GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mechanics of materials, PG_00057378		
Field of study	Mechanical Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2022/2023
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	English
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Institute of Ocean Engineering and Ship Technology -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Bogdan Rozmarynowski	
	Teachers	dr hab. inż. Bogdan Rozmarynowski mgr inż. Paweł Bielski	

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	10.0	30.0	100

Subject objectives	1. Providing knowledge in the field of analysis and solving problems of mechanics and strength of one-dimensional systems (bars, beams, frames) and selected two-dimensional systems (plates). 2. Preparing the student to solve problems involving complex cases of material strength. 3. Developing the ability to assess the stability of structural elements (forms of stability loss, critical forces). 4. Consolidation of skills of numerical solutions using FEM (finite element method).

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U06] when solving engineering problems on design, technology and operation of machines is able to assess and classify typical methods and tools, define systemic and ex-technical aspects using modern calculating methods and design tools or modifying the current ones	The student equipped with knowledge in the field of mathematical methods of analysis and numerical experiments can apply it to solve engineering tasks of the mentioned scope using the Finite Element Method tool as a modern and effective computational method implemented in commercial computer systems (e.g. Femap, Ansys, ABAQUS, etc).	[SU3] Assessment of ability to use knowledge gained from the subject
	[K7_W02] possesses a wide and profound knowledge on continuum mechanics and materials strength within the range of modelling and simulating multi-function mechanical systems	The student is able to define the types of planar and spatial bar and surface systems and determine the functions of internal forces (freely supported beams, continuous beams, statically determinate and indeterminate frames, trusses, grids, plates). The student knows how to recognize deformation states (axial and eccentric tension / compression, bending, torsion) and can perform calculations in terms of the state of deformation and stress.	[SW1] Assessment of factual knowledge
	[K7_W01] possesses a profound mathematical knowledge useful in the analysis and description of the operation of complex mechanical systems, technological processes and operating properties of machines and devices; is familiar with the main development trends	The student has the ability to use computational methods as well as strength and material analysis techniques to analyze and describe the operation of the mentioned systems, processes and device properties.	[SW1] Assessment of factual knowledge

Subject contents	**INTRODUCTION** • Definition of MoM (Mechanics of Materials) • Basic structural concepts in MoM • Static indeterminacy • 3D structural members **STRESS and STRAIN** • Stress and strain concepts, 3D Hooks law • Stresses and strains in 1D/2D states • Relationships between elastic constants **MECHANICAL PROPERTIES OF MATERIALS** • Tension and compression tests • Stress strain diagrams • Elastic vs. plastic behaviour • Failure of materials due to creep and fatigue **DEFORMATION STATES** • Tension/compression • Bending • Torsion • Transverse shear • Combined deformations **ENERGY METHODS** • External work and strain energy • Elastic strain energy for various types of loading • Principle of virtual work • Castiglianos theorem **YIELD CRITERIA** • Yield criterion - basics • Tresca and von Mises yield criteria • Effective stress **FINITE ELEMENT METHOD APPROACH TO MoM** • Bar systems • Surface systems **FUNDAMENTALS OF NONLINEAR MECHANICS** • Material (Lagrange) and spatial (Euler) descriptions • Numerical procedures in non-linear mechanics
Prerequisites and co-requisites	The student knows and is able to apply the laws of technical mechanics. He knows and is able to solve simple cases of material strength. He knows the basics of higher mathematics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
TUTORIAL TEST	60.0%	60.0%
EXAM TEST	60.0%	40.0%

Recommended reading

Basic literature	1. Hibbeler R.G.: Mechanics of materials, Prentice-Hall Int. Inc., 10th Ed., 2017, ISBN 10: 0-13-431965-6. 2. Gere J.M., Goodno B., J.: Mechanics of materials. Brief Ed. Cengage Learning, 2011. 1. Sadd M.H. *Elasticity theory, applications and numerics*. Elsevier, Oxford 2005 3. Marti P. Theory of structures, Fundamentals, Framed structures, Plates and Shells. Wilhelm Ernst & Sohn, Berlin, 2013. 4. Zienkiewicz O.C., Taylor R.L.: The Finite Element Method for Solid and Structural Mechanics. 6th edition, Elsevier Butterworth-Heinemann, 2005.
Supplementary literature	1. Case J.: Strength of Materials and Structures. 4th edition, John Wiley 1999 (Knovel, GUT eLibrary) 2. K.J. Bathe: Finite Element Procedures. Prentice Hall 1996. 3. O.C. Zienkiewicz, R.L. Taylor: The Finite Element Method. Vol. 1 The Basis. 5th Edition BH 2000.
eResources addresses	Adresy na platformie eNauczanie: Mechanics of Materials, MSc, 2022/2023, Summer, [L,T] (PG_00057378) - Moodle ID: 28941 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=28941

Example issues/ example questions/ tasks being completed	What differs plane state of stresses of the plane state of strains? What determines elongation of the axially tensioned bar? Describe and review yield criteria.of Tresca and von Mises.
Work placement	Not applicable