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

Lp.	Course Code	Course	Hours	Sem	ECTS	Syllabus
1	1080-BUKBD-MSA-0403	Computer Methods for Structural Design	45 h (15 h Lecture 30 h Workshop)	2	4	(**Name of course:** Computer Methods for Structural Design)
2	1080-BUKBD-MSA-0409	Industrial Concrete Construction	45 h (15 h Lecture 30 h Project)	2	3	(**Name of course:** Industrial Concrete Construction)
3	1080-BUKBD-MSA-0404	Mechanics of Structures 3	45 h (30 h Lecture 15 h Projec)	2	4	(**Name of course:** Mechanics of Structures 3)
4	1080-BUKBD-MSA-0309	Reliability of Structures	30 h (30h Workshop)	2	2	(**Name of course:** Reliability of Structures)
5	1080-BUKBD-MSA-0405	Special Concrete Structures	60 h (30 h Lecture 30 h Project)	2	4	(**Name of course:** Special Concrete Structures)
6	1080-BUKBD-MSA-0406	Special Metal Structures	60 h (30 h Lecture 30 h Project)	2	4	(**Name of course:** Special Metal Structures)
7	1080-BUKBD-MSA-0304	Theory of Elasticity and Plasticity II	30 h (15 h Lecture 15 h Project)	2	3	(**Name of course:** Theory of Elasticity and Plasticity II)

Name of course: Computer Methods for Structural Design

Coordinator of course: Tomasz Sokół, Ph.D., Eng.

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0403

Nominal semester: 2 / AY 2024/2025

Number of ECTS credits: 4

Language of course: english

Form of didactic studies and number of hours per semester:

- Lecture 15h
- Computer lessons 30h

Preliminary requirements:

Basic knowledge of algebra and mathematical analysis, knowledge of matrix and differential, completed a course strength of materials and structural mechanics of statics, dynamics and stability of the structure, basics of the theory of elasticity and plasticity. Basics of linear FEM static.

Limit of students: none

Purpose of course:

The ability to model complex flat and spatial structures using finite element method, understanding and application of FEM algorithms to solve the advanced structural mechanics problems, an understanding of the theoretical basis of approximate methods for solving nonlinear boundary value problems and eigenprobles, the ability to interpret and verify the results obtained on computer. Gaining knowledge of design optimization and nonlinear programming methods.

Contents of education:

Modeling of complex engineering structures using finite element method. Creating a geometric model of structure and mesh generation in Ansys FEA system. Practical application of adaptive techniques to automatically correct the accuracy of the solution. Alternative methods for FEM: finite difference method, Ritz and Galerkin methods, the concept of meshless methods. Analysis of the initial stability and vibration problems by solving a generalized eigenproblems. The dynamics of discrete systems and overview of the method of integration of motion equations. FEM algorithm in nonlinear mechanics. Selected problems of design optimization: size, shape and topology optimization. Optimal design of structures subjected to multi-load cases.

Methods of evaluation:

Credit with a course consists in collecting min. 50% of points of theoretical knowledge and and practical skills. The first one is verified in one final test. Practical skills in FEM-modelling and FEM-software is evaluated in three computational projects.

Exam: no

Literature:

[1] A. Ralston, P. Rabinowitz, A First Course in Numerical Analysis: Second Edition, McGraw-Hill, 1978; [2] O.C. Zienkiewicz, The Finite Element Method in Engineering Science, McGraw-Hill, 1971; [3] O.C. Zienkiewicz, R.L. Taylor, The Finite Element Method, Fifth Edition, Volume 1: The Basis, Butterworth-Heinemann, 2000; [4] S.S. Rao, Engineering Optimization, Theory and Practice, Third Edition, John Wiley & Sons, Inc., New York, 1996; Other links are included in the web-page.

