aware of the need to raise their professional and personal competences* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Key issues concerning sustainable construction: from tradition to innovation and back* |
| **L2** | *Basic technologies applied in sustainable construction* |
| **L3** | *Natural local raw materials and traditional technologies* |
| **L4** | *Recycled and reused products in sustainable construction* |
| **L5** | *Advanced and smart materials and technologies in sustainable construction* |
| **L6** | *Case studies of the application of traditional and advanced technologies in sustainable construction* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Study of sustainable construction technologies for a single family house (or a multi–family house)* |
| **P2** | *Selection of a sustainable technological method for constructing a single-family house (or a multi-family house)* |
| **P3** | *Familiarization with open online tools for LCA of buildings depending on selected building materials and technologies (Athena Institute software)* |

| Required textbooks and other course materials | |
|---|---|
| **1** | *Hall M. (ed.) Materials for Energy Efficiency and Thermal Comfort in Buildings. Woodhead Publishing Ltd, 2010, 760 p. Part II. Materials and sustainable technologies: improving energy efficiency and thermal comfort in built environment, Part III. Application of advanced building materials and design: improving energy efficiency and thermal comfort in built environment, pp. 175-708.* |
| **2** | *Abraham L., Agnello S., Ashkin S.P. et al. Sustainable Building Technical Manual: Green Building Design, Construction, and Operations. Public Technology, Inc, 1996.* |
| **3** | *Spegel R., Meadows D. Green building materials. A guide to product selection and specification. 2nd ed., John Wiley & Sons, 2006, 361p.* |
| **4** | *Pulaski M.H. (Ed.) The Field Guide for Sustainable Construction. Design-Build Institute of America, 2004,312p.* |
| **Recommended textbooks and other course materials** | |
| **1** | *Ahlberg J., Georges E., Norlén M. The potential of hemp buildings in different climates. A comparison between a common passive house and the hempcrete building system. Uppsala Universitet, Uppsala, Sweden, 2014.* |
| **2** | *El Khouli S., John V., Zeumer M. Sustainable Construction Techniques. Detail Green, 2015, 152 p.* |
| **3** | *Elsayed M. Straw Bale is Future House Building Material. Egypt, 2000.* |
| **4** | *Flatau R. Cordwood Construction: Best Practices: A log home building method using renewable resources and time honored techniques: 1. Cordwood Construction Resources, 2012.* |
| **5** | *Hunter K., Kiffmeyer D. Earthbag building. The tools, tricks and techniques. New Society Publishers, 2004, 260 p* |
| **6** | *Myhrman M., MacDonald S.O. Build it with Bales. A Step-by-Step Guide to Straw-Bale Construction. Version Two, 1997.* |
| **7** | *Sutton A., Black D., BRE Walker P. Hemp lime. An introduction to low-impact building materials. Information Paper IP 14/11, University of Bath, United Kingdom, 2011.* |
| **8** | *Walker P. Inaugural Lecture. Grow your own building: the use of earth, hemp and straw in modern construction. BRE Centre for Innovative Construction Materials, University of Bath, United Kingdom, 2009.* |


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|---|---|
| **The author of the programme:** | *Dr. Eng. Stanislaw Fic Prof. PL, Dr. Eng. Nataliya Lushnikova* |
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| **Organisational unit:** | *Department of Construction* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

| | |
|---|---|
| **Course:** | *Environmental Loads* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK4Aa* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *60* |
| Lecture | *30* |
| Classes | *-* |
| Laboratory | *30* |
| Project | *-* |
| **Number of ECTS credits:** | *4* |
| **Form of assessment:** | *Lecture – examination, laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining knowledge within the scope of combination of actions in construction systems, establishing the usable loads; wind, snow and temperature action on engineering structures.* |
| **CO2** | *Gaining the knowledge within the scope of determining other dynamic actions on engineering structures and reducing the dynamic response of these structures.* |
| **CO3** | *Gaining the skills within the scope of collecting environmental loads for engineering structures as well as determining internal forces in roller systems for a full combination of environmental actions.* |
| **CO4** | *Gaining the skills at determination of the dynamic response for complex structures for different cases of dynamic loads as well as determining the parameters of a tuned mass damper.* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having knowledge and abilities in the field of mathematics which enable for solving engineering problems* |
| **2** | *Having knowledge and abilities within the scope of theoretical and mechanical engineering* |
| **3** | *Having knowledge and abilities in the field of computational methods* |

