Faculty: Civil Engineering;
Course of studies: Civil Engineering
Cycle: Master
Course offer for Winter semester

Lp.	Course Code	Course	Hours	Sem	ECTS	Syllabus
1	1080-BUKBD-MSA-0407	Building Fire Safety	30 h (15 h Lecture 15 h Project)	1	2	**Name of course: Building Fire Safety**
2	1080-BUKBD-MSA-0305	Concrete Structures	45 h (15 h Lecture 30 h Project)	1	4	**Name of course: Concrete Structures**
3	1080-BUKBD-MSA-0402	Engineering of Building Materials	45 h (30 h Lecture 15 h Project)	1	2	**Name of course: Engineering of Building Materials**
4	1080-BUKBD-MSA-0308	Finite Element Method	30 h (15 h Lecture 15 h Project)	1	3	**Name of course: Finite Element Method**
5	1120-BUKBD-MSA-9300	Mathematics - Selected Issues	75 h (30 h Lecture 45 h Exercise)	1	5	**Name of course: Mathematics - Selected Issues**
6	1080-BUKBD-MSA-0306	Metal Structures	45 h (15 h Lecture 30 h Project)	1	4	**Name of course: Metal Structures**
7	1080-BUKBD-MSA-0303	Theory of Elasticity and Plasticity I	60 h (30 h Lecture 15 h Exercise 15 h Project)	1	4	**Name of course: Theory of Elasticity and Plasticity I**
8	1080-BUKBD-MSA-0401	Timber Structures	45 h (15 h Lecture 15 h Exercise 15 h Project)	1	3	**Name of course: Timber Structures**
9	1080-BU000-MSA-0201	Building Law	15 h (15 h Lecture)	1	2	**Name of course: Building Law**
10	1180-BU000-MSA-9202	Intellectual Property Law	15 h (15 h Lecture)	1	1	**Name of course: Intellectual Property Law**
11	1080-BUKBD-MSA-0408	Computer-aided Design of Structures	45 h (45 h Computer lessons)	3	2	**Name of course: Computer-aided Design of Structures**

12	1080-BUKBD-MSA-0307	Design Methodology of Construction Processes	45 h (15 h Lecture 30 h Project)	3	2	**Name of course: Design Methodology of Construction Processes**
13	1080-BUKBD-MSA-0410	Industrial Metal Construction	45 h (15 h Lecture 30 h Project)	3	3	**Name of course: Industrial Metal Construction**
14	1080-BU000-MSA-0301	Decision Making and Negotiation Theory	15 h (15 h Exercise)	3	1	**Name of course: Decision Making and Negotiation Theory**

Name of course: Building Fire Safety

Type of course: Compulsory
Level of education: Second cycle studies
Programme: Civil Engineering
Group of courses: Obligatory
Code of course: 1080-BUKBD-MSA-0407
Number of ECTS credits: 2
Language of course: English
Form of didactic studies and number of hours per semester:

Lecture:	15h
Project type of course:	15h

Preliminary requirements:
No formal requirements, however students should have basic knowledge about fire safety of buildings and knowledge about structural designing of concrete, steel and timber structures.

Purpose of course:
Improvement of basis of fire safety engineering.

Contents of education:
Lectures: 1. Dangerous of fire (examples). 2. Legal regulations 3. Fire in buildings, fire load density. 4. Euro-classes, fire tests (R resistance, I insulation, E Integrity). 5. Influence of fire on concrete and steel mechanical properties. Phenomenons occurring in concrete heated up to fire temperature. 6. Fire as an accidental design situation. 7. 500C Isotherm Method. 8. Design of steel structures for fire resistance. 9. Assessment structures after fire. Design: 1. Design of simple supported beam or slab for fire resistance (500C Isotherm Method) 2. Design of simple steel structural element for fire resistance.

Methods of evaluation: Test of lectures, project defence.
Exam: no
Literature:
Eurocodes: 1990, 1991-1-2, 1992-1-2, 1993-1-2, 1995-1-2 Buchanan A.H.: Structural Design for Fire Safety. John Wiley and Sons Ltd. 2004. Lennon T.: Structural Fire Engineering. ICE Publishing 2011. fib bulletins: fib Bulletin 38/2007. Fire design for concrete structures – materials, structures and modelling. fib Bulletin 46/2008. Fire design of concrete structures – structural behaviour and assessment. fib Bulletin 54/2010 – Structural concrete; Textbook on behaviour, design and performance; Chapter 6: Design of concrete buildings for fire resistance Kowalski R.: Calculations of reinforced concrete structures fire resistance. Architecture Civil Engineering Environment. Journal of the Silesian University of Technology, Vol. 2, No. 4/2009, p. 61-69. Kowalski R.: Mechanical properties of concrete subjected to high temperature. Architecture Civil Engineering Environment. Journal of the Silesian University of Technology, Vol. 3, No. 2/2010, p. 61-70. Kowalski R., Kisieliński R.: On mechanical properties of reinforcing steel in RC beams subjected to high temperature. Architecture Civil Engineering Environment. Journal of the Silesian University of Technology, Vol. 4, No. 2/2011, p. 49-56. Available on the website www.acee-journal.pl

General academic profile - knowledge

Student has obtained basic knowledge about factors determining the fire resistance of structural elements. Has knowledge about the impact of fire on structures and about assessing the structure condition after fire.

Student has the knowledge about how to determine the fire resistance of structural elements.

General academic profile - skils

Student is able to define basic steps of complex structural systems analysis in fire.

Student is able to provide required fire resistance for structural elements, on the base of consideration of fire as an accidental design situation.

General academic profile - social competences

Student is aware of the consequences of underestimation of fire safety and fire protection problems.