Effects of education

General academic profile - knowledge

Charakterystyka W1

The graduates have knowledge of the theoretical foundations of computer methods for: linear and nonlinear statics, dynamics and stability of the structure, as well as extended knowledge of structural optimization (optimization of shape and topology). They understand the nature of the approximate solutions obtained by discrete methods.
Verification: Test of theoretical knowledge from the lecture.
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

General academic profile - skils

Charakterystyka U1

The graduates can define computational models used for computer analysis of the design and choose suitable for this purpose software/method. They can verify the results obtained by computer.
Verification: Realization and defense of the three computational projects.
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 K1

The graduates can work independently and in a team to solve the specific problem. They draws conclusions and describes the results of their own work.
Verification: Reports on project work done partly independently and partly as a team with a comparison of the results obtained with various programs. Observation of students' work in the computer room.
Field of study related learning outcomes: K2_K02
Area of study related learning outcomes: P7U_K, I.P7S_KK

Name of course: Industrial Concrete Construction

Coordinator of course: Rafał Ostromęcki, Ph.D., Eng.

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0409

Nominal semester: 2 / AY 2024/2025

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:

It is assumed, that students have basic knowledge of reinforced concrete structures theory and design rules as well as building mechanics and materials strength.

Limit of students: 15

Purpose of course:

Developing the skills of understanding the action and design of selected industrial objects, understanding the problems of designing the structures located in the areas of mining activity as well as objects providing the support to machines. Preparation of the project of an industrial chimney, gas flow, statical and thermal calculations. Alternatively, the design of other structures of Industrial reinforced concrete construction.

Contents of education:

Lectures: Types and function of industrial structures, general information on industrial buildings. Industrial chimneys – technology, structure, actions on chimneys, shape influence on internal forces (second order effects), reinforcement detailing, types and design of chimneys foundations, details of chimneys structure. Cooling towers – technology, shape, equipment, general information on actions, structural elements and solutions, design. Building engineering in the areas of mining damages – general information on surface effects of mineral extraction, actions against the damages to objects, structural solutions practiced. Foundations for machinery – general information on types of foundations loaded dynamically, types of forces generated by machines, design of foundations. Project: Preparation of the project of an industrial chimney – defining the height and diameter of chimney, basing on technological data, gas flow and thermal calculations, calculation of internal forces with respect to second order effects, design of reinforcement, check for chimneys stability, design of circular foundation slab (moments calculation, reinforcement), preparation of structural drawings.

Methods of evaluation:

1. Colloquium covering the material of lectures. 2. Elaboration of a project. Final grade will be 50% colloquium grade and 50% project grade. Colloquium grade of major meaning in case of unclear situation.

Exam: no

Literature:

[1] EN-13084-1:2007. Free standing chimneys. Part 1 – general requirements. [2] EN-13084-2:2007. Free standing chimneys. Part 2 – concrete chimneys. [3] L. Kral „Elementy budownictwa przemysłowego” (in polish). [4] A. Mielnik „Budowlane konstrukcje przemysłowe” (in polish). [5 R. Dowgird „Prefabrykacja w budownictwie przemysłowym” (in polish). [6] J. Ledwoń „Żelbetowe chłodnie powłokowe” (in polish). [7] J. Ledwoń „Budownictwo na terenach górniczych” (in polish). [8] J. Lipiński „Fundamenty i konstrukcje wsporcze pod maszyny” (in polish).

Effects of education

General academic profile - knowledge

Charakterystyka W1

The graduate knows selected calculation tools and computer programs supporting construction processes according to the specialization profile.
Verification: Colloquium, project work.
Field of study related learning outcomes: K2_W05
Area of study related learning outcomes: P7U_W, I.P7S_WG.o, III.P7S_WG

Charakterystyka W2

The graduates have knowledge of basic standards, regulations and guidelines for the design of building and civil engineering structures to the extent consistent with the specialization profile.
Verification: Colloquium, project work
Field of study related learning outcomes: K2_W09
Area of study related learning outcomes: P7U_W, I.P7S_WG.o

Charakterystyka W3

The graduate is aware of risks of failure associated with the designed object structure and have expertise needed to provide the required safety according to the standards. ired safety according to the standards.
Verification: Colloquium, project work.
Field of study related learning outcomes: K2_W14_KB
Area of study related learning outcomes: P7U_W, I.P7S_WK, III.P7S_WK

