



Subject card

Subject name and code	Engineering Mechanics, PG_00059003						
Field of study	Environmental Engineering						
Date of commencement of studies	October 2023	Academic year of realisation of subject			2023/2024		
Education level	first-cycle studies	Subject group			Obligatory subject group 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			6.0		
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						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	20.0	0.0	0.0	0.0	50
	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	50		4.0		98.0	152
Subject objectives	The introduction of the main principles of structural statics and the classification of structural systems. Vector algebra - solving systems of forces. Presentation of internal forces and the relationships between load and internal forces. Analysis of beams: simple and continuous beams; frames: simple, non-rectangular, three-hinged. Analysis of arches. Pressure line-compliant design. Analysis of planar and spatial trusses. Analysis of complex and mixed systems; structural gratings and girders. Presentation of the influence lines, their extreme loading and the envelope of internal forces.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	<p>[K6_W02] has knowledge of physics, including mechanics, thermodynamics, optics, electricity and magnetism, nuclear physics and solid state physics, including knowledge necessary to: 1) understand the basic physical phenomena related to material durability, fluid mechanics and hydraulics, building physics, geodetic measurements ; 2) understanding the principles of operation of basic electrical devices and systems; 3) solving project tasks of the sanitary industry;</p>	<p>Student umie dokonywać obliczeń statycznych układów sił, redukować je. Student umie analizować przypadki szczególne układów sił. Student rozumie równowagę układów statycznych. Student umie obliczać reakcje podporowe i siły wewnętrzne w belkach prostych oraz ma umiejętność sporządzania wykresów sił wewnętrznych bez zapisywania ich równań. Student umie rozwiązywać konstrukcje wieloelementowe: belki ciągłe przegubowe, belki o nieprostokątnej siatce prętów., ramy proste, ramy o nieprostokątnej siatce prętów, układy trójprzegubowe, łuki. Student potrafi formować konstrukcje prętowe w zgodności z ich linią ciśnienia. Student umie rozwiązywać płaskie konstrukcje kratowe metodą równoważenia węzłów i metodą przecięć. Student umie rozwiązywać ruszty, dźwigary załamane, układy złożone i mieszane. Student umie sporządzać linie wpływowe, ekstremalnie je obciążać oraz na ich podstawie rysować obwiednie sił wewnętrznych.</p>	<p>[SW3] Assessment of knowledge contained in written work and projects</p>
	<p>[K6_W08] has elementary knowledge of construction: including building materials, their strength, construction mechanics and building physics, moisture migration in buildings, heat transfer through building partitions</p>	<p>The student knows the main concepts and principles of theoretical mechanics. The student has the ability to use vector notation to solve problems of mechanics. The student has a full understanding of bar systems in terms of their statics. The student is able to classify structural systems and systems of forces. The student is able to transform a real engineering object into a series of appropriate static schemes. The student correctly identifies statically determinate and indeterminate structures. The student knows the types of structural interactions. The student knows the relationships between the structure and its loads. The student is aware of the principles of general structural dimensioning.</p>	<p>[SW3] Assessment of knowledge contained in written work and projects</p>

Subject contents	<p>The main principles of statics. Basic concepts of theoretical mechanics. Algebra of vectors. Forces and moments of forces. The main vector and the main moment of the system of forces. Reduction and equilibrium of the general system of forces. Reduction of the system of forces relative to a point, 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 planar system of forces. Degrees of freedom. Centers of gravity. The place of general mechanics in structural analysis. Assumptions made in structural mechanics. Classification of structural types. Types of structural interactions. Boundary (support) conditions of structural systems. Static determinability. Kinematics of flat bar systems. Simple beams. Support reactions and internal forces in simple beams. Differential relationships between load and internal forces. Ability to draw graphs of internal forces without equations. Continuous pin-joint beams. Indirectly loaded beams. Beams with a non-rectangular grid of bars. Simple frames with a rectangular grid of elements. Internal force transmission analysis. Equilibrium in the corners offrames. Frames with a non-rectangular grid of bars. Three-hinged systems. Parabolic and circular arches. Pressure lines. Flat and spatial truss structures. Methods of solving trusses. Solving by nodal equilibrium method and the method of cross-sections. Complex and mixed systems. Structural gratings. Girders. Definition of internal forces in spatial systems. Influence lines of straight beams and pin-joint continuous beams. Influence lines of trusses. Influence lines of simple frames, three-hinged frames and complex systems. Extreme loading of influence lines. Envelopes of bending moments.</p>											
Prerequisites and co-requisites	Mathematics Physics											
Assessment methods and criteria	<table border="1" data-bbox="448 1032 1493 1137"> <thead> <tr> <th data-bbox="448 1032 794 1070">Subject passing criteria</th> <th data-bbox="794 1032 1141 1070">Passing threshold</th> <th data-bbox="1141 1032 1493 1070">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 1070 794 1099">exam</td> <td data-bbox="794 1070 1141 1099">60.0%</td> <td data-bbox="1141 1070 1493 1099">60.0%</td> </tr> <tr> <td data-bbox="448 1099 794 1137">practice-oriented test</td> <td data-bbox="794 1099 1141 1137">60.0%</td> <td data-bbox="1141 1099 1493 1137">40.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	exam	60.0%	60.0%	practice-oriented test	60.0%	40.0%
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<p>Example issues/ example questions/ tasks being completed</p>	<p>Calculate the values of internal forces in three vertical lattice bars supporting a rigid plane stress structure/ plate.</p> <p>Determine the diagrams of internal forces (N - normal, V - shear, M - bending moments) in a free-supported beam, subjected to a given load.</p> <p>Determine the diagrams of internal forces (V - shear, M - bending moments) in a continuous pin-joint beam, subjected to a given load.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Determine the values of axial forces (S) in all elements of a simply supported truss subjected to a given load.</p> <p>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).</p> <p>Draw the diagrams of internal forces for the specified structural grating (V - shear force, M - bending moments).</p> <p>Draw the diagrams of internal forces for the specified girder (V - shear force, M -bending moments, Ms - torsional moments).</p> <p>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 value of the moment.</p>
<p>Work placement</p>	<p>Not applicable</p>