Name of course: Concrete Structures

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory
Code of course: 1080-BUKBD-MSA-0305

Number of ECTS credits: 4

Language of course: English

Form of didactic studies and number of hours per semester:

Lecture:	15h
Project type of course:	30h

Preliminary requirements:

There are no formal prerequisites. It is assumed that students possess basic knowledge of reinforced concrete theory and design rules as well as strength of materials and building mechanics.

Purpose of course:

Extend knowledge about design of the reinforced concrete structures using Eurocodes including design of basic reinforced concrete elements,and "strut and tie" method.

Contents of education:

Lectures: Design of the reinforced concrete structures using Eurocodes including design of basic reinforced concrete elements, prestressed structures and "strut and tie" method. Lab/project classes: Preparation of few short projects concerning design of basic structural reinforced concrete.

Methods of evaluation:

Lectures: results from tests. Project: results from homework/projects. Final grade is calculated as a mean of the grades from the project class and the exam.

Exam: no

Literature:

[1] EN-1990:2007. Eurocode 0: Basis of structural design; [2] EN-1991-1-1:2004. Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight and imposed loads; [3] EN-1992-1-1:2004. Eurocode 2. Design of concrete structures. Part 1-1: General – Common rules for building and civil engineering structures; [4] Class notes from lectures and project classes.

General academic profile - knowledge

The graduate knows rules for design and detailing of structural elements.

General academic profile - skils

The graduates are able to design selected reinforced concrete elements in accordance with design codes and guidelines.

General academic profile - social competences

The graduates understand responsibility of an Engineer, are reliable while presenting and interpreting their results.

Verification: tests, homeworks

Name of course: Engineering of Building Materials

Type of course:Compulsory

Level of education:Second cycle studies

Programme:Civil Engineering

Group of courses:Obligatory

Code of course:1080-BUKBD-MSA-0402

Number of ECTS credits:2

Language of course: English

Form of didactic studies and number of hours per semester:

- Lecture 30h
- Exercise type of course 15h

Preliminary requirements:

Knowledge of chemistry of construction materials and knowledge of the general characteristics of different groups of building materials. Courses passed : Building Chemistry, Building Materials I and II, Concrete Structures, Metal Structures.

Purpose of course:

Explanation of issues related to the relationship: composition - structure-properties-application, ability of looking for solutions taking into account the material and technological relationship "microstructure - property - the destination of a building" and its impact on the stability of building structures, and the inclusion of these relationships in the design process of buildings.

Contents of education:

The main contents of the course include: defining terms related to Engineering of Building Materials - EBM, including the role and tasks of EBM and distinguishing features the EBM among materials science and engineering. Feedback man - material - technology - construction - ecology as an indicator issues IMB. Model Cloth: composition - structure - properties - applications. The principle of sustainable development in respect of buildings. Division of composite building materials. Controlling the properties of composite building materials. A function of material applied to building materials. Polymers and polymer composites in construction. Metals and alloys in construction. Methods of designing experiments and analyzing the results. Methods of materials design and optimization of materials. Methods of describing the structure of the building materials; the use of electron microscopy and image analysis and stereology fractography. Basic requirements for buildings in the light of European directives. Durability and reliability of material solutions. Causes damage to building structures. Principles of diagnosis structures using destructive methods, low- and non-destructive. Design principles repair, surface protection and strengthening of building structures.

Methods of evaluation:

• PowerPoint presentation and a report on a chosen topic in the field of new materials and material and structural conditions of formation properties of composite building materials. • The written exam on topics presented during lectures.

Exam: yes

Literature:

Bibliography: [1] Ashby M.F. and Jones, D.R.H., Engineering Materials 1, Second Edition.Butterworth Heineman, Oxford, 1996. [2] Ashby M.F. and Jones, D.R.H., Engineering Materials 2, Second Edition.Butterworth Heineman, Oxford, 1998. [3] Neville, A. M., Properties of concrete, John Wiley & Sons, 2012, 884pp; [4] Czarnecki L., Łukowski P., Polymer-cement concretes, Cement Wapno Beton, 15 (5), 2010, 243-258; available on www.icpic-community.org [5] Czarnecki L., Polymer concretes, Cement Wapno Beton, 15 (2) 2010, 63-85; available on www.icpic-community.org [6] Kurzydłowski K.J., Ralph B. „Quantitative description of material microstructure"; CRC, New York, 1995 [7] Wojnar L., Image Analysis: Applications in materials engineering, CRC, New York, 1995. [8] Czarnecki L. (ed), The International Journal for Restoration of Buildings and Monuments, Vol. 13 (3), 2007, 141-151; [9] Czarnecki L., Garbacz A. (eds), Adhesion in Interfaces of Building Materials: a Multi-scale Approach, seria Advances in Materials Science and Restoration AMSR No. 2, Aedificatio Publishers, 2007;

Website of the course: http://pele.il.pw.edu.pl/moodle/

Effects of education

General academic profile - knowledge

Student can indicate the basic elements of the microstructure in the case of basic types of composite building materials and analyze the impact of the composition and microstructure on their technical characteristics and durability.
Verification: Exam
Field of study related learning outcomes: K2_W10, K2_W18_KB
Area of study related learning outcomes: P7U_W, I.P7S_WG.o, III.P7S_WG

Student can choose the method of analysis of the microstructure basic types of building materials.
Verification: exam
Field of study related learning outcomes: K2_W08, K2_W12
Area of study related learning outcomes: P7U_W, I.P7S_WG.o, I.P7S_WK

Student can indicate the reason causes corrosion of composite building materials and analyze their impact on the sustainability of buildings. He knows the basic methods for assessing the status of the building structure.
Verification: exam
Field of study related learning outcomes: K2_W09, K2_W13, K2_W14_KB, K2_W18_KB
Area of study related learning outcomes: P7U_W, I.P7S_WG.o, III.P7S_WG, I.P7S_WK, III.P7S_WK

General academic profile - skils

The student is able to acquire information from literature databases and other carefully selected sources, also in English; can integrate the information obtained, to make them interpret and critically evaluate and draw conclusions and formulate and fully justify opinions; can prepare a scientific study and a summary in English.