Charakterystyka W4

The graduate knows the general principles for shaping of industrial structures.
Verification: Colloquium, project work.
Field of study related learning outcomes: K2_W16_KB
Area of study related learning outcomes: I.P7S_WG.o, III.P7S_WG, P7U_W

General academic profile - skils

Charakterystyka U1

Preparation of the project of an industrial chimney, gas flow, statical and thermal. calculations. Alternatively, the design of other structures of Industrial reinforced concrete construction.
Verification: Project work.
Field of study related learning outcomes: K2_U05
Area of study related learning outcomes: P7U_U, I.P7S_UW.o

Charakterystyka U2

The graduate can prepare project drawing documentation, including calculations proper for the stage of the design process taking into consideration different levels of detail. They can prepare and interpret engineering drawings of construction structures to the extent consistent with the specialization profile.
Verification: Project work.
Field of study related learning outcomes: K2_U10
Area of study related learning outcomes: P7U_U, I.P7S_UW.o, III.P7S_UW.o

Charakterystyka U3

The graduates can define and classify effects on chosen industrial structures. They can define the load and load combinations.
Verification: Colloquium, project work.
Field of study related learning outcomes: K2_U17_KB
Area of study related learning outcomes: P7U_U, I.P7S_UW.o

Charakterystyka U4

The graduate knows how to apply appropriate methods of protecting materials and structures against corrosion and fire.
Verification: Colloquium, project work.
Field of study related learning outcomes: K2_U21_KB
Area of study related learning outcomes: P7U_U, I.P7S_UW.o

General academic profile - social competences

Charakterystyka K1

The graduate is aware of the need for further development of their professional and personal competence and is ready to implement it.
Verification: Colloquium, project work.
Field of study related learning outcomes: K2_K02
Area of study related learning outcomes: P7U_K, I.P7S_KK

Charakterystyka K2

The graduate understands the importance of personal responsibility in engineering activity, including accuracy and reliability when presenting and interpreting the results of their own work.
Verification: Colloquium, project work.
Field of study related learning outcomes: K2_K03
Area of study related learning outcomes: P7U_K, I.P7S_KK

Charakterystyka K3

The graduate can acquire needed information from various sources, integrate, interpret, and critically evaluate as well as draw up conclusions, and formulate and fully justify their own opinions.
Verification: Colloquium, project work.
Field of study related learning outcomes: K2_K06
Area of study related learning outcomes: P7U_K, I.P7S_KK

Name of course: Mechanics of Structures 3

Coordinator of course: Grzegorz Dzierżanowski, Ph.D. (Habil.), Assoc. Prof.

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0404

Nominal semester: 2 / AY 2024/2025

Number of ECTS credits: 4

Language of course: english

Form of didactic studies and number of hours per semester:

- Project type of course15 h
- Lecture 30 h

Preliminary requirements:

Good knowledge of the material presented during the courses on Strength of Materials 1, 2, and Mechanics of Structures 1, 2 in the scope taught at the Faculty of Civil Engineering, Warsaw University of Technology.

Limit of students: by the decision of the Dean

Purpose of course:

Extending the knowledge on selected topics in the theory of bar structures and cable structures, not included in the scope of the courses on Strength of Materials 1, 2 and Mechanics of Structures 1, 2.

Contents of education:

Selected topics in: a) statics and dynamics of rigid-joint grillages and curved bars, b) statics of cables and cable nets.

Methods of evaluation:

Homework project, written and oral exam.

Exam: yes

Literature:

1. Chopra A.K., Dynamics of Structures, Prentice Hall 2012.; 2. Krenk S., Hogsberg J., Statics and Mechanics of Structures, Springer 2013.; 3. Lecture notes

Effects of education

General academic profile - knowledge

Charakterystyka W1

Extending the knowledge on selected topics in the theory of bar structures and cable structures, not included in the scope of the courses on Strength of Materials 1, 2 and Mechanics of Structures 1, 2.
Verification: Homework project, written and oral exam.
Field of study related learning outcomes: K2_W03
Area of study related learning outcomes: P7U_W, I.P7S_WG.o

General academic profile - skils

Charakterystyka U1

Can solve selected problems in advanced structural mechanics.
Verification: Homework project, written and oral 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

Can work independently on a project and knows how to verify the results.
Verification: Homework project.
Field of study related learning outcomes: K2_K03
Area of study related learning outcomes: P7U_K, I.P7S_KK

Name of course: Reliability of Structures

Coordinator of course: Ewa Szeliga, Ph.D., Eng.

