



## Subject card

Subject name and code	Strength of Materials, PG_00055417						
Field of study	Mechatronics						
Date of commencement of studies	October 2023		Academic year of realisation of subject			2024/2025	
Education level	first-cycle studies		Subject group			Obligatory subject group in the field of study Subject group related to scientific research in the field of study	
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 and Mechatronics -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Wiktoria Wojnicz				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	15.0	0.0	0.0	75
	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	75		6.0		69.0	150
Subject objectives	The aim of the course is to familiarize students with methods applied in the area of strength of materials						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W04] has organized and theoretically supported, advanced knowledge in the field of general mechanics, strength of materials, theory of mechanisms and machine dynamics, fluid dynamics, hydraulics and pneumatics, machine construction and engineering graphics	The student has the ability to analyze the basics of material strength, the compressive / tensile strength of a straight bar, strength analysis for statically indeterminate bar systems, torsional strength of bars, beam strength - bending, deformation of a bent beam, bar shear (shear bar), stress states, stress state and deformations, methods of determining stresses (shear forces, bending moments) and deformations for statically indeterminate bar systems, determination of elastic energy, stresses and deformations of bars and bar systems - energy methods, determination of elastic energy, stresses and deformations of beams and frames using the Maxwell method -Mohra, bar buckling, basics of the finite element method FEM. The student has the ability to model issues related to the strength of materials in the field of rigid bodies, biomechanics, mechanical systems, vibrations and basic mechanical structures.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects
	[K6_U01] is able to acquire information from literature, databases and other, properly chosen sources, integrate these information, interpret them, draw conclusions and formulate opinions	The student has the ability to solve basic problems related to the strength of materials, including the performance of simple engineering tasks. The student has the ability to analyze basic issues related to the strength of materials in the field of theory and solving simple tasks and practical problems. This includes the topics mentioned in the subject purpose and later. The student has the ability to assess the usefulness of the presented content both from the point of view of designing technical objects and their operation in the broadly understood technology, energy and environmental protection.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
	[K6_U03] has self-learning skills	The student has the ability to analyze basic issues related to the strength of materials in the field of theory and solving simple tasks and practical problems. This applies to the topics mentioned in the purpose of the subject.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task

Subject contents	<b>LECTURES/TUTORIALS</b>  Area moments of inertia. Tension and compression of bars. Statically indeterminable problems. Thermal and assembly deformations. Torsion of bars. Bending of beams. Determination of inner forces and stresses in bars (dimensioning). Plane state of stresses. Mohrs circle. Principal stresses and maximum shear stresses. Theorem of Castigliano. Theorem of Menabrei-Castigliano. Method of Maxwell-Mohr. Buckling investigation. Calculation of statically indeterminable systems with a use of the force method. Unsymmetrical beam bending. Eccentric loading. Bending of thin-walled bars. Bending of curved bars. Calculation of thin-walled shells of revolution. Determination of stresses of the pressure vessels. Calculation of thick-walled cylindrical shells. The Lamé problem. Calculation of thick-walled pipes.  <b>LABS</b>  Static tensile and compression tests. Metal tension test: determination of elasticity modulus, conventional elasticity limit and conventional plasticity limit. Investigation of metal hardness. Metal torsion test and determination of shape elasticity modulus. Beam deflection investigation. Metal impact strength test. Impact test of a metal tension.		
Prerequisites and co-requisites	The student should have basic information in the field of applied physics and mathematics, mathematical analysis, numerical methods, solid state mechanics, including kinetics and dynamics, technical drawing and the basics of programming.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Tutorials passing	56.0%	30.0%
	Labs passing	56.0%	30.0%
	Lectures passing	56.0%	40.0%
Recommended reading	Basic literature	<ol style="list-style-type: none"><li>1. Bąk R., Burczyński T.: Wytrzymałość materiałów z elementami ujęcia komputerowego. WNT, Warszawa 2001.</li><li>2. Dyląg Z., Jakubowicz A., Orłoś Z.: Wytrzymałość materiałów. WNT, Warszawa, t. I 1996, t. II 1997.</li><li>3. Misiak J.: Mechanika techniczna. Statyka i wytrzymałość materiałów. WNT, Warszawa 1996.</li><li>4. Kaliński K. J.: Nadzorowanie procesów dynamicznych w układach mechanicznych. Gdańsk: Wydaw. PG 2012.</li><li>5. Gallagher R. H.: Finite element analysis fundamentals. New Jersey: Prentice Hall 1975.</li><li>6. Niezgodziński M.E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. Warszawa: WNT 1996.</li><li>7. Walczyk Z.: Wytrzymałość materiałów. Wyd. PG, Gdańsk t. I 2000, t. II 2001.</li><li>8. Żmuda J.: Projektowanie konstrukcji stalowych. <a href="#">Wydawnictwo Naukowe PWN</a>, 2016.</li></ol>	
	Supplementary literature	<ol style="list-style-type: none"><li>1. Ship Construction by D. J. Eyres, Butterworth-Heinemann, 2001.</li><li>2. Elements of Modern Ship Construction by <a href="#">David J. House</a>, 2010.</li><li>3. Ship Construction 7th Edition, by <a href="#">George J Bruce</a>, Butterworth-Heinemann, May 2012.</li><li>4. Ship Construction and Welding by <b>Mandal</b>, Nisith Ranjan, <a href="#">Springer Series on Naval Architecture, Marine Engineering, Shipbuilding and Shipping</a>.</li></ol>	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"><li>1. Assembly stresses - arise as a result of correcting dimensional differences of the connected elements of the structure. Example. To install a bar of length <math>l</math> between two vertical walls, increase its length by <math>\Delta</math>. A tensile force <math>N</math> appears in the cross-section of the bar, which causes assembly stresses.</li><li>2. Example. A beam with a length of <math>2l</math> and stiffness <math>EI</math>, pinned at its ends, is loaded with a uniformly distributed load <math>q</math> acting on length <math>l</math>. Formulate the equation of deflection angles and deflection axis and determine the deflection angle and deflection at point B.</li></ol>		
Work placement	Not applicable		