Verification: Content of ppt presentation and report on the selected topic. The way of presentation on exercises.
Field of study related learning outcomes: K2_U21_KB, K2_U04, K2_U06, K2_U08, K2_U09, K2_U12, K2_U18_KB
Area of study related learning outcomes: I.P7S_UW.o, P7U_U, I.P7S_UO, I.P7S_UU

General academic profile - social competences

Student is able to work in a group in collecting data and preparing the presentation and report on selected issues. It is aware of the importance and understanding of non-technical aspects and effects of engineering activities, including its impact on the environment, and the related responsibility for decisions. Student understands the need for learning throughout life.
Verification: Content of ppt presentation and report on the selected topic. The way of presentation on exercises.
Field of study related learning outcomes: K2_K02, K2_K03, K2_K04, K2_K05, K2_K06, K2_K07
Area of study related learning outcomes: P7U_K, I.P7S_KK, I.P7S_KO

Name of course: Finite Element Method

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0308

Number of ECTS credits: 3

Language of course: English

Form of didactic studies and number of hours per semester:

Lecture15h

- Project type of course 15h

Preliminary requirements:

Equilibrium equations, principle of virtual work, strain-displacement relations, constitutive equations, calculating partial derivatives and integrals of the functions, matrix equations and other elementary skills in linear algebra. Elementary skills in differential calculus. Comprehension of the main laws of structural mechanics in static scope. The compulsory completion of the course on mechanics of structures II.

Purpose of course:

A thorough understanding of the basics of finite element method and different aspects of numerical calculations in static analysis of elastic bodies: the choice of elements, finite element mesh generation, variational equilibrium equations, calculation of the stiffness matrix, introduction of the boundary conditions, estimation errors of numerical solutions, etc.

Contents of education:

Finite Element Method (FEM) – introduction to the terminology and basic definitions that are required for the development of the finite element method, example of a one-dimensional, two-point boundary value problem – an elastic string, scalar-product (or inner-product), the main properties of scalar-product: additivity, homogeneity, symmetry, positive definiteness, Schwarz inequality, Lebesgue integrals, definition of the functional representing the total potential energy, principle of minimum potential energy, principle of virtual work, mathematical prove of the both equivalences, Mixed Finite Element Method (MFEM) – short introduction to the terminology and basic definitions that are required for the development of the mixed finite element method. Partition of the one-dimensional domain into subintervals, finite element space, Galerkin finite element method, Ritz finite element method, basis (hat or chapeau) functions, stiffness matrix and the load vector, proof that stiffness matrix is positive definite, short the derivation of an error estimate for the finite element method. Stationary problem in two dimensions - an elastic membrane fixed at its boundary and subject to a transversal load, principle of virtual work (Galerkin variational form), Green's formula, divergence theorem, basis functions for Poisson equation, element oriented versus node oriented technique of assembling of the global stiffness matrix and global load vector, allocation matrix, boundary conditions. Finite Element Spaces, triangle finite elements, space of linear functions, space of quadratic functions, definition of polynomials – Pascal triangle, methods of defining the local basis functions, conforming finite element, Argyris triangle, nonconforming finite elements, Crouzeix-Raviart triangle finite element, Comparison and visualisation of the numerical solutions based on the conforming and nonconforming triangle finite element, rectangle finite elements, finite element spaces in three dimensions, Pascal pyramid, tetrahedron, linear, quadratic, cubic polynomials, rectangular parallelepiped, prism, introduction to the isoparametric finite elements, master (reference) finite element versus real finite elements, definitions of the geometry mappings relating both types of elements, differentiation and integration for isoparametric elements, derivation of the stiffness matrix and the load vector for a triangular element in the Poisson equation, short introduction and example of mixed finite element approximation for Poisson equation. An Introduction to Continuum Mechanics, main notation and definitions, 2D and 3D case, Cauchy stress tensor, unit outer normal vector along the boundary, density of the applied surface force per unit length (area), density of the applied body force per unit area (volume), displacement vector, local differential equilibrium equation, traction boundary conditions, symmetry conditions, displacement boundary conditions, strain tensor, constitutive equations: relation between stresses and strains – Hooke's law, fundamental equivalence of the local differential formulation and principle of virtual work (Galerkin variational form), triangular isoparametric element and cubic (C3D8) isoparametric element in 2D and 3D linear theory of elasticity, changing the domain of integrations, calculating the norm of the normal outer vector, calculating the gradients of the integral functions expressed by partial derivatives with respect to the variables parameterizing the master element, derivation of the equilibrium equations in the finite element method for the problem of statics of two- and three-dimensional bodies, detailed discussion of the calculation of the elements of the stiffness matrix and the load vector in two dimensional, linear elasticity, detailed discussion of the aggregation of the components of the stiffness matrix and the load vector of one finite element to the global stiffness matrix and the global load vector of the entire structure, short discussion of methods for taking into account displacement boundary conditions, discussion of the implementation of the finite element method on the basis of own program in C++ for two-dimensional static problem along with a demonstration of data preparation for a commercial ABAQUS system and comparison of numerical results obtained from both programs.

Methods of evaluation:

Colloquium no 1 and 2 checks the understanding of the fundamentals of the FEM method and project - homework (static numerical calculations of mebrane and 2D plate structure on the base of the original program in C ++ and Python implemented by Sławomir Czarnecki).

Exam: no

Literature:

[1] Zienkiewicz O.C.: The Finite Element Method. McGraw-Hill, 1977; [2] Bathe K.J.: Finite Element Procedures in Engineering Analysis, Prentice-Hall, 1982; [3] Rakowski G., Kacprzyk Z.: Metoda Elementów Skończonych w Mechanice Konstrukcji, OWPW, 2016; [4] Ciarlet P. G.: The Finite Element Method for Elliptic Problems, SIAM, Philadelphia, 2002; [5] Czarnecki S.: Finite Element Method. Part 1-8, lectures & examples in *.pdf format accessible at: MicrosoftTeams

Notes:

The course prepares the students (from a theoretical and partially practical point of view) to the course on computational modelling delivered in succeeding semesters.

