GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Engineering Mechanics , PG_00044370		
Field of study	Civil Engineering		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2020/2021
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	Part-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	8.0
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	dr inż. Karol Winkelmann	
	Teachers	dr inż. Karol Winkelmann dr inż. Mateusz Sondej dr inż. Magdalena Oziębło	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	25.0	0.0	0.0	0.0	55
	E-learning hours included: 0.0						
	Adresy na platformie eNauczanie: Mechanika Ogólna (SN) 2021 - Moodle ID: 12832 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=12832						

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	55	7.0	138.0	200

Subject objectives	Introduction to the main principles of structural statics and classification of structural systems. Learning vector algebra - solving systems of forces. Presentation of internal forces and relationships between the load and internal forces. Analysis of beams: straight and continuous; and frames: straight, non-rectangular, three-jointed. Analysis of arches. Design in line with the pressure line. Analysis of flat and spatial trusses. Analysis of complex and mixed systems; of flat grates and angled girders. Presentation of influence lines, their extreme loading and envelopes of internal forces.

Learning outcomes		Course outcome	Subject outcome	Method of verification
		[K6_W05] knows laws of mechanics used in rod constructions in scope of statics and stability, has an elementary knowlege on dynamics	The student has a full understanding of the beam systems in terms of their static analysis. The student knows how to classify structural systems and systems of forces, the student also knows the types of structural interactions. The student is able to transform a real-life engineering object into a series of appropriate static diagrams. The student correctly identifies statically determinate and indeterminate structures.	[SW3] Assessment of knowledge contained in written work and projects
		[K6_W04] has knowledge of general mechanics, strength of materials and general rules of construction	The student knows the main concepts and principles of statics and theoretical mechanics. The student has the ability to use vector notation to solve mechanics problems and to determine internal forces in statically determinate flat beam systems. On this basis, the Student is aware of the principles of general technical dimensioning of structures.	[SW3] Assessment of knowledge contained in written work and projects
		[K6_U03] can analyze simple rod constructions in scope of: calculations of constructions statically determined and undetermined; determining of modal frequencies; calculations of linear stability and bearing capacity in critical and boundary states	The student knows how to calculate static systems of forces, and how to reduce them. The student knows how to analyze specific cases of systems of forces. The student knows how to calculate support reactions and internal forces in simple beams and is able to plot internal forces without writing their equations. The student knows how to solve multi-element structures: continuous pin-jointed beams, non-rectangular beams, simple frames, frames with non-rectangular element mesh, three-pin-joint systems. The student knows how to solve flat truss structures by the method of node-wise determination and the method of sections. The student knows how to solve grates, girders, complex and mixed systems. The student knows how to draw influence lines, how to load them extremely and how to draw envelopes of internal forces on their basis.	[SU1] Assessment of task fulfilment

Subject contents	The main principles of statics. Basic concepts of theoretical mechanics.
	Algebra of vectors. Force and moment. Main vector and main moment of the system of forces.
	Reduction and equilibrium of systems of forces. Reduction of the system of forces in relation to a point, the resultant of the system of forces. A force couple.
	Special cases of the system of forces: the system of convergent forces, the system of parallel forces, the flat system of forces. Degrees of Freedom. Center of gravity.
	The role of theoretical mechanics in structural analysis. Assumptions of structural mechanics. Classification of structural systems. Types of structural interactions.
	Boundary (support) conditions of structural systems.
	Static determination. Kinematics of flat beam systems.
	Straight beams. Support reactions and internal forces in straight beams.
	Differential relationships between load and internal forces. Ability to plot internal forces without writing their equations.
	Continuous pin-joint beams. Beams loaded indirectly.
	Beams with a non-rectangular mesh.
	Straight frames with a rectangular bar mesh. Analysis of internal forces transmission. The equilibrium of the corners of frame systems.
	Frames with a non-rectangular bar mesh. Three-hinged systems.
	Parabolic and circular arches. Pressure lines.
	Flat and spatial truss structures. Truss solving methods. The node-wise static determination method and the method of sections.
	Complex and mixed systems.
	Flat grates. Girders.
	Definition of internal forces in spatial systems.
	Influence lines for straight beams and continuous articulated beams.
	Truss influence lines. The influence lines of frames, three-hinged and complex systems.
	Extreme loading on the influence lines. Bending moment envelopes.
Prerequisites and co-requisites	Mathematics Physics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
exam	60.0%	60.0%
practice-oriented test	60.0%	20.0%
lecture-oriented test	60.0%	20.0%

Recommended reading	Basic literature	1. Branicki C., *Structural mechanics in computational examples.* Volume 1. Gdansk University of Technology Publishing House, Gdańsk 1975. 2. Lubowiecka I., Skowronek M., *Structural mechanics in computational examples.* Gdansk University of Technology Publishing House, Gdańsk 2000. 3. Górski J., Przewłócki J., Skowronek M., Winkelmann K., *Mechanics and Strength of Materials.* Gdansk University of Technology Publishing House, Gdańsk 2015.
	Supplementary literature	1. Cywiński Z., *Structural mechanics in computational examples.* Volume I. PWN Warsaw 1999. 2. Konopińska-Zmysłowska V., Mleczek A., Oziębło M., Tomaszewska A., *Selected problems of mechanics of beam systems. A set of calculational examples for Students of Environmental Engineering.* Gdansk University of Technology Publishing House, Gdańsk 2016 3. Niezgodziński T., *Theoretical mechanics,* WN PWN Warsaw 2002. 4. Nizioł J., *Methodology of solving problems in mechanics,* WNT Warsaw 2002. 5. Nowacki W., *Structural mechanics.* Volume 1, PWN Warsaw 1974. 6. Wilde P., Wizmur M., *Theoretical mechanics.* PWN Warsaw 1984.
	eResources addresses	Mechanika Ogólna (SN) 2021 - Moodle ID: 12832 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=12832
Example issues/ example questions/ tasks being completed		Calculate the values of internal forces in three vertical lattice bars supporting a rigid plane stress structure/ plate. Determine the diagrams of internal forces (N - normal, V - shear, M - bending moments) in a free-supported beam, subjected to a given load. Determine the diagrams of internal forces (V - shear, M - bending moments) in a continuous pin-joint beam, subjected to a given load. Determine the diagrams of internal forces (N - normal, V - shear, M - bending moments) in a frame with a rectangular mesh of elements, subjected to a given load. Determine the diagrams of internal forces (N - normal, V - shear, M - bending moments) in a frame with a non-rectangular mesh of elements, subjected to a given load. Determine the diagrams of internal forces (N - normal, V - shear, M - bending moments) in a three-hinged frame with a rectangular mesh of elements, subjected to a given load. Determine graphs and values of internal forces in the frame-truss system: N - normal, V - shear, M - bending moments in the frame elements, S - axial forces in the truss elements. Determine the values of axial forces (S) in all elements of a simply supported truss subjected to a given load. Draw the pressure line of the system under the specified load between the three given points (construction joints - A, B and C). Determine the key elevations of the optimal structure (pressure line). Draw the diagrams of internal forces for the specified structural grating (V - shear force, M - bending moments). Draw the diagrams of internal forces for the specified girder (V - shear force, M -bending moments, Ms - torsional moments). For the given simply supported beam, draw the vertical reactions (Ra, Rb) influence lines and the internal force influence lines(Talfa, Malfa in the alpha section of the beam). Basing on the influence lines, set the load of a technical vehicle with a given axle weight so that Malfa bending moment reaches its extreme values. Determine the values. moment.
Work placement		Not applicable