COURSE DESCRIPTION CARD - SYLLABUS

Course name
Strength of materials [S1MiTPM1>WM]

Course

Field of study
Materials and technologies for automotive industry

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
30

Laboratory classes
15

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Basic knowledge of mathematics, mechanics, engineering graphics and other areas of training in the field of study. Structured theoretical knowledge of the field of study. Solving basic tasks in geometry and mathematical analysis. Solving basic problems of solid mechanics. Ability to find the necessary information in literature, databases, catalogs. Use of information and communication techniques appropriate for engineering tasks. Ability to study independently. Understanding of the need for lifelong learning and acquisition of new knowledge. Understanding of the society-wide impact of engineering activities. Understanding of the need to undertake teamwork. The student is aware of the interrelationship between mathematical knowledge, physical knowledge, technical sciences, biology and medicine.

Course objective

To learn the methods of testing the strength of materials and checking the strength of structures, to master the basic principles of mechanics and strength analysis. To learn the theoretical and practical problems of strength analysis based on the mechanical properties of materials, as a basis for the proper design of structures. To convey selected strength issues in an understandable form. To point out the constraints necessary in construction due to safety and reliability, regulations, standards. To indicate the areas of acceptable solutions, effective solutions to the problem. To raise awareness of the complexity of construction: the need for construction and testing of prototypes, the formulation of conditions for safe operation, the need for a systematic approach to problems.

Course-related learning outcomes

Knowledge:
1. Student has knowledge in mathematics including algebra, analysis, theory of differential equations, probability, analytical geometry necessary to: describe the operation of discrete mechanical systems, understand computer graphics methods, describe the operation of electrical and mechatronic systems.
2. Student knows the basic concepts of mechanics: statics, dynamics and kinematics. He knows and understands the principles of statics and the equilibrium conditions of plane force systems.
3. Student should know how to characterize the basic methods of strength testing of materials and methods of checking the strength of structures.
4. Student shall have knowledge of: determination of external and internal forces and moments, determination of stresses and displacements in bars and bar systems, torsion of bars with circular sections.
5. Student knows and understands the determination of normal stresses in beams and the determination of elements of the deflection line of beams. Has theoretical and practical knowledge of basic strength testing.

Skills:
1. Student is able to obtain information from literature, databases and other appropriately selected sources (including in English).
2. Studnet is capable of self-education and logical thinking.
3. Studnet is able to conduct and develop basic strength tests.
4. Student is able to carry out strength calculations of structures and formulate basic problems in the language of mechanics and solve them (in tension, compression, torsion and bending), is able to freely convert units according to the SI system.
5. Student is able to critically analyze the way of functioning and evaluate existing technical solutions from the field of materials engineering and technologies used in the automotive industry.

Social competences:
1. Student understands the need for lifelong learning, is able to inspire and organize the learning process of others.
2. Student is able to cooperate in a group, assuming various roles in it.
3. Student is able to set priorities for the realization of a task defined by him/herself or others.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: An exam consisting of a practical part (solving calculus tasks, 2-3 tasks)
and theoretical part (open questions and closed questions, about 5 tasks - depending on the level of difficulty).
0-50% - ndst
51-60% - dst,
61-70% - dst plus,
71-80% - db,
81-90% - db plus,
91% - bdb
Exercises: One or two colloquia on checking the strength of different types of structures (if two, then one in the middle of the semester and the other at the end of the semester; if one, then at the end of the semester).
0-50% - ndst

51-60% - dst,
61-70% - dst plus,
71-80% - db,
81-90% - db plus,
91% - bdb
Laboratory: Credits on the basis of discussions (with a grade) on the theory during laboratory exercises, provided that all exercises are completed and all reports are accepted by the instructor.

Programme content

Lecture: Introduction to strength of materials. Tension and compression. Geometrical characteristics of plane figures. Torsion of shafts. Bending of beams. Composite strength.
Exercises: Tension and compression. Geometrical characteristics of plane figures. Torsion of shafts. Bending of beams. Composite strength.
Laboratory: Determination of mechanical properties of structural materials using experimental methods.

Course topics

Lecture: Basic concepts in statics. Definition of force, division of forces, systems of forces. Ties and reactions of ties. Internal forces. Uniaxial state of stress and strain. Stretch diagram. Hooke's law. Equilibrium conditions of plane force systems. Statically determinable and non-determinable bar systems. Tangential stresses, form strains. Generalized Hooke's law. Allowable stresses and factor of safety of structures. Moments of inertia of plane figures, center of gravity of a section, principal central axes of inertia. Steiner's theorem. Torsion of shafts and rods of circular cross-section. Diagrams of bending moments and transverse forces. Normal and tangential stresses in bent beams. Deflections of beams. Statically indeterminate beams - Clebsch's method. Statically indeterminate beams. Material strain hypotheses. Eccentric compression. Composite strength.
Exercises: Bar and bar-beam systems statically determinate and statically indeterminate. Geometrical characteristics of plane figures. Torsion of shafts - statically determinate and statically indeterminate systems. Bending of beams - statically determinate and statically indeterminate systems.
Laboratory: Static tensile test. Measurement of hardness by Brinell, Vickers, Poldi, Rockwell methods, Measurement of microhardness by Vickers method. Fatigue of materials. Impact test. Characterization of springs. Strain gauging.

Teaching methods

Lecture: presentation illustrated by examples given on the blackboard, solving tasks.
Exercises: solving tasks, discussion.
Laboratory: 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.
5. Badania eksperymentalne w wytrzymałości materiałów. Pod redakcją S. Joniaka, WPP. 2006.

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.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	63	2,50