GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mechanics of materials, PG_00057439		
Field of study	Mechanical Engineering		
Date of commencement of studies	February 2022	Academic year of realisation of subject	2021/2022
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	Part-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Zakład Mechaniki, Wytrzymałości i Sterowania Złożonych Obiektów Technicznych -> Institute of Mechanics and Machine Design -> Faculty of Mechanical Engineering and Ship Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Mirosław Gerigk	
	Teachers	dr hab. inż. Mirosław Gerigk	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	20.0	20.0	0.0	0.0	0.0	40

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	40	10.0	50.0	100

Subject objectives

The aim of the course is to familiarize students with the basic issues related to the strength of materials, from the basis of material strength, simple strength cases, complex strength to energy methods in strength and the basics of the FEM method.

The aim of the lectures is to deliver to the students the knowledge and abilities to solve the complex problems concerning the bars, shells, 3D structures, mechanics of cracking and fatique strength, vibrations of bars and selected problems of finite element method as well.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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 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. A student is able to consider the phenomena of the loads impact on the elsto-plastic fixed body for the complex state of strength of structure. A student is able to assess the complex state of loads and stress. A student is able to assess the complex states of loads, stress and deformation using the strength hypotheses and enery-based methods.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects
[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 has the ability to solve basic problems related to the strength of materials, including the performance of simple engineering tasks. A student is able to solve hiper-static and non hiper-static problems of strength of the bars, beams and structures of a elsto-plastic character. A student is able to investigate the mechanical characteristics of the structures. A student is able to solve the 2-D and 3-D finite element strength of materials problems. A student is able to solve the strength of materials problems in different fields of technology.	[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
[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 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. Many of these topics relate to mechanical and medical engineering. A student may consider the complex problems concerning the strength of materials as the complex tension, compresion, torsion and bending problems. A student is able to consider the complex problems of strength of materials associated with the thin-walled and thick shells.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects

Subject contents

The lectures concern, in turn: the basis 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, state of stress 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.

Selected problems of combined stress including the oblique bar bending, bar torsion together with bending and tension (compression), bending and tension (compression) of curved bar. Stress of thin-walled bars of the opened and closed cross section. Analysis of hiper-static and non hiper-static structures using the force method and three-momentum method. Plates and shells: bending of thin-walled plates, thin-walled shells, membrane theory of shells, bending theory of of thin-walled cylindrical shells. Cylindrical and sphere tanks. Stress of tanks under the pressure. Thick-walled cylindrical shells. Stress in shells uder the pressure. Thick-walled pipes. Stress in interference joints. Cracking and fatique stress. Vibrations of elasto-plastic structures. Finite elemnt method FEM.

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. A student is able to solve the ordinary and partial differencial eguations. A student has the selected knowledge in maths: linear algebra, analitical geometry, trygonometry, differencial and integral calculus. A student has the selected knowledge in general mechanics: statics, kinetics, dynamics. A student has the knowledge in strength of materials I (B.Sc. course).

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
half term exam, final exam	56.0%	100.0%

Recommended reading

Basic literature

Literatura:

1. Bąk R., Burczyński T.: Wytrzymałość materiałów z elementami ujęcia komputerowego. WNT, Warszawa 2001.
2. Dyląg Z., Jakubowicz A., Orłoś Z.: Wytrzymałość materiałów. WNT, Warszawa, t. I 1996, t. II 1997.
3. Misiak J.: Mechanika techniczna. Statyka i wytrzymałość materiałów. WNT, Warszawa 1996.
4. Kaliński K. J.: Nadzorowanie procesów dynamicznych w układach mechanicznych. Gdańsk: Wydaw. PG 2012.
5. Gallagher R. H.: Finite element analysisfundamentals. New Jersey: Prentice Hall 1975.
6. Niezgodziński M.E., Niezgodziński T.: Wzory, wykresy i tablice wytrzymałościowe. Warszawa: WNT 1996.
7. Walczyk Z.: Wytrzymałość materiałów. Wyd. PG, Gdańsk t. I 2000, t. II 2001.
8. Żmuda J.: Projektowanie konstrukcji stalowych. Wydawnictwo Naukowe PWN, 2016.
1. Kaliński K.: Materiały do wykładów z przedmiotu "Wytrzymałość materiałów" sem IV.
2. Banasiak M.: Ćwiczenia laboratoryjne z wytrzymało ci materiałów. PWN, Warszawa 2000.

Supplementary literature

Literatura uzupełniająca:

1. Ship Construction by D. J. Eyres, Butterworth-Heinemann, 2001.

2. Elements of Modern Ship Construction by David J. House, 2010.

3. Ship Construction 7th Edition, by George J Bruce, Butterworth-Heinemann, May 2012.

4. Ship Construction and Welding by **Mandal**, Nisith Ranjan, Springer Series on Naval Architecture, Marine Engineering, Shipbuilding and Shipping.

eResources addresses

Example issues/ example questions/ tasks being completed	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 l between two vertical walls, increase its length by D. A tensile force N appears in the cross-section of the bar, which causes assembly stresses. 2. Example. A beam with a length of 2l and stiffness EI, pinned at its ends, is loaded with a uniformly distributed load q acting on length l. Formulate the equation of deflection angles and deflection axis and determine the deflection angle and deflection at point B. Additionally: Analysis of combined stress of a bar under bending and tension (compression). Analysis of stress of a bar under oblique bending. Analysis of stres of hiper-static structures by the force method. Analysis of stress and deformations of plates under bending. Application of FEM method to solve the 2-D and 3-D structures stress problems.
Work placement	Not applicable