Effects of education

General academic profile - knowledge

Charakterystyka K2_W04

The students understand the computer methods in mechanics based on the finite element formulation.
Verification: Colloquium (test) no 1, 2
Field of study related learning outcomes: K2_W04
Area of study related learning outcomes: I.P7S_WG.o, P7U_W

General academic profile - skils

Charakterystyka K2_U03

The students know how to calculate the global stiffness matrix and the global vector of loadings, how to solve numerically the defined this way the linear system of algebraic equations and how to calculate the displacement vector field and stress tensor field.
Verification: homework.
Field of study related learning outcomes: K2_U03
Area of study related learning outcomes: P7U_U, I.P7S_UW.o, III.P7S_UW.o

General academic profile - social competences

Charakterystyka K2_K01

The students is able to co-operate in group.
Verification: Interviews with students during consultations, homework (project - design work) and observation of the students.
Field of study related learning outcomes: K2_K02, K2_K04
Area of study related learning outcomes: P7U_K, I.P7S_KK

Name of course: Mathematics - Selected Issues

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1120-BUKBD-MSA-9300

Number of ECTS credits: 5

Language of course: English

Form of didactic studies and number of hours per semester:

- Lecture30h
- Exercise type of course 45h

Preliminary requirements:

Calculus I, II and Linear Algebra.

Purpose of course:

To get knowledge of mathematics enabling to formulate and solve problems in the field of civil engineering using mathematical tools.

Contents of education:

1. Fourier series, Dirichlet's Th., approximation of function with Fourier series. Half-range sine and cosine expansions. 2. Ordinary differential equations with constant and variable coefficients. Euler's equation. 3. Quasi-linear 1st order partial differential equations. Characteristic strips. General a particular integral surfaces. 4. Higher-order linear partial differential equations. Classifications of PDEs and reduction to the canonical form. 5. Method of d'Alembert for hyperbolic equations with initial conditions (unbounded string). Equations for free and forced vibrations. 6. Fourier's method for hyperbolic equations – for free, forced and damped vibrations. 7. Fourier's method for parabolic equations – heat conduction equation. Homogeneous and inhomogeneous equations. Temperature distribution in the insulated and non-insulated rod. 8. Fourier's method for elliptic equations. Laplace's equation over rectangle and disc. 9. One-dimensional random variables, cumulative distribution function, and their properties. Discrete and continuous random variables. Mean value, variance, modal value, median, and moments. 10. Multidimensional random variables (with special case n=2). Independent random variables and marginal distribution. 11. Limit Theorem 12. Mean value and variance estimators. Maximum likelihood method. 13. Confidence interval for mean value and variance. Necessary quantity of measurements for sampling. 14. Testing the parametric hypotheses with respect to mean value and variance. 15. Testing the hypotheses for distribution. Chi-square (and independence) test. Median's test 16. Regression analysis.

Methods of evaluation:

Tests: I-III carries 40% . Examination: written exam carries 60%. Both components have to be passed on at least 20% and 30% level, respectively.

Exam: yes

Literature:

Advanced Modern Engineering Mathematics, Glyn James, Pearson, 2004.

Effects of education

General academic profile - knowledge

Charakterystyka W1

Can formulate problems in the field of civil engineering using mathematical tools.
Verification: Exam, tests.
Field of study related learning outcomes: K2_W01
Area of study related learning outcomes: P7U_W, I.P7S_WG.o

General academic profile - skils

Charakterystyka U1

Can solve problems in the field of civil engineering using mathematical tools.
Verification: Tests, Exercises.
Field of study related learning outcomes: K2_U01, K2_U02
Area of study related learning outcomes: P7U_U, I.P7S_UW.o

Charakterystyka U2

Solving problems using mathematical tools.
Verification: Exercises.
Field of study related learning outcomes: K2_U01, K2_U06
Area of study related learning outcomes: P7U_U, I.P7S_UW.o

General academic profile - social competences

Charakterystyka K1

Has creativity skills in solving problems.
Verification:
Field of study related learning outcomes: K2_K02, K2_K03, K2_K04
Area of study related learning outcomes: P7U_K, I.P7S_KK

Name of course: Metal Structures

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0306

Number of ECTS credits: 4

Language of course: English

Form of didactic studies and number of hours per semester:

- Lecture 15h
- Project type of course 30h

Preliminary requirements:

Pre-requisites – full knowledge and understanding of the courses Metal Structures I and II of the 1st-degree study.

Purpose of course:

The aim of the course is to equip a student with adequate background information and practical experience in designing of steel skeletal structures taking into account the joint deformability and resistance. The student is expected to demonstrate the basic knowledge and understanding of rules applied in Eurocodes for the calculation of frame beam-to-column joint properties and of column base-to-foundation joint properties. Practical knowledge will be checked through the completion of the project of steel semi-rigid framework.

Contents of education:

1. Textbooks and structural codes. Basic terminology and nomenclature for steel joints and connections. 2. Structural joints and modelling of joint moment-rotation characteristics. 3. Methods of analysis of steel frameworks - elastic vs inelastic (MLA vs MNA), geometrically linear vs geometrically nonlinear (GLA vs GNA). Rules for engineering practice. 4. Calculation of buckling length for compression members of semi-rigid frameworks. 5. Types of steel frame beam-to-column joints – welded joints, bolted joints, unstiffened joints, and stiffened joints. 6. Calculation of beam-to-column joint resistance and initial stiffness - design examples of typical joints. 7. Classification of beam-to-column joints by stiffness, resistance and rotation capacity - examples of classification. 8. Calculation of column base joint resistance and initial stiffness - design examples of typical joints. 9. Classification of column base joints - examples. 10. Determination of the beam-to-column joint moment-rotation characteristic – exact curvilinear and simplified piecewise linear. Design project. Design of a frame with unstiffened beam-to-column joints.

