GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical methods in civil engineering, PG_00072439		
Field of study	Civil Engineering		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2026/2027
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	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Transportation Engineering -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology		
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

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	30.0	0.0	0.0	0.0	45

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	45	3.0	27.0	75

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] uses, to a deeper extent, appropriately selected analytical, numerical and experimental tools and methods to carry out tasks in the construction industry	The student combines knowledge in the field of mathematics with knowledge from other fields. The student uses mathematical methods in the description of technical problems.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
[K7_W02] explains the meaning and interdependence of the key components describing systems and processes in civil engineering and related fields, using in-depth knowledge in line with the main trends in the development of scientific disciplines related to the field of study	The student knows the basic concepts in the field of differential and integral calculus, partial differential equations, tensor calculus; furthermore, the student knows the principles of their application in construction and its surroundings.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

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. 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. 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. Elements of variational calculus and their applications in civil engineering. Functional, extremum of a functional, Euler's equation. 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. Application of operator methods, including solving differential equations. Introduction to probabilistic methods and mathematical statistics in civil and transport engineering.

Course content – exercises

Applying the knowledge presented during lectures.

Prerequisites and co-requisites

Knowledge in the field of mathematical analysis, algebra, vector calculus, ordinary differential equations, probabilistic theory.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exam (passing the tutorials is a prerequisite for taking the exam).	60.0%	100.0%
Passing the tutorials upon a fulfilment of a conjunction of conditions: passing the colloquium covering the scope of topics from tutorials and lectures (exercises and theory), and obtaining a positive grade of the current work on the tutorials.	55.0%	0.0%

Recommended reading

Basic literature	W. Żakowski, W. Leksiński: Matematyka, cz.IV. WNT. T. Trajdos: Matematyka, cz.III. 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. E. Mieloszyk: Nieklasyczny rachunek operatorów w zastosowaniu do uogólnionych układów dynamicznych. Wyd. IMP PAN, Gdańsk 2008. A. Milewska: Metody probabilistyczne i statystyka matematyczna w inżynierii lądowej i transportowej. Wyd. PG, Gdańsk 2025.
Supplementary literature	W. T. Thomson: Theory of Vibrations. Unwin Hyman. K. Maurin: Analiza. PWN.
eResources addresses	

Example issues/ example questions/ tasks being completed	Perform decomposition of odd loads using Fourier series. Write the definition of eigenvalues and eigenvectors of matrix. Determine the quadric of the inertia of the mass system and calculate the moment of inertia relative to the straight line.
Practical activites within the subject	Not applicable

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