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|---|---|
| **4** | *Having knowledge and abilities in the field of computer methods* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows the probabilistic, theoretical principles of determining the combination of loads.* |
| **LO 2** | *Knows the theoretical principles of determining usable loads; wind, snow and temperature action as well as has the knowledge on the standardisation records.* |
| **LO 3** | *Knows the theoretical principles referring to the analysis of systems subjected to dynamic actions as well as the ways to reduce the dynamic response of systems.* |
| | In terms of skills: |
| **LO 4** | *Is able to define usable loads, wind, snow and temperature loads for different types of engineering structures.* |
| **LO 5** | *Can define a full combination of environmental loads as well as determine an envelope of internal forces from the assumed environmental loads.* |
| **LO 6** | *Can perform the dynamic analysis subjected to actions variable in time as well as select the parameters of a tuned mass damper for a given case of dynamic excitation.* |
| | In terms of social competence: |
| **LO 7** | *Is responsible for reliability of obtained results of own research and their interpretation.* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Probabilistic theoretical principles of determining the combination of actions, the discussion of EUROKOD 0 standard (PN-EN 1990)* |
| **L2** | *Usable loads and wind action. The discussion of EUROKOD 1-1 standard (PN-EN 1991-1-1) as well as EUROKOD 1-4 (PN-EN 1991-1-4)* |
| **L3** | *Snow and temperature action. The discussion of EUROKOD 1-3 standard (PN-EN 1991-1-3) as well as EUROKOD 1-5 (PN-EN 1991-1-5)* |
| **L4** | *Matrix equations of motion of construction systems as well as the ways to develop a damping matrix.* |
| **L5** | *Dampers of vibrations* |
| **L6** | *Dynamic analysis of construction systems with tuned mass dampers attached.* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Collection of environmental loads on one-storey buildings or multi-storey buildings as well as determining an envelope of internal forces from assumed loads.* |
| **Lab2** | *Collection of environmental loads on a support system (chimney). The dynamic analysis of a system subjected to actions variable in time as well as designing tuned mass damper for given case of dynamic excitation.* |

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| **Organisational unit:** | *Department of Structural Mechanics* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

| | |
|---|---|
| **Course:** | *Aerodynamics of Engineering Structures* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK4Ab* |
| **Year:** | *I* |
| **Semester:** | *2* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *60* |
| Lecture | *30* |
| Classes | *-* |
| Laboratory | *30* |
| Project | *-* |
| **Number of ECTS credits:** | *4* |
| **Form of assessment:** | *Lecture – examination, laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Gaining knowledge about: dynamic characteristics of structures (natural frequencies, mode shapes, damping, impulse response function, transmittance); Wind Engineering and, in particular: the basics of the theory of stochastic processes, characteristics of wind in the atmospheric boundary layer as a random process, the wind flow around bluff-bodies, dynamic wind actions on structures, aerodynamic phenomena, aerodynamic interference, Standards issues related to the wind actions on structures, pedestrians wind comfort, research in wind tunnels and in full scale, similarity criteria, aerodynamic damping, basics of Computational Fluid Dynamics.* |
| **CO2** | *Gaining the ability to solve engineering problems connected with wind loads on structures* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having knowledge and abilities in the field of structural mechanics* |
| **2** | *Having knowledge and abilities in the field of strength of materials* |
| **3** | *Having knowledge and abilities in the field of computational methods* |
| **4** | *Having knowledge and abilities in the field of computer methods* |
| **5** | *Having knowledge and abilities in the field of steel structures* |
| **6** | *Having knowledge and abilities in the field of reinforced concrete structures* |

| Learning outcomes (LO) | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Student has a theoretical knowledge about the wind actions on people and structures* |
| **LO 2** | *Student has a knowledge about modern methods of assessing wind actions* |
| **LO 3** | *Student has a knowledge about existing standards in the field of wind actions* |
| | In terms of skills: |
| **LO 4** | *Student is able to apply the existing standards in the field of wind actions to advanced engineering structures* |
| **LO 5** | *Student is able to solve problems associated with wind actions on engineering structures beyond standards contents* |
| **LO 6** | *Student is able to model and apply loads to advanced engineering structures using a computer programs based on a Finite Element Method* |
| | In terms of social competence: |
| **LO 7** | *Student is responsible for the accuracy and interpretation of the results of its work* |