Methods of evaluation:

For the part of the course related to lectures, a satisfactory mark for the test dealing with steel semi-continuous frameworks and calculation of semi-rigid joint properties, and for the project part – project submitted and defended within the semester with a mark to be at least satisfactory. The above-stated marks contribute to the course credit that is an average of two components, namely marks for the class test and for the project.

Exam: no

Literature:

[1] SIMOES DA SILVA L., SIMOES R., GERVASIO H.: Design of steel structures. ECCS Eurocode Design Manuals, Ernst&Sohn, Wiley, Portugal 2010. [2] HOGAN T.J., THOMAS I.R.: Design of Structural Connections. 4th Edition, Australian Institute of Steel Construction, Sydney 1994. [3] GARDNER L., NETHERCOT D.A.: Designers' Guide to EN 1993-1-1. Eurocode 3: Design of Steel Structures. Thomas Telford, London 2005. [4] Set of Eurocodes (Eurocode 0, Eurocode 1, Eurocode 3).

Effects of education

General academic profile - knowledge

Charakterystyka W1

A graduate knows the design principles of selected frame structures with semi-rigid joints.
Verification: Passing a test related to the scope of lectures. Consultations of the project (obligatory min. 3 times). Submission and defence of the project prepared during one semester.
Field of study related learning outcomes: K2_W09, K2_W14_KB, K2_W15_KB
Area of study related learning outcomes: P7U_W, I.P7S_WG.o, I.P7S_WK, III.P7S_WK

Charakterystyka W2

The graduate has extensive knowledge on design, construction and exploitation of selected building and engineering structures to the extent consistent with the profile of specialization.
Verification: Passing a test related to the scope of lectures. Consultations of the project (obligatory min. 3 times). Submission and defence of the project prepared during one semester.
Field of study related learning outcomes: K2_W13, K2_W14_KB
Area of study related learning outcomes: P7U_W, I.P7S_WG.o, III.P7S_WG, I.P7S_WK, III.P7S_WK

General academic profile - skils

Charakterystyka U1

The graduate has the ability to define computational models of frame structures and design them including semi-rigidity of joints.
Verification: Consultations of the project (obligatory min. 3 times). Submission and defence of the project prepared during one semester.
Field of study related learning outcomes: K2_U05, K2_U10, K2_U15_KB, K2_U17_KB, K2_U19_KB
Area of study related learning outcomes: P7U_U, I.P7S_UW.o, III.P7S_UW.o

General academic profile - social competences

Charakterystyka K1

The graduate has awareness of the need for further development of their professional and personal competence.
Verification: Passing a test related to the scope of lectures.
Field of study related learning outcomes: K2_K02, K2_K05, K2_K06
Area of study related learning outcomes: P7U_K, I.P7S_KK, I.P7S_KO

Charakterystyka K2

The graduate understands the importance of personal responsibility in an engineering activity, including accuracy and reliability when presenting and interpreting the results of their own work.
Verification: Passing a test related to the scope of lectures. Consultations of the project (obligatory min. 3 times). Submission and defence of the project prepared during one semester.
Field of study related learning outcomes: K2_K03, K2_K07
Area of study related learning outcomes: P7U_K, I.P7S_KK, I.P7S_KO

Name of course: Theory of Elasticity and Plasticity I

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0303

Number of ECTS credits: 4

Language of course: English

Form of didactic studies and number of hours per semester:

- Lecture30h
- Exercise type of course 15h
- Project type of course 15h

Preliminary requirements:

Algebra with Geometry, Calculus, Theoretical Mechanics, Strength of Material, Mechanics of Structures, Computer Methods in Civil Engineering.

Purpose of course:

Understanding of assumptions of the theory of elasticity and knowledge of basic governing equations. Ability to formulate the initial/boundary value problem for the typical three-dimensional and two-dimensional (plane stress and plane strain) problems. Analysis of selected problems for disks and half-spaces.

Contents of education:

This course will introduce basic definitions of strain and stress tensors, derive strain deformation relationships for small deformations, derive compatibility conditions for strain tensors, equilibrium equations, and formulate constitutive properties of anisotropic and isotropic elastic materials. Introduce the principle of virtual work and the principle of minimum of potential energy, the strain energy density and constitutive relationships of linear elasticity. Introduce the Airy stress functions for 2-D plane stress and plane strain problems in Cartesian and cylindrical coordinate systems. A few examples in 3-D stress analysis will be provided.

Methods of evaluation:

Two tests. Homework is obligatory and includes two projects. Examination: written exam an oral exam. The homework exercises will train students in the use of principles of elasticity theory for developing estimates of stress or internal forces and displacement fields for use in elastic stress analysis. The students are encouraged to learn the use of software tools such as MAPLE, Mathematica, MathCAD and/or MATLAB to aid the algebraic manipulations and numerical solution of boundary value problems assigned as homework or project.

Exam: yes

Literature:

[1] Boresi A.P., Chong K.P.: Elasticity in Engineering Mechanics, Elsevier Science Publishing Co., Inc., New York – London, 1987. [2] Knowles J.K.: Linear Vector Space and Cartesian Tensors, Oxford University Press, New York – Oxford, 1998. [3] Timoshenko S., Goodier N.: Theory of Elasticity, McGraw-Hill Book Company, Inc., New York – London, 1934. [4] Ugural A. C., Fenster S.K.: Advanced strength and applied elasticity, Prentice Hall, 1987. [5] Rees D.W.A.: Mechanics of Solids and Structures. Imperial College Press, London 2000.

