GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Theory of Elasticity and Plasticity, PG_00046464		
Field of study	Civil Engineering		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2024/2025
Education level	second-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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Structural Mechanics Department -> Faculty of Civil and Environmental Engineering		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Jarosław Górski	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	30.0	0.0	0.0	0.0	60
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	60	5.0	60.0	125

Subject objectives

Determination of stresses, strains and deflections in 2D systems - plane stress, plates at bending
Choosing the appropriate computational method for a given problem, computational strategies
Determination of safety reserves due to plasticity in 2D and 3D stress states

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W03] has knowledge of Continuum Mechanics, knows rules of static analysis, stability and dynamics of complex rod, shell and volume structures, both in linear and basic nonlinear regime	The student resembles the problems of solid body mechanics in the subject range, is able to match the solid body mechanics domain to the practical engineering directions in structural design	[SW1] Assessment of factual knowledge
[K7_U06] is able to choose proper tools (measuring, analytical or numerical) to solve engineering problems, to acquire, filtrate, proces and analyse data	The student selects the appropriate computational method according to the problem	[SU1] Assessment of task fulfilment
[K7_U03] can perform classic statical and dynamical analysis of rod structures stability (trusses, frames and ties), both statically determined and undetermined as well as surface structures (plates, membranes and shells)	The student formulates and solves the problems of solid body mechanics in the subject range, points out practical application in the engineering structural domain	[SU1] Assessment of task fulfilment
[K7_W04] has knowledge on advanced strength of materials, modeling and optimisation of materials and constructions; has knowledge of fundamentals of Finite Element Method and general nonlinear analysis of engineering constructions and systems	The student resembles the problems of solid body mechanics in the subject range	[SW1] Assessment of factual knowledge

Subject contents	Preliminaries. Assumptions and scope of theory of elasticity. Tensor calculus, Cartesian tensors, tensor algebra, differential operators, integral theorems. Plane stress and plane strain. Airy function in plane stress, plane stress solutions in Cartesian and polar coordinates. Kinematics of continuum, deformation tensors and strain tensors, compatibility conditions. Stress state, Cauchy stress tensor. Balance principles in the theory of elasticity, groups of equations in the theory of elasticity. Constitutive laws, linearly elastic material, generalized Hooke's law, Lame and engineering constants, hyperelastic materials. Boundary problem of elasticity. Two-dimensional problem solution by means of Airy stress function - Cartesian and polar coordinate systems. Theory of thin elastic plates, kinematic assumptions, stresses and strains, equilibrium of a plate, boundary conditions, rectangular and circular plates – examples, plate strips. Elements of theory of plasticity.
Prerequisites and co-requisites	Structural Mechanics Strength of Materials
Assessment methods and criteria	see table below

Subject passing criteria	Passing threshold	Percentage of the final grade
exam	60.0%	100.0%

Recommended reading	Basic literature	1. Bielewicz E.: Strength of Materials. Politechnika Gdańska, Gdańsk 1992. 2. Girkmann K.: Dźwigary powierzchniowe. Arkady, Warszawa 1957 (transl. R. Dąbrowski).
	Supplementary literature	1. Holzapfel G.: Nonlinear Solid Mechanics. A continuum approach for engineers. John Wiley & Sons 2000. 2. Fung Y.C.: Podstawy mechaniki ciała stałego. PWN Warszawa, 1969. 3. Kączkowski Z.: Płyty – obliczenia statyczne. Arkady, Warszawa 1980. 4. Kmiecik M., Wizmur M., Bielewicz E.: Analiza nieliniowa tarcz i płyt. Wyd. PG, Gdańsk 1995. 5. Kreja I.: Mechanika ośrodków ciagłych. Wydawnictwo CURE, Politechnika Gdańska, Gdańsk.
	eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	Express features of the stress distribution in 2D plane systems subjected to point loads Resolve the terms: elasticity, plasticity, brittleness, illlustrate them in figures - diagrams Match the computational methods in engineering bar structure field and advanved 2D and 3D system analysis
Work placement	Not applicable