STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Strength of Materials	**1010101121010100028**

Field of study	Profile of study (general academic, practical)	Year /Semester
Sustainable Building Engineering First-cycle	**(brak)**	**1 / 2**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
-	**English**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
First-cycle studies	**full-time**

No. of hours	No. of credits
Lecture: **45** Classes: **30** Laboratory: **15** Project/seminars: **30**	**8**

Status of the course in the study program (Basic, major, other)	(university-wide, from another field)
(brak)	**(brak)**

Education areas and fields of science and art	ECTS distribution (number and %)
technical sciences	**8 100%**
Technical sciences	**8 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Mathematics: algebra (including matrix calculus), mathematical analysis (including differential and integral calculus), geometry, planimetry, trigonometry - level 6 of KRK. Physics at level 5 of KRK. Theoretical mechanics: knowledge of the equilibrium equations and internal forces in rod elements of a structure - level 6 of KRK.
2	**Skills**	Mathematics: skills of calculation of derivatives and integrals of functions, the ability to use matrix calculus - level 6 of KRK. Physics: ability to apply the principles of Newton - level 5 of KRK. Theoretical mechanics: the ability to use the balance equations to determine the reactions and internal forces in statically determined bar systems - level 6 of KRK.
3	**Social competencies**	Students can work in groups. The student follows the rules of ethics.

Assumptions and objectives of the course:

Acquire the knowledge, skills and competence in solving problems of stress, strain and displacement in the rod elements of the structure and mechanics of materials.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student has knowledge of the strength of materials and principles of general structure design: knows the basic concepts of material strength (stress, strain, displacement, axis of gravity and main cross-section, isotropy, homogeneity), knows physical and geometrical relationships and strength hypotheses for linear theory (obtained on lecture) - [KSB_W04]

2. Student knows the principles of structural theory and analysis of rod systems in the field of statics and stability (obtained at the lecture) - [KSB_W06]

Skills:

1. Student is able to perform static analysis of bar structures: calculate stresses at the bar cross-section for basic cases of internal forces, determine beam displacements using differential equations, determine the critical force for basic axial compression cases (obtained on exercises and projects) - [KSB_U06]

2. Student is able to conduct laboratory experiments leading to the determination of basic material and strength parameters of building materials (obtained during laboratory classes) - [KCB_U08]

Social competencies:

1. Student is responsible for the reliability of the obtained results of their work and their interpretation - [KSB_K02]
2. Student has the ability to critically evaluate the results of their own work - [KSB_K08]

Assessment methods of study outcomes

Description of the methods to check the effects

Evaluation of lectures

Written exam (duration: 120 minutes) on the date specified at the beginning of the semester (effect KSB_W04, KSB_W06, KSB_U06, KSB_U08, KSB_K02, KSB_K08). 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

Auditorium classes are counted on the basis of positive grades (at least 3.0) from tests (duration of each 90 minutes), dates given at the beginning of the semester (KSB_W04, KSB_W06, KSB_U06, KSB_U08, KSB_K02, KSB_K08).

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

Design exercises are counted on the basis of positive grades (at least 3.0) from project tasks. Design exercises are subject to individual defense (oral or written form) (effect KSB_W04, KSB_W06, KSB_U06, KSB_U08, KSB_K02, KSB_K08).

Rating scale: very good (5.0), good plus (4.5), good (4.0), satisfactory plus (3.5), satisfactory (3.0), insufficient (2.0)

Laboratory assessment

Laboratory exercises are counted on the basis of positive grades (at least 3.0) from laboratory exercises reports and minimum 1 colloquium. Reports are subject to defense by the team performing the exercise (oral or written form) (effect KSB_W04, KSB_W06, KSB_U06, KSB_U08, KSB_K02, KSB_K08).

Rating scale: very good (5.0), good plus (4.5), good (4.0), satisfactory plus (3.5), satisfactory (3.0), insufficient (2.0)

Course description

Lectures

1. Geometrical parameters of figures
2. Theory of experimental research methods
3. Normal force, bending moment (bending straight)
4. Shear force
5. Principal stresses
6. Skew bending
7. Eccentric action of normal force
8. Normal stresses under the foundation
9. Torsion of circular and thin-walled closed sections
10. Torsion of rods with a thin-walled open section
11. Determination of beams displacements
12. Stability of rod systems
13. Strain state, physical (constitutive) relations
14. Strength hypotheses
15. Stress state at a point

Exercises

1. Determination of internal forces in systems subjected to non-uniform loading
2. Determination of geometric parameters of figures
3. Determination of geometrical parameters of figures, analysis of axially loaded bars
4. Bending moment action. Designing of cross-sections in bending, stresses in a rectangular cross-section
5. Shear force in the I-section and box section
6. Colloquium
7. Skew bending
8. Eccentric action of normal force
9. Cantilever beam in a complex load condition
10. Determination of normal stresses under foundations
11. Determination of beam displacements

12. Determination of the critical force of compressed rods
13. Stress analysis at a point
14. Colloquium
15. Retrieval test

Projects
1. Explanation of organizational principles, discussion of subject matter, project commissioning
2. Project No. 1 - determination of internal forces in beams
3. Project No. 2 - determination of internal forces in frames
4. Project No. 3 ? determination of geometrical parameters of a symmetrical cross-section.
5. Defense of projects No. 1 and 2.
6. Project No. 4 ? determination of geometrical parameters of an asymmetrical cross-section
7. Defense of projects no. 3 and 4
8. Project No. 5 - determination of stresses in beams
9. Defense of project No. 5
10. Project No. 6 - skew bending of a beam
11. Project No. 7 - eccentric action of normal force
12. Project No. 8 - beams subjected to complex loads (also torsion)
13. Defense of projects no. 6, 7, 8
14. Project No. 9 - determining the critical force for a compressed rod
15. Submission of project No. 9.

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

METHODS OF EDUCATION
Information lecture
Practice method
Project method
Laboratory method

Basic bibliography:

1. S. Timoshenko, Strength of materials, P. 1, Elementary theory and problems, Van Nostrand Reinhold Company 1970.
2. R.D. Snyder, E.F. Byars, Engineering mechanics: statics and strength of materials, McGraw Hill Book Company, cop. 1973.

Additional bibliography:

1. G.M. Seed, Strength of materials: an undergraduate text, Saxe-Coburg Publications, 2000
2. B. Skalmierski, Mechanics and strength of materials, PWN-Polish Scientific Publishers ; Elsevier Scientific Publishing Company, 1979.
3. B. Turoń, G. Piątkowski, Strength of materials: internal forces in statically determinate structures ? examples for beams, Politechnika Rzeszowska im. Ignacego Łukasiewicza. Oficyna Wydawnicza, 2015.

Result of average student's workload

Activity	Time (working hours)

1. Participation in the lectures (contact hours)	45
2. Participation in the classes (contact hours)	30
3. Participation in the laboratory classes (contact hours, practical)	15
4. Participation in the project classes (contact hours, practical)	30
5. Preparations for laboratory classes (self-study)	7
6. Reports from laboratory experiments (self-study)	8
7. Completion (at home) project exercises (self-study, practical)	30
8. Participation in the consultations (contact hours)	5
9. Exercises before classes tests (self-study)	15
10. Exercises before projects defense (self-study)	10
11. Exercises before the final exam (self-study)	12
12. Participation in the final exam (contact hours)	3

Student's workload

Source of workload	hours	ECTS
Total workload	210	8
Contact hours	128	5
Practical activities	75	3