COURSE DESCRIPTION CARD - SYLLABUS

Course name
Strength of materials [N1Mech2>WM]

Course

Field of study
Mechatronics

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
part-time

Requirements
compulsory

Number of hours

Lecture
16

Laboratory classes
8

Other
0

Tutorials
16

Projects/seminars
0

Number of credit points

6,00

Coordinators

Lecturers

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

Familiarizing students with strength of materials and strength tests, teaching students basic concepts of mechanics and strength of materials. Presenting theoretical and practical engineering methods of analysing the strength of structures that are based on material properties. Delivering in understandable form selected strength of materials issues, i.e. modelling indeterminate systems or solving complex strength problems. Showing the restrictions imposed on structures due to their strength, safety and regulations (standards, law). Discussing the methods of solving strength problems in an effective and proper way, highlighting the importance of building and testing prototypes, showing a system approach to solving engineering problems.

Course-related learning outcomes

Knowledge:
The graduate knows and understands the basics of theoretical and experimental analysis of the strength of materials to the extent necessary for the field of study.
Graduate understands basic models and calculation methods used in the construction. He has ordered a basic knowledge of solid mechanics and the strength of materials.
The graduate has basic knowledge of computational methods in the mechanics and strength of materials and has knowledge of material properties tests.

Skills:
Can obtain information from literature, databases and other properly selected sources (also in English) in the field of mechanical engineering and other engineering and technical areas in line with the studied field.
It has the ability to self-learning, including "improving" professional competence.
He can carry out basic tests of mechanical properties of materials and measurements of stress in structural elements and operate specialized equipment research.
Can use mathematical apparatus to describe concepts of mechanics, technological structures and processes, can apply known methods and mathematical models as well as computer simulations to analyze and evaluate the performance of components and systems in devices. Can formulate problems and knows how to use mathematical methods in engineering practice.
Can solve technical problems based on laws of mechanics and perform analysis of the strength of machines and mechanical.

Social competences:
Understands the need for lifelong learning; can inspire and organize the learning process of others
He/she realizes the importance of non-technical aspects and effects of engineering activities, including its impact on the environment and the associated responsibility for making decisions.
Can cooperate and work in a group adopting different roles.
Can accurately identify priorities for implementation of tasks assigned by him/her or others.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during the lecture is verified during the exam, which consists of a calculation task and 5 theoretical issues:
- <50% - ndst, >51-60% - dst, >61-70% - dst plus, >71-80% - db, >81-90% - db plus, >91% - bdb
Knowledge and skills acquired during the exercises are verified on the basis of 4 tests written during the semester:
- <50% - ndst, >51-60% - dst, >61-70% - dst plus, >71-80% - db, >81-90% - db plus, >91% - bdb
Laboratories are awarded based on the oral answer from the theory of the exercise during laboratory exercises. We get credit on condition that all the exercises are completed and the teacher accepts all reports.

Programme content

Statically determinate and indeterminate bar systems and bar-beam systems.
Moments of inertia of plane areas.
Twisting of shafts and rods with rectangular cross section.
Bending of beams with constant and variable stiffness.
Compound stresses.
Experimental methods - Static tensile strength test, Hardness measurements, Fatigue of materials, Static measurement of strain gauges, Characteristics of springs, Impact bending test.

Course topics

Lectures and tutorials:
Basic concepts of statics. Definition of force, division of forces, systems of forces. Constrains and constrains reactions. Internal forces. One-dimensional stresses and deformations state. Stress-strain diagrams. Hooke's Law. Equilibrium conditions of plane force systems. Statically determinate and indeterminate bar systems and bar-beam systems. Shearing stresses, non-dilatational strain (deviatoric strain). Generalized Hooke's law. Allowable stress, factor of safety structural and strength condition.

Mohr’s circle of stress. Material failure theories. Moments of inertia of plane areas, centroids of cross section, main principal axes (principal moment of inertia). Steiner's theorem (parallel axis theorem). Twisting of shafts and rods with rectangular cross section. Bending of beams with constant and variable stiffness. Shear-force and bending-moment diagrams in bending beam. Normal stresses and shear stresses in beams. Deformation of beams bent (deflection and angle of rotation): direct integration of the differential equation of the elastic line, the generalized equation of the elastic line a beam (Clebsch's method). Solving statically indeterminate beams: the analytical method, application of the universal of integration of the elastic line equation. Equation of neutral axis. Compound stresses: compression (tension) and bending, bending and torsion.
Laboratories:
Static tensile strength test, Hardness measurement methods: Brinell, Vickers and Poldi, Rockwell hardness measurement method and the measurement method of the Vickers microhardness, Fatigue of materials (Locati method), Static measurement of strain gauges: measurement of stresses in the thin-walled tank, Characteristics of springs, Impact bending test.

Teaching methods

Lecture: multimedia presentation illustrated with examples given on a board, problem solving.
Tutorials: problem solving, discussion.
Laboratory: performing experiments, calculations and selection of test parameters.

Bibliography

Basic:
1. Zielnica J., Wytrzymałość Materiałów, WPP, wyd. III, Poznań 2000, str. 554.
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.
5. Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, WNT, Warszawa, 1984.

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. Niezgodziński M. E., Niezgodziński T., Wzory, wykresy i tablice wytrzymałościowe, Wydawnictwo Naukowo-Techniczne Warszawa 2004.
6. Willems N., Easley T. J., Rolfe S. T., Strength of Materials, Mc GrawHill Book Company, 1981.
7. Gere M., Timoshenko S., Mechanics of Materials, PWS-Kent Publishing Company, Boston, 1984.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
Classes requiring direct contact with the teacher	42	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	108	4,50