COURSE DESCRIPTION CARD - SYLLABUS

Course name
Strength of materials [S1Bud1>WM2]

Course

Field of study
Civil Engineering

Year/Semester
2/3

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
15

Projects/seminars
15

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Knowledge: Mathematics: algebra (including matrix calculus), mathematical analysis (including differential and integral calculus), geometry, planimetry, trigonometry. Theoretical mechanics: knowledge of the equilibrium equations and internal forces in rod elements of a structure. Skills: Mathematics: skills of calculation of derivatives and integrals of functions, the ability to use matrix calculus. Physics: ability to apply the principles of Newton. Theoretical mechanics: the ability to use the balance equations to determine the reactions and internal forces in statically determined bar systems. Social competences: Students can work in groups. The student follows the rules of ethics.

Course objective

Acquiring knowledge, skills and competences in solving problems of stress, deformations and displacements in structural member elements and in the field of material strength.

Course-related learning outcomes

Knowledge:
The student has detailed knowledge in the field of mechanics, strength of materials and principles of general structural design, and knows the theories explaining the complex relationships between them (obtained during the lecture).
The student knows at an advanced level the principles of structure theory and analysis of rod systems in the field of statics and stability (obtained during the lecture).

Skills:
The student is able to make a list of loads acting on buildings and perform static analysis of statically determinate rod structures (obtained during exercises and projects).

Social competences:
The student is responsible for the reliability of the results of their work and their interpretation. The student is ready to critically assess their knowledge and received content, as well as critically evaluate the results of their own work.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Evaluation of lectures
Written exam (duration: 90-120 minutes) on the date specified at the beginning of the semester. The basis for passing is to obtain a sufficient minimum score (3.0).
Rating scale: very good (5.0), good plus (4.5), good (4.0), satisfactory plus (3.5), satisfactory (3.0), insufficient (2.0).
Evaluation of exercises
The classes are passed on the basis of positive grades (at least 3.0) from tests, dates given at the beginning of the semester.
Rating scale: very good (5.0), good plus (4.5), good (4.0), satisfactory plus (3.5), satisfactory (3.0), insufficient (2.0).
Project evaluation
Project classes are passed on the basis of positive grades (at least 3.0) from project tasks. Project tasks are subjected to individual defense (oral or written form).
Rating scale: very good (5.0), good plus (4.5), good (4.0), satisfactory plus (3.5), satisfactory (3.0), insufficient (2.0)
Laboratory evaluation
Laboratory exercises are passed on the basis of positive grades (at least 3.0) from laboratory exercises reports and a minimum of 1 test. Reports are subjected to defense by the team performing the exercise (oral or written form).

Programme content

The program content includes determination of internal forces in 3D systems, stability of bar systems, relations between displacements, strains and stresses, physical relations, relative volume change, isotropy and anisotropy of the material, tensor decomposition into axiator and deviator, elastic energy, stress hypotheses, stress state at a point, tensor transformation, differential equations of equilibrium.

Course topics

Lectures
1. Stability of rod systems
2. Relations between displacements, strains and stresses. Constitutive relations.
3. Relative volume change, isotropy and anisotropy, axiator and deviator, strain energy.
4. Strength hypotheses, Tresca"s hypothesis
5. Huber-Mises-Hencky hypothesis
6. Stress state at a point
7. Tensor transformation. Differential equations of equilibrium

Exercises
1. Internal forces in 3D systems
2. Torsion. Stresses in a circular cross-section

3. Determination of beam displacements
4. Determination of the critical force of compressed rods
5. Constitutive and geometrical relations, strength hypotheses
6. Test
7. Stress analysis at a point
8. Resit test
Projects
1. Project No. 5 - eccentric action of normal force
2. Project No. 6 - internal forces in 3D systems
Defense of project no. 5
3. Internal forces in 3D systems - continuation
4. Project no. 7 - beams subjected to complex loads (also torsion)
Defense of project no. 6
5. Project No. 8 - determining the critical force for a compressed bar
Defense of project no. 7
6. Defense of project No. 8
7. Submission of projects (additions)
Laboratories
1. Providing the rules for the implementation of laboratory exercises, providing health and safety rules
2. Exercise No. 1. Metals - tensile test
3. Exercise No. 2. Analysis of a flat truss loaded with concentrated force
4. Exercise No. 3. Beam analysis - simple bending
5. Exercise No. 4. Torsion of a rod with a circular cross-section - determining of the shear modulus
Exercise No. 5. Skew bending of a rod
6. Photoelasticity. Determination of the photoelasic constant.
7. Determination of critical load
8. Test

Teaching methods

Information lecture
Practice method
Project method
Laboratory method

Bibliography

Basic
1. A. Gawęcki, Mechanika materiałów i konstrukcji prętowych, tomy 1 i 2, Wydawnictwo Politechniki. Poznańskiej 1998.
2. A. Boruszak, R. Sygulski, K. Wrześniowski, Wytrzymałość materiałów, doświadczalne metody badań, PWN, 1984.
3. J. Dębiński, J. Grzymisławska, Wytrzymałość Materiałów cz.1-5, Wydawnictwo Politechniki Poznańskiej, 2019-2023.
4. J. Dębiński, J. Grzymisławska, Ćwiczenia laboratoryjne z wytrzymałości materiałów, Wydawnictwo Politechniki Poznańskiej, 2016.
Additional
1. S. Piechnik, Wytrzymałość materiałów, Politechnika Krakowska, Kraków 1999
2. A. Jakubowicz, Z. Orłoś, Wytrzymałość Materiałów, tomy 1 i 2, WNT, Warszawa, 1999 i 1997
3. Z. Cywiński, Mechanika budowli w zadaniach. Układy statycznie wyznaczalne, PWN Warszawa 1999
4. J. Grabowski, A. Iwanczewska, Zbiór zadań z wytrzymałości materiałów, Oficyna Wydawnicza Politechniki Warszawskiej, 1994.

Breakdown of average student's workload

	Hours	ECTS
Total workload	110	5,00
Classes requiring direct contact with the teacher	60	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	50	2,00