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0309

Nominal semester: 2 / AY 2024/2025

Number of ECTS credits: 2

Language of course: english

Form of didactic studies and number of hours per semester:

- Exercise type of course 30h

Preliminary requirements:

The following are required: - basis of probability and statistics, - basis of structural design.

Limit of students: 15

Purpose of course:

The objective of the course is to develop understanding of the reliability-based methods of structural analysis. The course covers the following major areas: - basis of reliability analysis of structural members and structural systems, - reliability-based design code calibration.

Contents of education:

The course contains the following topics: - review of fundamentals of probability and statistics not covered by the course of Mathematics (some probability distributions, probability papers), - fundamentals of structural reliability (limits states, structural safety, probability of structural failure), - structural reliability analysis methods (Cornell reliability index, Hasofer-Lind reliability index, Rackwitz-Fiessler procedures, Monte-Carlo simulation), - development of design codes (statistical models or resistance, statistical models of loads and loads combinations, calibration of partial safety factors), - reliability of structural systems.

Methods of evaluation:

The course grade is based upon the result of the final class-test scheduled for the end of semester.

Exam: no

Literature:

[1] J.R. Benjamin, C.A. Cornell, “Probability, Statistics and Decision for Civil Engineers”, McGraw-Hill, New York, 1970; [2] R.E. Melchers, “Structural Reliability Analysis and Predictions”, Ellis Horwood Limited (div. of John Wiley & Sons), New York, 1987; [3] A.S. Nowak, K.R. Collins, “Reliability of Structures”, McGraw-Hill Book, New York, 2000.

Effects of education

General academic profile - knowledge

Charakterystyka W1

Gains knowledge on reliability of components and structures.
Verification: test
Field of study related learning outcomes: K2_W01, K2_W14_KB
Area of study related learning outcomes: P7U_W, I.P7S_WG.o, I.P7S_WK, III.P7S_WK

General academic profile - skils

Charakterystyka U1

Can solve problems in reliability.
Verification: test
Field of study related learning outcomes: K2_U06, K2_U15_KB
Area of study related learning outcomes: P7U_U, I.P7S_UW.o, III.P7S_UW.o

General academic profile - social competences

Charakterystyka K1

Can formulate and solve problems.
Verification: test
Field of study related learning outcomes: K2_K02, K2_K03
Area of study related learning outcomes: P7U_K, I.P7S_KK

Name of course: Special Concrete Structures

Coordinator of course: Rafał Ostromęcki, Ph.D., Eng.

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0405

Nominal semester: 2 / AY 2024/2025

Number of ECTS credits: 4

Language of course: english

Form of didactic studies and number of hours per semester:

- Lecture 30h
- Project type of course 30h

Preliminary requirements:

It is assumed, that students have basic knowledge of reinforced concrete structures theory and design rules as well as building mechanics and materials strength.

Limit of students: 15

Purpose of course:

Developing the skills of understanding the action and design of thin-walled coverings, storage tanks for liquids or loose materials and concrete arches. Preparation of the project of a tank, consisting of thin-walled shell elements.

Contents of education:

Lectures: Thin-walled covers – types of shells, internal forces in shells, membrane state of stresses, membrane theory, calculation of forces in axially symmetrical loading case of rotational shells, moments theory, shell supported on ring-beams, cylindrical shells – structural components, internal forces distribution, simplified methods for calculation, reinforcement in shells. Tanks for liquids – perpendicular tanks, distribution of internal forces, simplified methods of calculation of internal forces, detailing and construction of reinforcement. Silos – types, actions on silos' walls, calculations and reinforcement. Arches – types, calculation and detailing, structural details, reinforcement. Project: Circular tanks for liquids - calculations and learning to understand the internal forces distribution. Elaboration of the project of reinforced concrete cylindrical tank with shell covering.