Effects of education

General academic profile - knowledge

Charakterystyka W1

The graduates know the assumptions and equations of the theory of elasticity and plasticity.
Verification: Tests, Homework, Exam.
Field of study related learning outcomes: K2_W02
Area of study related learning outcomes: P7U_W, I.P7S_WG.o

General academic profile - skils

Charakterystyka U1

The graduates can solve selected boundary and initial valued problems of elasticity.
Verification: Project, Test, Exam.
Field of study related learning outcomes: K2_U02
Area of study related learning outcomes: P7U_U, I.P7S_UW.o

General academic profile - social competences

Charakterystyka K1

The graduates understand the importance of personal responsibility in engineering activity.
Verification: Exam, Project.
Field of study related learning outcomes: K2_K03, K2_K04
Area of study related learning outcomes: P7U_K, I.P7S_KK

Name of course: Timber Structures

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0401

Number of ECTS credits: 3

Language of course: English

Form of didactic studies and number of hours per semester:

- Lecture15h
- Exercise type of course 15h
- Project type of course 15h

Preliminary requirements:

Timber structures – basis of design (Timber structures –first degree course). Numerical methods in design.

Purpose of course:

The ability to analyse and design the modern timber structures, especially structures made from glued laminated timber.

Contents of education:

Performances of solid wood, glulam, LVL and other wood-based materials. Technology of glulam: principal stages of fabrication, testing, modelling, durability and preservative treatment. Characteristic and design of the elements and structures made from glulam: straight beams and columns, pitched and cambered beams, long-span trusses, three pin portals with their design variations, two or three pin arches, 3D structures. Fire resistance and structural fire design of the glulam structures.

Methods of evaluation:

Each student execute and attest his individual project, principally based composed of the glulam elements. The lectures are attested on the ground of the written works.

Exam: no

Literature:

[1] E.C. Ozelton, J.A Baird: Timber designers Manual, Blackwell Science, 2004; [2] D.E. Breyer. K.J. Fridley, K.E. Cobeen: Design of wood structures, McGraw-Hill, Professional Publishing, NY 1999; [3] A. Kermani: Structural Timber design, Wiley-Blackwell 1999.

Effects of education

General academic profile - knowledge

Charakterystyka W1

Know the rules of design of timber structures.
Verification:
Field of study related learning outcomes: K2_W09, K2_W13
Area of study related learning outcomes: P7U_W, I.P7S_WG.o, III.P7S_WG

General academic profile - skils

Charakterystyka U1

Can design complex timber structures.
Verification:
Field of study related learning outcomes: K2_U05
Area of study related learning outcomes: P7U_U, I.P7S_UW.o

General academic profile - social competences

Charakterystyka K1

Is noticed of continuing education.
Verification:
Field of study related learning outcomes: K2_K03, K2_K05, K2_K02
Area of study related learning outcomes: P7U_K, I.P7S_KK, I.P7S_KO

Name of course: Building Law

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BU000-MSA-0201

Number of ECTS credits: 2

Language of course: English

Form of didactic studies and number of hours per semester:

- Lecture 15h

Preliminary requirements:

General knowledge on investment process.

Purpose of course:

Learning of the provisions of the Act on the Building Law and implementing regulations to the Act.

Contents of education:

Discussion on the Building Law and its implementing acts.

Methods of evaluation:

Test.

Exam: no

Literature:

Act on the Law Building (in Polish); Regulation on technical conditions to be met by buildings and their location.

Effects of education

General academic profile - knowledge

Charakterystyka W1

Knowing of Act named Building Law.
Verification: test
Field of study related learning outcomes: K2_W11
Area of study related learning outcomes: P7U_W, I.P7S_WK, III.P6S_WK

General academic profile - skils

Charakterystyka U1

Student can determine fields of applying Building Law. He can determine relationship between particpants of inwestment process and administrative units and chamber of civil engineers.
Verification: Test
Field of study related learning outcomes: K2_U12, K2_U14
Area of study related learning outcomes: P7U_U, I.P7S_UU, I.P7S_UK

General academic profile - social competences

Charakterystyka K1

Student understands non-technical aspects of building investment process and it's influence on environment and local community. He realizes responsibility of participants of investment process.
Verification: test
Field of study related learning outcomes: K2_K05
Area of study related learning outcomes: P7U_K, I.P7S_KO

Name of course: Intellectual Property Law

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1180-BU000-MSA-9202

Number of ECTS credits: 1

Language of course: English

Form of didactic studies and number of hours per semester:

- Lecture 15h

Preliminary requirements:

None

Purpose of course:

The aim of the course is to make students familiar with the system of intellectual property protection. The student will know the sources of law, the general concepts and issues of legal protection of intellectual property. The student will be able to distinguish between types of intellectual property, identify and characterize the major issues concerning intellectual property protection system. Students will also have awareness of the importance and scope of intellectual property protection.

Contents of education:

The lecture is to familiarize students with the most important issues of intellectual property protection in terms of national law, such as: national sources of law of intellectual property protection; general concepts of the subject of protection of intellectual property rights; allocation of intellectual property rights; personal and material copyright; the patentability - the requirements for patent protection; patent information - information sources, databases, types of patent examination; Practical examples of the functioning of patent protection; path to deal with the new invention.

Methods of evaluation:

Test

Exam: no

Literature:

Law on Copyright and Related Rights of 4 February 1994. (Journal of Laws No. 24, item. 83 amended).