| Course content | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Introduction to wind engineering* |
| **L2** | *Basis of theory of stochastic processes. The characteristics of wind in the atmospheric boundary layer* |
| **L3** | *Flow around bodies with different cross sections* |
| **L4** | *Dynamic impact of wind on structures, aerodynamic phenomena* |
| **L5** | *Wind action on engineering structures in Standards* |
| **L6** | *Similarity criteria and model tests in wind tunnels* |
| **L7** | *Issues of wind comfort* |
| **L8** | *Theoretical basis of Computational Fluid Dynamics* |
| **L9** | *Damping techniques* |
| **Form of classes – laboratories (Lab)** | |
| | Course content |
| **Lab1** | *Solution to a specific engineering problem, for example: steel or reinforced concrete chimney, high-rise building, the bridge or footbridge, etc. Gathering wind effects according to different Standards, and creating model of a structure in the FEM. Running static, modal and dynamic analyses under considered loads* |

| Required textbooks and other course materials | |
|---|---|
| **1** | *Holmes J.D., Wind Loading of Structures, Taylor & Francis, 2007* |
| **2** | *Simiu E., Scanlan R.H. Wind effects on structures. Fundamentals and applications to design* |
| **Recommended textbooks and other course materials** | |
| **1** | *Dyrbye C., Hansen S.O., Wind Loads on Structures, Wiley, 1997* |

| | |
|---|---|
| **The author of the programme:** | *Dr. Tomasz Lipecki, MSc. Paulina Jamińska* |
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| **Organisational unit:** | *Department of Structural Mechanics* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

| | |
|---|---|
| **Course:** | *Low Energy Buildings* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK5Aa* |
| **Year:** | *II* |
| **Semester:** | *3* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | - |
| Laboratory | - |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – examination, laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *Obtaining knowledge about architectural and structural solutions, installations for ventilation, heating and utility hot water used in low-energy buildings.* |
| **CO2** | *Obtaining skills in solving engineering problems connected with the design of building form and partitions aiming at diminishing heat losses and providing suitable heat gains from solar radiation.* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *Having knowledge of mathematics, necessary for solving basic engineering problems* |
| **2** | *Having knowledge of building physic, general building construction and installation systems, necessary for designing building elements and partitions.* |

| Learning outcomes (LO) | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *Knows the definitions and characteristics of low-energy buildings.* |
| **LO 2** | *Knows the rules of choosing the location and form of low-energy buildings.* |
| **LO 3** | *Knows the recommendations for designing opaque and transparent partitions in low-energy buildings.* |
| **LO 4** | *Knows the capabilities and methods of acquiring solar energy, characterizes active and passive solar building elements.* |
| **LO 5** | *Knows the installations for ventilation, heating and utility hot water used in low-energy buildings.* |
| | In terms of skills: |
| **LO 6** | *Is able to calculate the elements of building's energy balance.* |
| **LO 7** | *Is able to assess the construction of building's partitions and construction joints, taking into account their resultant insulating properties.* |
| **LO 8** | *Is able to assess the construction of glazed elements, taking into account capability of acquiring solar energy.* |
| | In terms of social competence: |
| **LO 9** | *Is responsible for reliability of the calculation results and their interpretation.* |
| **LO 10** | *Is aware of the need to raise the professional and personal competences.* |

| Course content | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Renewable and non-renewable energy sources. The structure of energy demand in buildings. Definitions and characteristics of low-energy buildings.* |
| **L2** | *Influence of location, form and functional arrangements on the heating demand.* |
| **L3** | *Construction of opaque building partitions in low-energy buildings. Solutions allowing to minimize thermal bridges. Requirements concerning airtightness of the building's envelope.* |
| **L4** | *Windows in low-energy buildings. Factors influencing their thermal and optical properties.* |
| **L5** | *Passive and active systems of solar energy conversion.* |
| **L6** | *Installations for ventilation, heating and utility hot water used in low-energy buildings.* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Calculation of heat losses through the outer shell of a building, taking into account different structural solutions. Evaluation of the effect of thermal bridges on the resultant heat loss coefficients.* |
| **P2** | *Calculation of heat losses and solar gains through the windows, taking into account different structural solutions.* |
| **P3** | *Calculation of ventilation heat losses. Evaluation of internal heat gains.* |

| | |
|---|---|
| **P4** | *Energy balance of a building. Assessment of the influence of particular elements on the energy demand.* |

| **Required textbooks and other course materials** | |
|---|---|
| **1** | *R. Hastings, M. Wall: "Sustainable Solar Housing. Strategies and Solutions", Earthscan, London 2007.* |
| **2** | *R. Hastings, M. Wall: "Sustainable Solar Housing. Exemplary Buildings and Technologies", Earthscan, London 2007.* |
| **3** | *E. Dean: "Energy Principles in Architectural Design", California Energy Commission, California 1981.* |
| **Recommended textbooks and other course materials** | |
| **1** | *B. Sørensen: "Renewable Energy", Elsevier Science 2004.* |
| **2** | *V. Quaschning: "Understanding Renewable Energy Systems", Earthscan, London 2005.* |
| **3** | *J. Duffie, W. Beckman: "Solar Engineering of Thermal Processes".* |

| | |
|---|---|
| **The author of the programme:** | *PhD eng. Magdalena Grudzińska, PhD eng. Anna Życzyńska* |
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| **Organisational unit:** | *Department of General Constructions* |

