COURSE DESCRIPTION CARD - SYLLABUS

Course name
Strength of materials II [N2MiBM1>WM]

Course

Field of study
Mechanical Engineering

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
part-time

Requirements
compulsory

Number of hours

Lecture
12

Laboratory classes
8

Other (e.g. online)
0

Tutorials
10

Projects/seminars
0

Number of credit points

4,00

Coordinators

Lecturers

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Prerequisites

A student has basic knowledge about mathematics, strength of materials, engineering graphics and other areas of studies. A student has theoretical knowledge of areas of studies. A student can solve basic problems of geometry and mathematical analysis. A student can solve basic problems of solid mechanics. A student can search for necessary information and facts in literature, scientific databases and catalogues. A student can use information and communication techniques for realizing engineering tasks. A student has the ability to self-study. A student understands a need for lifelong learning and acquiring knowledge. A student understands general social results of engineering activities. A student understands a need for teamwork. A student is aware of connections between mathematics, physics and technical sciences.

Course objective

To learn theoretical and practical problems related to endurance analysis based on the mechanical properties of materials as the basis for proper design of different constructions. Acquaintance with advanced issues of strength of materials II in theoretical terms and practical applications, including: stability of bar systems, beams on elastic substrate and Clapeyron’s systems. Delivering in understandable form selected endurance issues using energy methods, ie reciprocal-work theory and reciprocal-displacement theory, Castigliano"s theories and Castigliano-Menabre"s least work, Maxwell- Mohr"s methods and forces. Strength calculations of frames and arcs by displacement and force method. Transmission of selected computational issues from the strength of materials II construction elements under the influence of basic loads and complex loads. Design of technological connections and analysis of deformation and displacement in various types of structures or parts of structures such as rods, shafts, beams and flat frames.

Course-related learning outcomes

Knowledge:
1. Graduate has extended and well-founded knowledge in mathematics and has ordered, theoretically founded general knowledge in the subject of analytical mechanics.
2. Graduate has extended and well-founded knowledge in the field of strength of materials, understands basic models and calculation methods used in design.
3. Graduate has knowledge in the area of theory of plasticity and elasticity, is familiar with the basics of the theory of plasticity and elasticity. He/she knows which phenomena in nature and technology refer to the theory of plasticity and elasticity.
4. Graduate has knowledge in the area of computer aided modelling of machine design including simplifying assumptions in modelling, creation of a physical model of a mechanical system.

Skills:
1. Graduate knows how to retrieve information from literature, databases and other properly selected sources, also in English or another language deemed as the language of international communication in the area of the course; knows how to integrate the retrieved information, how to integrate and interpret it and then critically evaluate as well as to how draw conclusions and formulate and fully justify opinions.
2. Is able to work individually and in teams, knows how to use information and communication technologies typically used in implementation of engineering activities, knows how to use a variety of techniques to communicate in a team and in an environment, also in English or another foreign language deemed as the language of international communication in the area of mechanical engineering. Knows how to prepare and deliver an oral presentation in Polish and in a foreign language on detailed issues in mechanics and mechanical engineering.
3. Knows how to formulate selection criteria for a relevant mathematical method to solve a given engineering problem. He/she knows how to apply a relevant mathematical method to solve an engineering problem.
4. Knows how to carry out strength analyses of elements of machines and mechanical systems by means of basic methods of advanced strength analysis of construction, stability, by means of energy-based methods in strength analysis of construction.
5. Knows how to apply basic laws of analytical mechanics and simplified models to solve simple problems in the area of mechanics and mechanical engineering and knows how to select modelling methods in design, how to carry out basic calculations in modelling, how to select effective optimization procedures for practical engineering applications.

