GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Strength of Materials, PG_00044376						
Field of study	Civil Engineering						
Date of commencement of studies	October 2025		Academic year of realisation of subject	2026/2027			
Education level	first-cycle studies		Subject group				
Mode of study	Part-time studies		Mode of delivery	at the university			
Year of study	2		Language of instruction	Polish			
Semester of study	3		ECTS credits	8.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Department of Mechanics of Materials and Structures -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Tomasz Ferenc				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	10.0	10.0	10.0	0.0	60
	E-learning hours included: 0.0						
	eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=1346						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours	Self-study	SUM	
	Number of study hours	60		7.0	133.0	200	
Subject objectives	Determination of stresses, strains and deflections in bar elements. Identification of the problems of Strength of Materials. Analysis of complex stress states. Stability analysis of structural elements. Assessment of limit load carrying capacity of cross-sections of bar elements.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U01] Apply knowledge and understanding of mathematics as well as sciences and engineering disciplines underlying civil engineering to solve engineering problems and issues.	The student uses knowledge of mathematics, physics, structural statics and strength of materials to solve problems in structural mechanics, including solving computational tasks	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment
[K6_W02] Demonstrate knowledge and understanding of the processes and established methods of analysis / solution of engineering issues & problems in the field of civil engineering and of their limitations.	The student transforms stresses and strains in plane states. The student determines stresses based on internal forces in bar systems. The student dimensions sections of members due to ultimate and serviceability limit states. The student recognises elastic and plastic/boundary state dimensioning. The student analyses the stability of a structure and its components.	[SW1] Assessment of factual knowledge
[K6_W05] Demonstrate knowledge and understanding of research methods (obtaining information, simulations, experimental methods) in the field of civil engineering.	The student transforms stresses and strains in plane states. The student determines stresses based on internal forces in bar systems. The student dimensions sections of members due to ultimate and serviceability limit states. The student recognises elastic and plastic/boundary state dimensioning. The student analyses the stability of a structure and its components.	[SW1] Assessment of factual knowledge
[K6_U05] Conducts research (obtaining information, simulations, experimental methods) in the field of construction in order to solve specific tasks and report research results.	The student solves tasks and design issues. The student prepares a report on the calculations made.	[SU1] Assessment of task fulfilment
[K6_K03] Can effectively, clearly and unambiguously convey information, describe activities and communicate their results/ outcomes to engineers or a wider audience using appropriate communication methods and tools.	The student presents the results of the calculations carried out in an understandable way and gives clear and adequate answers to the questions concerning them.	[SK5] Assessment of ability to solve problems that arise in practice [SK4] Assessment of communication skills, including language correctness [SK3] Assessment of ability to organize work

Subject contents

Course content – lecture

Assumptions and the scope of Strength of Materials (SM). Stress and strain - definitions. Plane stress and plane strain. Three-dimensional stress and strain state. Hookes law (constitutive relations). Classification of problems of Strength of Materials. Geometrical parameters of cross-sections. Axial tension (compression), stress concentration. Results of laboratory tests of materials: tension/compression. Uniaxial and biaxial bending. Bending with tension/compression, core of the cross-section, eccentric compression with the tension zone excluded. Free torsion of rods. Circular and rectangular cross-sections. Open thin-walled cross-sections, closed thin-walled cross-sections (Bredt formulae). Joints of structural elements. Shear stresses at bending. Open thin-walled cross-sections, shear centre (bending centre). Compound and multiple beams. Composite beams tension/compression, bending. Deflection line of a beam. Eulers equation, integration methods. Moment-area method (Mohrs method). Redundant cases. Potential energy of elastic strain. Clapeyrons theorem. Unit energy of elastic strain (shear, compression, bending, torsion). Castiglianos theorems calculating deflections (beams, frames, trusses), graphical integration. Stability of beams. Elastic and inelastic buckling. Design of axially compressed beams. Strength criteria, equivalent stresses. Elements of plasticity theory. Material models. Limit load-carrying capacity of a cross-section (axial tension/ compression, bending, tension/compression with bending). Plasticity zones of a beam. Cables.

Course content – exercises

Geometrical parameters of cross-sections. Axial tension (compression). Stress and strain - definitions. Plane stress and plane strain. Three-dimensional stress and strain state. Hookes law (constitutive relations). Bending with tension/compression. Free torsion of rods. Shear stresses at bending. Joints of structural elements. Compound and multiple beams. Deflection line of a beam. Eulers equation, integration methods. Stability of beams.

Course content – laboratory

Static tensile test. Determination of Young's modulus and Poisson's ratio. Bending test. Free torsion of a ring-shaped bar. Bending center. Deflection line of a bent beam. Stability of rods. Ultimate load-bearing capacity. Deformation of a cable.

Course content – project

Geometrical parameters of cross-sections. Axial tension (compression). Stress and strain - definitions. Plane stress and plane strain. Three-dimensional stress and strain state. Hookes law (constitutive relations). Bending with tension/compression. Free torsion of rods. Shear stresses at bending. Joints of structural elements. Compound and multiple beams. Deflection line of a beam. Eulers equation, integration methods. Stability of beams.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">Mechanics of Structures - determination of diagrams of internal forces in beam, frame and truss systems

Mathematics - basics of matrix calculus

Physics - the basics of the theory of elasticity</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>test (theoretical part)</td><td>60.0%</td><td>30.0%</td></tr>
<tr><td>project</td><td>60.0%</td><td>10.0%</td></tr>
<tr><td>laboratory</td><td>60.0%</td><td>10.0%</td></tr>
<tr><td>exam (computational tasks)</td><td>60.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">1. Bielewicz E. WYTRZYMAŁOŚĆ MATERIAŁÓW
2. Jastrzębski, Mutermilch, Orłowski WYTRZYMAŁOŚĆ MATERIAŁÓW
3. Jakubowicz, Orłoś WYTRZYMAŁOŚĆ MATERIAŁÓW
4. Orłowski, Słowiański WYTRZYMWŁOŚĆ MATERIAŁÓW. Przykłady obliczeń.
5. Zakrzewski, Zawadzki WYTRZYMAŁOŚĆ MATERIAŁÓW
6. Rżysko J. STATYKA I WYTRZYMAŁOŚĆ MATERIAŁÓW
7. Piechnik S. WYTRZYM. MAT. DLA WYDZ.BUDOWLAN.
8. Więckowski J. WYTRZYMAŁOŚĆ MATERIAŁÓW. Przykłady i teoria.
9. Piskorski, Trębacki ZBIÓR ZADAŃ Z WYTRZ. MATER.
10. Łączkowski R. WYTRZYMAŁOŚĆ MATERIAŁÓW
11. Praca zbiorowa prac. KMBiM, red. Czesław Szymczak ZBIÓR ZADAŃ Z WYTRZYMAŁOŚCI MATERIAŁÓW</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">no items</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">Computational problems in the following areas:
- Determining stresses in compression, bending, shear and torsion
- Determining principal stresses, Hooke's law
- Load-bearing capacity of bolted connections
- Stability of a bar under axial compression
Theoretical problems in the following areas:
- Concepts of stress and strain
- Geometric characteristics of plane figures
- Linear and nonlinear analyses, orders of structural theory</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="3">Not applicable</td></tr>
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