Methods of evaluation:

1. Exam in writing and oral, covering the lectures material. 2. Elaboration of a project. Final grade will be 50% exam grade and 50% project grade.

Exam: yes

Literature:

[1] EN-1992-1-1. Eurocode 2. Concrete Structures Design. Part I. [2] EN-1992-3. Eurocode 2. Concrete Structures Design. Part 3 – silos and tanks for liquids. Material from lectures. [3] W. Stachurski, J. Kobiak “Konstrukcje żelbetowe, tom 4, (in polish). [4] K. Grabiec „Żelbetowe konstrukcje cienkościenne” (in polish). [5] A Halicka, D. Franczak „Projektowanie zbiorników żelbetowych” (in polish).

Effects of education

General academic profile - knowledge

Charakterystyka W1

The graduates know the basic standards and guidelines for the design of tank structures. The graduates are aware of risks of failure associated with the designed building structure and have expertise needed to provide the required safety according to the standards. The graduates know design principles of selected shell structures taking into account flexible connections.
Verification: Exam, project
Field of study related learning outcomes: K2_W05, 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

The graduates can prepare project drawing documentation, including calculations and technical description proper for the stage of the design process taking into consideration different levels of detail. They can prepare and interpret engineering drawings of construction structures to the extent consistent with the specialization profile. The graduates can provide an adequate level of safety of the designed structure by applying standards for loads and design. The graduates can classify structural systems. The graduates can define and classify effects on structures. They can define the load and load combinations. The graduates can analyse and design selected shell structures including connection flexibility.
Verification: Exam, project work.
Field of study related learning outcomes: K2_U16_KB, K2_U17_KB, K2_U19_KB, K2_U20_KB, K2_U04, K2_U05, K2_U10
Area of study related learning outcomes: P7U_U, I.P7S_UW.o, I.P7S_UO, III.P7S_UW.o

General academic profile - social competences

Charakterystyka K1

The graduates understand the importance of personal responsibility in engineering activity, including accuracy and reliability when presenting and interpreting the results of their own work.
Verification: Exam, project work.
Field of study related learning outcomes: K2_K01, K2_K02, K2_K03, K2_K04, K2_K05, K2_K06, K2_K07
Area of study related learning outcomes: P7U_K, I.P7S_KR, I.P7S_KK, I.P7S_KO

Name of course: Special Metal Structures

Coordinator of course: Wioleta Barcewicz, Ph.D., C.Eng., Associate Professor

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0406

Nominal semester: 2 / AY 2024/2025

Number of ECTS credits: 4

Language of course: english

Form of didactic studies and number of hours per semester:

- Lecture 30h
- Project type of course 30h

Preliminary requirements:

The following courses passed: Metal Structures I, II and III on the level of BSc degree.

Limit of students: 15

Purpose of course:

The aim of the course is to equip the student with adequate background information considering design and manufacture of different types of shell and bar steel structures and practical experience in design of steel cylindrical tank for storing liquids. The student is expected to demonstrate the basic knowledge and full understanding of advanced techniques for analysis and design of structural elements made of steel using elastic and plastic design principles; such ability is gained through the completion of design semester project.

Contents of education:

Lecture and tutorial: Tanks for liquids, gases and water storage (types – considering also static terms and conditions of structural working, structural detailing, basics of design including loading conditions, transportation and assembly methods). Silos and containers/trays for bulk materials (types – considering also static terms and conditions of structural working, structural detailing, basics of design including loading conditions, transportation and assembly methods). Pipelines (types – considering also static terms and conditions of structural working, structural detailing, basics of design including loading conditions, transportation and assembly methods). Observation and telecommunication towers (types of structures, structural detailing, basics of design including loading conditions, transportation and assembly methods, differences between towers and masts). Telecommunication and broadcasting masts (types of structures, structural detailing, basics of design including loading conditions, transportation and assembly methods, differences between towers and masts). Supporting structures of overhead power lines (types of structures, structural detailing, basics of design including loading conditions, transportation and assembly methods). Steel spatial structures and domes (types of structures, structural

detailing, basics of design including loading conditions, transportation and assembly methods). Semester design project: Design of vertical, cylindrical, flat-bottomed, above ground, welded, steel tank for the storage of liquids (fuels) at ambient temperature. The project comprises static calculation, dimensioning of steel elements and preparation of technical drawings.