Effects of education

General academic profile - knowledge

Charakterystyka W1

Graduate knows system of intellectual property protection, knows sources of law, general terms and issues in legal protection of intellectual property. Student can distinguish kinds of intellectual property, indicate and characterize basic issues concerning system of intellectual property protection. Student is aware of the meaning and range of property protection.
Verification: test
Field of study related learning outcomes: K2_W12
Area of study related learning outcomes: P7U_W, I.P7S_WK

General academic profile - skils

Charakterystyka U1

Students can identify a type of intellectual property and indicate possible ways of its protection, they are aware of the importance of intellectual property protection, they recognize and define the role of exclusive rights in the modern world.
Verification: Test
Field of study related learning outcomes:
Area of study related learning outcomes:

General academic profile - social competences

Charakterystyka K1

Student is able to appreciate the need for the application of legal regulations related to the protection of intellectual property, is aware of the consequences of encroachment, even not culpable, in the exclusive rights without proper authorization.
Verification: test
Field of study related learning outcomes: K2_K03, K2_K05
Area of study related learning outcomes: P7U_K, I.P7S_KK, I.P7S_KO

Name of course: Computer-aided Design of Structures

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0408

Number of ECTS credits: 2

Language of course: English

Form of didactic studies and number of hours per semester:

- Computer lessons 45h

Preliminary requirements:

Expected: Computer Systems for Structural Analysis, Strength of Materials, Mechanics of Structures, Finite Element Method.

Purpose of course:

he aim of the course is to discuss the principles of the theoretical and practical aspects of modeling structures using FEM, applying and combining loads, performing static calculations (taking into account the accuracy of calculations and hardware limitations), interpretation of results (their accuracy, error-capturing skills) and dimensioning. During the course, the Autodesk Robot Structural Analysis Professional program is used, in which examples are presented. After completing the course, the student should be able to apply the acquired knowledge in practice to design and thesis.

Contents of education:

Computer aided structure design - introductory issues; classification of structural systems; calculation model of a building - concepts, characteristics, limitations; a computer program as the implementation of the adopted algorithm for solving the numerical model of a building. User interface, program preferences (units, materials, codes etc.). Building 2D and 3D models: frames, trusses, plates. Structure geometry (bars, nodes, panels); definition of supports and releases; meshing. Materials and section properties. Additional attributes. Loads types and loads combinations; claddings . Analyse types (linear, non-linear, modal). Viewing the results (tables, diagrams, maps). Designing (dimensioning) steel, timber and reinforced concrete elements. Optimisation of steel elements; codes parameters; members/group definitions.

Methods of evaluation:

Projects and practical exercises. Form of completion: Individual one big project or several smaller projects (two or three) of 2D structure like RC concrete slab or 3D structure like steel frame of building, steel truss tower, timber rafter framing - building model, applying loads, loads combinations, calculations, designing. Student should finish and defend her/his own work till the end of the semester.

Exam: no

Literature:

Autodesk Robot Structural Analysis Professional 2019 software help; tutorials from www.robobat.pl and internet.

Effects of education

General academic profile - knowledge

Charakterystyka W1

He knows the possibilities and scope of the ARSA Pro program.
Verification: Active participation in classes; execution and defense of home design works.
Field of study related learning outcomes: K2_W05, K2_W04
Area of study related learning outcomes: I.P7S_WG.o, III.P7S_WG, P7U_W

Charakterystyka W2

Knows the rules of modeling bar structures and plates.
Verification: Active participation in classes; execution and defense of home design works.
Field of study related learning outcomes: K2_W09, K2_W15_KB
Area of study related learning outcomes: P7U_W, I.P7S_WG.o

General academic profile - skils

Charakterystyka U1

Is able to build a flat and spatial bar system, define loads and their combinations, carry out calculations, interpret the obtained results.
Verification: Active participation in classes; execution and defense of home design works.
Field of study related learning outcomes: K2_U03, K2_U04, K2_U05, K2_U15_KB, K2_U17_KB, K2_U19_KB
Area of study related learning outcomes: P7U_U, I.P7S_UW.o, III.P7S_UW.o, I.P7S_UO

Charakterystyka U2

Is able to model a reinforced concrete slab, define loads and their combinations, perform calculations, interpret the obtained results.
Verification: Active participation in classes; execution and defense of home design works.
Field of study related learning outcomes: K2_U15_KB, K2_U17_KB, K2_U19_KB, K2_U03, K2_U04, K2_U05
Area of study related learning outcomes: I.P7S_UW.o, III.P7S_UW.o, P7U_U, I.P7S_UO

General academic profile - social competences

Charakterystyka K1

Can work in a team in the implementation of project tasks.
Verification: Active participation in classes; execution and defense of design work.
Field of study related learning outcomes: K2_K02, K2_K03
Area of study related learning outcomes: P7U_K, I.P7S_KK

Name of course: Design Methodology of Construction Processes

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0307

Number of ECTS credits: 2

Language of course: English

Form of didactic studies and number of hours per semester:

- Lecture 15h
- Project type of course 30h

Preliminary requirements:

General knowledge of construction.

Purpose of course:

Lecture of methodology of construction investment projects.

Contents of education:

Lecture: 1. Determination of the purpose and scope of the construction processes. 2. Methods for determining a set of design solutions (brainstorming; synectic, benchmarking; morphological method). 3. Multi-criteria method of selection and evaluation of design solutions. 4. Limitations appearing in determining a set of design solutions. 5. Optimization solutions realization (value management, value engineering). 6. Design brief. 7. Organisation and management of resources in the implementation of construction processes. 8. Scheduling and monitoring the progress of the construction process. 9. Cost management of construction processes. 10. Risk analysis in the construction process. 11. Permits and approvals required in construction processes. 12. Procurement, contracting, forms of entrepreneurship. 13. Quality control and standards reqiored in construction. 14. Commisionning and acceptance. 15. Post contrach activities. Project: Elaboration of Project Execution Plan.

