



Subject card

Subject name and code	Mathematical methods in civil engineering. , PG_00045837							
Field of study	Civil Engineering							
Date of commencement of studies	February 2024	Academic year of realisation of subject			2023/2024			
Education level	second-cycle studies	Subject group			Obligatory subject group in the field of study			
Mode of study	Full-time studies	Mode of delivery			at the university			
Year of study	1	Language of instruction			Polish			
Semester of study	1	ECTS credits			5.0			
Learning profile	general academic profile	Assessment form			assessment			
Conducting unit	Department of Railway Engineering -> Faculty of Civil and Environmental Engineering							
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Eligiusz Mieloszyk						
	Teachers	dr Anita Milewska prof. dr hab. inż. Eligiusz Mieloszyk						
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	5.0		60.0		125	
Subject objectives	Equipping a student with a specialized mathematical apparatus supporting technical subjects, including those related to civil engineering.							
Learning outcomes	Course outcome		Subject outcome			Method of verification		
	[K7_U03] can perform classic statical and dynamical analysis of rod structures stability (trusses, frames and ties), both statically determined and undetermined as well as surface structures (plates, membranes and shells)		The student combines knowledge in the field of mathematics with knowledge from other fields.			[SU2] Assessment of ability to analyse information		
	[K7_W01] has knowledge of higher mathematics, physics and chemistry, which is a base of subjects, such as construction theory and advanced material technology		The student knows the basic concepts in the field of differential and integral calculus, partial differential equations, tensor calculus.			[SW1] Assessment of factual knowledge		
	[K7_U06] is able to choose proper tools (measuring, analytical or numerical) to solve engineering problems, to acquire, filtrate, proces and analyse data		The student determines the Fourier series of functions, uses Fourier series to solve partial differential equations. The student determines the inertia tensor. Student determines the eigenvalues and eigenvectors of linear operations and inertia tensors and interprets them. The student uses mathematical methods in the description of technical problems.			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment		

Subject contents	<p>Partial differential equations, their classifications and types and applications in civil engineering. Selected methods of solving partial differential equations. Elements of the variational account and applications in civil engineering. Definition of a functional, definition of the extremum of a functional, basic lemma of a calculus of variations, Euler's equation, a precondition for the existence of an extremum of a functional, Jacobi's equation, Jacobi's condition. Conditions sufficient for the existence of the extreme of the functional. Tensor calculus and its applications in civil engineering. Matrices similar. Base in vector space. Matrix of transition from base to base. Linear operation and its matrix. Operation matrix when changing the base. Eigenvectors and eigenvectors of a linear operation and their determination. Tensor with a valence of 1 or 2. Tensor of inertia. Eigenvalues and eigenvectors of the inertia tensor. Invariants of changing the tensor base. Tensor quadric and its canonical form. Moments of inertia relative to a straight line. Sequences and series of functions, power series, orthogonal sequences and series. Fourier series. and trigonometric Fourier series. Decomposition of even and odd loads using Fourier series. Application of the Fourier series for solving partial differential equations. Operator methods and their applications in civil engineering. Laplace transform and Fourier transform. Frequency characteristics. Analysis of systems in the frequency domain. Basic properties of Laplace transform. Convolution of functions. Borel's theorem. Application of operator methods, including solving differential equations.</p>		
Prerequisites and co-requisites	Knowledge in the field of mathematical analysis, algebra, vector calculus, ordinary differential equations.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Conjunction of conditions: pass the colloquium covering the scope of topics from lectures and tutorials, and get a positive grade of the current work on the tutorials.	55.0%	100.0%
Recommended reading	Basic literature	<p>W. Żakowski, W. Leksiński: Matematyka, cz.IV. WNT.</p> <p>W. Żakowski, W. Kołodziej: Matematyka, cz.II. WNT.</p> <p>H. Bateman: Tables of integral Transforms. McGraw-Hill Book Company.</p> <p>L. C. Evans: Partial Differential Equations. AMS.</p> <p>I. M. Gelfand, S. W. Fomin: Rachunek wariacyjny. PWN.</p> <p>M.I.Krasnov, G.I.Makarenko, A.I. Kiselev: Problems and exercises in the calculus of variations. Mir Publishers.</p> <p>A. J. McConnel: Application of tensor analysis. Dover Publications Inc.</p>	
	Supplementary literature	<p>E. Mieloszyk: Nieklasyczny rachunek operatorów w zastosowaniu do uogólnionych układów dynamicznych. Wyd. PAN.</p> <p>W. T. Thomson: Theory of Vibrations. Unwin Hyman.</p>	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	<p>Perform decomposition of odd loads using Fourier series.</p> <p>Write the definition of an orthogonal matrix.</p> <p>Write the definition of eigenvalues and eigenvectors of matrix A.</p> <p>Write Weierstrass criterion and theorem on the differentiation of a series.</p> <p>Determine the quadric of the inertia of the mass system and calculate the moment of inertia relative to the straight line.</p>		
Work placement	Not applicable		