GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical methods in civil engineering. , PG_00045837		
Field of study	Civil 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
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		

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_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.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
[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_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

Subject contents	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.
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	W. Żakowski, W. Leksiński: Matematyka, cz.IV. WNT. W. Żakowski, W. Kołodziej: Matematyka, cz.II. WNT. H. Bateman: Tables of integral Transforms. McGraw-Hill Book Company. L. C. Evans: Partial Differential Equations. AMS. I. M. Gelfand, S. W. Fomin: Rachunek wariacyjny. PWN. M.I.Krasnov, G.I.Makarenko, A.I. Kiselev: Problems and exercises in the calculus of variations. Mir Publishers. A. J. McConnel: Application of tensor analysis. Dover Publications Inc.
Supplementary literature	E. Mieloszyk: Nieklasyczny rachunek operatorów w zastosowaniu do uogólnionych układów dynamicznych. Wyd. PAN. W. T. Thomson: Theory of Vibrations. Unwin Hyman.
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	Perform decomposition of odd loads using Fourier series. Write the definition of an orthogonal matrix. Write the definition of eigenvalues and eigenvectors of matrix A. Write Weierstrass criterion and theorem on the differentiation of a series. Determine the quadric of the inertia of the mass system and calculate the moment of inertia relative to the straight line.
Work placement	Not applicable