GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Strength of Materials, PG_00062069						
Field of study	Civil Engineering						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2025/2026			
Education level	first-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery	at the university			
Year of study	2		Language of instruction	Polish			
Semester of study	3		ECTS credits	6.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Department of Mechanics of Materials and Structures -> Faculty of Civil and Environmental Engineering -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Magdalena Rucka				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	45.0	30.0	0.0	15.0	0.0	90
	E-learning hours included: 0.0						
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	90		0.0	0.0	90	
Subject objectives	Determination of stresses, strains and deflections in bar elementsIdentification of the problems of Strength of MaterialsAnalysis of complex stress statesStability analysis of structural elementsAssessment of limit load-carrying capacity of cross-sections of bar elements.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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 has knowledge of structural statics and strength of materials, describes the behaviour of structures under external influences and analyses the extent to which analytical models are valid. The student recognises basic material models and identifies strength cases.	[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_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	[SU1] Assessment of task fulfilment [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
[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 [SK3] Assessment of ability to organize work [SK4] Assessment of communication skills, including language correctness

Subject contents

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). Boundary problem of linear elasticity theory. Classification of problems of Strength of Materials. Axial tension (compression), statically indeterminate cases, stress concentration. Results of laboratory tests of materials: tension/compression. Geometrical parameters of cross-sections. 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. Beams on elastic foundation, Winklers hypothesis. 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. Stresses perpendicular to the beam axis under bending. Curvilinear beams, tension/compression, bending. Elements of rheology, time-dependent material models. Results of laboratory tests of materials: creep, relaxation and fatigue tests. Restrained torsion of open-shaped thin-walled cross-sections.

Prerequisites and co-requisites

Course Engineering Mechanics should be completed. Course Experimental Methods in Strength of Materials should be taken.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	60.0%	80.0%
Project tasks	60.0%	20.0%

Recommended reading	Basic literature	Bielewicz E.: Wytrzymałość materiałów. Politechnika Gdańska, Gdańsk 1968, 1972, 1977, 1980, 1984, 2001, 2006. Szymczak Cz., Skowronek M., Witkowski W., Kujawa M.: Wytrzymałość materiałów. Zadania. PG, Gdańsk 2002, 2009. Dyląg Z., Jakubowicz A., Orłoś Z.: Wytrzymałość materiałów, tom I, Wydawnictwa Naukowo-Techniczne, 2003. Chróścielewski J.: Materiały pomocnicze do wykładu z Wytrzymałości Materiałów (na portalu eNauczanie).
	Supplementary literature	Piechnik S.: Wytrzymałość materiałów, podręcznik dla studentów wyższych szkół technicznych. PK, Kraków 2000. Jastrzębski P., Mutermilch J., Orłowski W.: Wytrzymałość materiałów. Arkady, Warszawa 1974. Orłowski W., Słowiański L.: Wytrzymałość materiałów, przykłady obliczeń. Arkady, Warszawa 1978. Jakubowicz A., Orłoś Z.: Wytrzymałość materiałów. WNT, Warszawa 1968. Magnucki K., Szyc W.: Wytrzymałość materiałów w zadaniach, PWN, Warszawa-Poznań 1987. Dyląg Z., Jakubowicz A., Orłoś Z.: Wytrzymałość materiałów, tom II, Wydawnictwa Naukowo-Techniczne, 2003.
	eResources addresses	
Example issues/ example questions/ tasks being completed	Determine axial forces in a truss / truss-frame system, determine stresses and deflections. Draw the normal stress diagram at a cross-section of a beam at bending, determine the allowable load due to elastic load-carrying capacity. Determine buckling load of a bar, given boundary conditions and a cross-section, perform the elastic buckling check.	
Work placement	Not applicable	

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