Methods of evaluation:

Satisfactory marks for submission of the design project of vertical, cylindrical, flat-bottomed, above ground, welded, steel tank for the storage of liquids (fuels) at ambient temperature produced within the semester and consulted min. 3 times. Passing the written exam within the examination session with at least a satisfactory mark. Course aggregate is an average mark of two components, namely the mark for the semester design project and the examination mark.

Exam: yes

Literature:

EN 1991-4: Eurocode 1 – Actions on structures – Part 4: Silos and tanks; EN 1993-4-2: Eurocode 3 – Design of steel structures – Part 4-2: Tanks; EN 1993-1-1: Eurocode 3 – Design of steel structures – Part 1-1: General rules and rules for buildings; EN 1993-1-6: Eurocode 3 – Design of steel structures – Part 1-6: Strength and Stability of Shell Structures; EN 14015: Specification for the design and manufacture of site built, vertical, cylindrical, flat-bottomed, above ground, welded, steel tanks for the storage of liquids at ambient temperature and above.

Effects of education

General academic profile - knowledge

Charakterystyka W1

A graduate has knowledge about special metal structures.
Verification: Exam.
Field of study related learning outcomes: K2_W09, K2_W13, K2_W14_KB, K2_W16_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 can prepare a project on the given topic.
Verification: Consultations (obligatory min. 3 times), submission and defence of the project.
Field of study related learning outcomes: K2_U17_KB, K2_U19_KB, K2_U20_KB, K2_U05, K2_U10, K2_U15_KB, K2_U16_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 the responsibility of being a designer.
Verification: Consultations (obligatory min. 3 times), submission and defence of the project.
Field of study related learning outcomes: K2_K02, K2_K03, K2_K05
Area of study related learning outcomes: P7U_K, I.P7S_KK, I.P7S_KO

Name of course: Theory of Elasticity and Plasticity II

Coordinator of course: Aleksander Szwed, PhD; Marcin Gajewski, PhD

Type of course: Compulsory

Level of education: Second cycle studies

Programme: Civil Engineering

Group of courses: Obligatory

Code of course: 1080-BUKBD-MSA-0304

Nominal semester: 2 / AY 2024/2025

Number of ECTS credits: 3

Language of course: english

Form of didactic studies and number of hours per semester:

- Lecture15h
- Project type of course15h

Preliminary requirements:

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

Limit of students: One group - 30

Purpose of course:

Understanding of assumptions of the thin plate theory and knowledge of basic governing equations. Ability to formulate the initial/boundary value problem for plates. Understanding of plasticity theory and limit state analysis of structures. Understanding of modelling of time-dependent and tine-independent material and construction behaviour.

Contents of education:

This course will introduce the theory of Kirchhoff's plates and basic analytical methods of their solutions in Cartesian and polar coordinate systems. Yield conditions will be discussed, constitutive relationships of plasticity and elasto-plasticity will be derived.

Methods of evaluation:

Two tests. Examination: written and oral exam. Homework is obligatory and include two projects. The homework exercises will train students in the use of principles of elasticity theory and theory of plates 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] Kamenjarzh J.A.: Limit Analysis of Solid and Structures, CRC Press, Boca Raton – Tokyo, 1996. [3] Knowles J.K.: Linear Vector Space and Cartesian Tensors, Oxford University Press, New York – Oxford, 1998. [4] Timoshenko S., Woinowsky-Kriger S.: Theory of Plates and Shells, McGraw-Hill Book Company, Inc., New York – London, 1959. [5] Ugural A. C., Fenster S.K.: Advanced strength and applied elasticity, Prentice Hall, 1987.

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 boundary and initial valued problems.
Verification: Project, Tests, 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: Project, Exam.
Field of study related learning outcomes: K2_K03, K2_K04
Area of study related learning outcomes: I.P7S_KK, P7U_K