Social competences:
1. Is well aware of the necessity for continuous learning; knows how to inspire and organize the process of learning of other people.
2. Is aware of the importance and understanding of non-technical aspects and results of engineering activities including its influence on the environment involving responsibility for decisions taken.
3. Knows how to cooperate and work in teams assuming various roles within.
4. Knows how to prioritize steps in order to carry out a task either defined by him/herself or by others.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Written and oral examination (3 computational tasks and 5 theoretical questions + conversation with the teacher lecture on the issues of strength II)
- <50% - ndst, >51-60% - dst, >61-70% - dst plus, >71-80% - db, >81-90% - db plus, >91% - bdb
Assessment of tutorials (There are Two tests in a semester and offer solutions to the exercises questions prepared by the teacher training):
- <50% - ndst, >51-60% - dst, >61-70% - dst plus, >71-80% - db, >81-90% - db plus, >91% - bdb
Self-semester work,
Assessment: activity at lectures and accounting exercises.
Laboratories:
A positive result is based on discussion led when doing tests (questions on the theory of those tests). Moreover, students need to conduct all tests and all their reports from tests must be approved.Assessment: activity at lectures and accounting exercises.In order to receive a positive grade and pass the course a student needs to achieve more than 50% of total points in each test. The final grade is based on the following rules:
very good – if the ratio of sums of achieved and total points is bigger than 91%,
good plus – if the ratio of sums of achieved and total points is between 81-90%,
good – if the ratio of sums of achieved and total points is between 71-80%,
sufficient plus – if the ratio of sums of achieved and total points is between 61-70%,
sufficient – if the ratio of sums of achieved and total points is between 51-60%.

Programme content

Lectures and tutorials
Beams on elastic foundations, the differential equation of the deflection of the beam, the boundary conditions and expected solution. Compression of bending beams. Loss of stability of compression rods: buckling in the elastic and elastic-plastic range. Generalized forces and generalized displacements. Clapeyron’s systems. Energy methods. Displacement and susceptible description of deformation of elastic structures. Betty"s reciprocal-work theorem and Maxwell"s reciprocal-displacement theorem. Examples of computing. Castigliano’s theorem and Castigliano-Menabre the principle of minimum strain energy. Use of these methods to calculate the displacement of bar structures. The Maxwell-Mohr method of displacement calculation. The canonical equations of force method, force method. Strength calculations of frames and arcs by displacement and force method.
Laboratories
Static tensile strength test, Static torsion strength test, Dynamic measurement of strain gauges (coefficient of dynamic surpluses), Elastoptics and Ultrasonic Defectoscopy.

Teaching methods

1. Lecture: presentation illustrated with examples administered on the blackboard, solving tasks.
2. Exercises: solving tasks on the board (problem solving), discussion.
3. Laboratory exercises: conducting experiments, solving tasks, discussion.

Bibliography

Basic
1. Zielnica J., Wytrzymałość Materiałów, WPP 1996.
2. Ostwald M., Podstawy wytrzymałości materiałów, Wydawnictwo PP, Poznań, 2007.
3. Magnucki K., Szyc W., Wytrzymałość materiałów w zadaniach: pręty, płyty i powłoki obrotowe, Wydawnictwo Naukowe PWN, 2000.
4. Leyko J., Mechanika ogólna t.1, PWN, Warszawa, 1997
Additional
1. Banasik M., Grossman K., Trombski M., Zbiór zadań z wytrzymałości materiałów. PWN 1992.
2. Osiński Z., Mechanika ogólna, PWN, Warszawa, 1994.
3. Ostwald M., Wytrzymałość materiałów. Zbiór zadań. Wydawnictwo PP, Poznań, 2008.
4. Dyląg Z., Jakubowicz A., Orłoś Z., Wytrzymałość materiałów t.1 i 2, WNT, Warszawa, 2000.
5. Polskie Normy.
6. Niezgodziński M. E., Niezgodziński T., Wzory, wykresy i tablice wytrzymałościowe, Wydawnictwo Naukowo-Techniczne Warszawa 2004.
7. Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981.
8. Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

Breakdown of average student's workload

	Hours	ECTS
Total workload	120	4,00
Classes requiring direct contact with the teacher	60	2,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,00