Methods of evaluation:

Completion of the course follows the presentation and defense of the project and passed a test of lectures. Test consists of answers to 3 questions. Each response is assessed from 0

to 1 pts .; max. score 3 points. Conversion grade - total points + 2. Assessment test: rating 2 to 5

Exam: no

Literature:

[1] Jaworski K. M.: Metodologia projektowania realizacji budowy. Wydawnictwo Naukowe PWN. Warszawa 1999. [2] Motzko Ch. , Martinek W. , Klingerberger J. , Binder F. : Zarządzanie procesami budowlanymi i lean construction. Biblioteka Managerów Budowlanych. Darmstadt, Warszawa 2011. [3] Akram S. , Minasowicz A. , Kostrzewa B. , Mukherjee J. , Nowak P.. : Zarządzanie wartością w przedsięwzięciach budowlanych. Biblioteka Managerów Budowlanych. Ascot, Warszawa 2011. [4] Texeira J.C. , Kulejewski J. , Krzemiński M., Zawistowski J. : Zarządzanie ryzykiem w budownictwie. Biblioteka Managerów Budowlanych. Guimaraes 2011. [5] Praca Zbiorowa pod redakcja W. Martinka; Kierowanie budową i projektem Budowlanym. Weka. Warszawa 2002. [6] Kompendium wiedzy o zarządzaniu projektami. PMBOK Guide. MT&DC. Warszawa 2003. [7] Werner W.A.; Zarządzanie w procesie inwestycyjnym; Oficyna Wydawnicza Politechniki Warszawskiej. Warszawa 1998.

Effects of education

General academic profile - knowledge

Charakterystyka W1

Gain knowledge on methodology of construction investment projects.
Verification: Test
Field of study related learning outcomes: K2_W07
Area of study related learning outcomes: P7U_W, I.P7S_WG.o, III.P7S_WG

General academic profile - skils

Charakterystyka U1

Prepare project in the topic.
Verification: Project
Field of study related learning outcomes: K2_U01, K2_U06, K2_U11, K2_U12, K2_U13, K2_U14
Area of study related learning outcomes: P7U_U, I.P7S_UW.o, I.P7S_UK, I.P7S_UU, III.P7S_UW.o

General academic profile - social competences

Charakterystyka K1

Understands responsibility of an engineer.
Verification: Project
Field of study related learning outcomes: K2_K03, K2_K05
Area of study related learning outcomes: P7U_K, I.P7S_KK, I.P7S_KO

Name of course: Industrial Metal Construction

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0410

Number of ECTS credits: 3

Language of course: English

Form of didactic studies and number of hours per semester:

- Lecture 15h
- Project type of course 30h

Preliminary requirements:

Knowledge about principles of design of metal structures.

Purpose of course:

The aim of the course is to equip the student with adequate background information and practical experience in design of crane supporting steel structures and steel chimneys structures. The student is expected to demonstrate the basic knowledge and understanding of rules applied in Eurocodes for the calculation of chosen industrial structures. Practical knowledge will be checked through the completion of the project of runway beam and chimney.

Contents of education:

Lectures: I. Runway beams - crane supporting structures: 1. General characteristics and classification groups of cranes and tracks of driving. 2. Basis of design runway beams, action induced by cranes and machinery, fatigue resistance. 3. Construction and calculation of runway beams, types of beams, principles of shaping. 4. Surge girder structures, structural details of runway beams, structural end stop. II. Steel chimneys: 1. General characteristic of steel chimneys, classification, types of construction, material issues, structural components. 2. Actions and environmental influences on chimneys, the basic dynamic characteristics of chimneys. 3. Calculation of self-supported chimneys: local stability of structural shells, deflection of the chimney top, the effect of vortex shedding, checking of fatigue resistance, bolted flange connections, connection with foundation. Semester project: calculation of runway beam with surge girder and steel chimney.

Methods of evaluation:

Passing a written work and/or oral part at the end of the semester with at least the satisfactory mark (lectures) Satisfactory marks for submission and defense of the projects of a runway beam with surge girder and a chimney (project classes). Course aggregate is an average mark of two components, namely the project aggregate and the written work or/and oral part.

Exam: no

Literature:

Eurocodes EN 1991-3, EN 1991-1-4, EN 1993-1-6, EN 1993-1-9, EN 1993-3-2, EN 1993-6

Effects of education

General academic profile - knowledge

The graduates have knowledge about principles of shaping and structural designing of steel chimney structures.

The graduates have knowledge about principles of shaping and structural designing and dimensioning of crane supporting structures.

The graduates know the basic standards, regulations and guidelines for design of crane supported structures and steel chimneys.

General academic profile - skils

The graduates are able to design main crane supported structure - runway beam

The graduates are able to design single wall chimney steel structure with inner liner.
The graduates can do structural drawings of runway beam and steel chimney structure.
The graduates can apply the basic standards, regulations and guidelines in design of runway beams and steel chimney structures.
The graduates can determine static and dinamic actions caused by cranes.
The graduates can define and determine permanent, technological, thermal and environmental effects acting on chimneys structures.

General academic profile - social competences

The graduates study lecture materials. Complete knowledge with information from literature and other accessible sources.
The graduates do projects looking for correct, rational and economically justified solutions.

Name of course: Decision Making and Negotiation Theory

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1180-BU000-MSA-9204

Number of ECTS credits: 1

Language of course: English

Form of didactic studies and number of hours per semester:

- Exercise type of course 15h

Purpose of course:

Give the students most basic informations about conflicts, group dynamic, communication, negotiation skills.

Contents of education:

Theory of Conflict, communication, negotiation procedures and processes.

Methods of evaluation:

2 tests (50% and 50%).

Exam: no

Literature:

[1] R. Fisher, W. Ury, B. Patton, Getting to yes; [2] R. Cialdini „Influence. Science and Practice”.

Effects of education

General academic profile - knowledge

The graduates have knowledge about conflict situations, sources of conflicts, emotions, its' recognition. The graduates learn how to react in conflict situations, what are possible strategies in conflicts.

General academic profile - skils

The graduates learn communication in group, learn to recognize and name emotions and deal with them. Students learn technics of communication, which is helpful to achieve goals.

General academic profile - social competences

The graduates can work on an assigned task independently or in a team. Can determine priorities to help achieve their goals. Students are more aware of social processes, dynamic of conflict and can read other's emotions.