GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mechanics of materials, PG_00064828		
Field of study	Mechanical 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	English
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
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. Beata Zima	
	Teachers	dr hab. inż. Bogdan Rozmarynowski	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	0.0	0.0	30
	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	30	5.0	15.0	50

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_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose	The student is able to assess the applicability of advanced methods and tools for solving complex engineering problems in the field of mechanics of materials. They effectively utilize appropriate techniques, such as strength analysis, stability assessment of structural elements, and the Finite Element Method (FEM), to develop practical technical solutions.	[SU2] Assessment of ability to analyse information
[K7_W01] explains and describes, on the basis of general knowledge of the scientific disciplines forming the theoretical basis of Mechanics and Mechanical Engineering, the structure and principles of operation of mechanical systems and processes	The student has the ability to apply computational methods and techniques for strength and material analysis to examine and describe the functioning of the specified systems, processes, and device properties.	[SW1] Assessment of factual knowledge
[K7_U01] utilizes information obtained from the literature and other sources in the field of Mechanics and Mechanical Engineering and presents and analyses the results of solutions to technical problems in this field	The student, equipped with knowledge of mathematical analysis methods and numerical experiments, is able to apply it to solve engineering tasks within the specified scope using the Finite Element Method (FEM) as a modern and effective computational approach implemented in commercial software systems (e.g., Femap, Ansys).	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information

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:

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

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