**Module/Course Syllabus**
***Civil Engineering***
***Specialization: Civil Engineering Structures and Ecological Engineering***
Master-degree programme

| | |
|---|---|
| **Course:** | *Passive Buildings* |
| **Type of the course:** | *Elective* |
| **Course code:** | *IIWK5Ab* |
| **Year:** | *II* |
| **Semester:** | *3* |
| **Form of the degree programme:** | *Full-time* |
| **Form of classes and number of hours per semester:** | *30* |
| Lecture | *15* |
| Classes | - |

| | |
|---|---|
| Laboratory | - |
| Project | *15* |
| **Number of ECTS credits:** | *2* |
| **Form of assessment:** | *Lecture – examination, laboratory – assessment* |
| **Course language:** | *English* |

| **Course objective (CO)** | |
|---|---|
| **CO1** | *To acquire knowledge of architectural, material and construction solutions applied in passive house design* |
| **CO2** | *To gain skills of using sources of information, formulating tasks and choosing engineering techniques employed in passive house design* |
| **CO3** | *To acquire a basic knowledge of technical solutions for fitting out passive houses with systems of heating, producing hot water, ventilating and cooling* |

| **Prerequisites in terms of knowledge, skills and other competencies** | |
|---|---|
| **1** | *The student has knowledge and skills of architectural and construction design, which allows him/her to use various engineering techniques in passive house design* |
| **2** | *The student has a basic knowledge of town planning, materials science, building installations, technical infrastructure of towns, construction law, and energy-saving building design* |

| **Learning outcomes (LO)** | |
|---|---|
| | In terms of knowledge: |
| **LO 1** | *The student has an extended knowledge of shaping the human environment with account taken of the relationships between people, architectural structures and the surrounding space* |
| **LO 2** | *The student knows the rules for designing passive houses and planning towns in the context of sustainable development* |
| **LO 3** | *The student knows the materials and technologies applied in modern building engineering* |
| **LO 4** | *The student knows the technical solutions for heating, cooling, hot water production, and ventilation systems in passive houses* |
| **LO 5** | *The student knows the rules for determining the value of indices of demand for building's final and primary energy* |
| | In terms of skills: |
| **LO 6** | *The student obtains information from literature, databases and other adequately selected sources; both in Polish and in the foreign language which is regarded as the language of international communication for architecture and town planning* |
| **LO 7** | *The student can assess the usefulness and possibility of applying modern techniques, technologies and materials* |
| **LO 8** | *The student can shape the human environment taking account of the relationships between people, architectural structures and the surrounding space in the context of sustainable development.* |

| | |
|---|---|
| | In terms of social competence: |
| **LO 9** | *The student can supplement and broaden his/her knowledge of modern tendencies in architectural design and town planning* |
| **LO 10** | *The student recognizes the necessity to increase his/her professional and personal competencies* |

| **Course content** | |
|---|---|
| **Form of classes – lectures (L)** | |
| | Course content |
| **L1** | *Evaluation of the passive house's standard on the basis of energy indices* |
| **L2** | *Influence of the location, shape of the building and functional arrangement of rooms on heating demand* |
| **L3** | *Examples of certified passive houses* |
| **L4** | *Critical analysis of the chosen design problems in passive houses* |
| **L5** | *Examples of the improvement in energy effectiveness in buildings which are in use* |
| **L6** | *Application of technical solutions which use renewable energy in the systems of heating and hot water production* |
| **L7** | *Installation of the systems of heating, hot water production, ventilation and cooling in passive houses* |
| **L8** | *Determination and requirements of technical specifications in respect of final and primary energy indices for different buildings* |
| **Form of classes – project (P)** | |
| | Course content |
| **P1** | *Elaboration of introductory assumptions for a newly-designed passive house* |
| **P2** | *Construction design of a passive house or adaptation of an architectural structure in use into passive one* |

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