COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematics [S1MiBM2>MAT1]

Course

Field of study
Mechanical Engineering

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
45

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

• Knowledge of mathematics at the secondary school level • Ability to think logically • Proficiency in using mathematical tools from secondary school to solve tasks • Capacity to learn with understanding • Ability to independently search for information in literature

Course objective

Learning about the applications of mathematical tools and methods to solve simple technical problems and indicating the possibilities of using mathematics in more complex problems.

Course-related learning outcomes

Knowledge
1. The student has the knowledge in mathematics including selected sections of mathematical analysis, algebra and analytic geometry.
2. Has knowledge of the use of mathematical apparatus to describe mechanical problems.
3. Has knowledge of the application of appropriate computational techniques supporting the engineer's work while understanding their limitations.
Skills

1. The student is able to use mathematical methods in the analysis of mechanical problems.
Social competences
1. The student is aware of the need to deepen and expand knowledge.
2. Is aware of the importance of mathematics in solving mechanical problems and is able to seek the opinion of experts in case of difficulties in solving a problem independently.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture: assessment of knowledge and skills demonstrated in the written exam. The exam is assessed in a point system. The condition of passing the exam is obtaining at least 50% of points.
Tutorials: two written assignments carried out under the teacher's supervision. The condition of receiving a positive grade from tutorials is obtaining at least 50% of points. Additional points can be obtained for activity during classes.

Programme content

1. LINEAR ALGEBRA
2. ELEMENTS OF ANALITYCAL GEOMETRY
3. FUNCTIONS AND THEIR PROPORTIES
4. SEQUENCES
5. LIMITS AND CONTINUITY OF FUNCTIONS
6. DERIVATIVE OF FUNCTION
7. INDEFINITE INTEGRALS
8. DEFINITE AND IMPROPER INTEGRALS
9. COMPLEX NUMBERS
10. INFINITE SERIES AND POWER SERIES

Course topics

Lecture:
1. LINEAR ALGEBRA
• matrix (definition, basis notations and examples)
• matrix operations (addition, subtraction, scalar multiplication, transposition, matrix multiplication, matrix inverse)
• determinants (definition, Sarrus' rule, Laplace expansion, propertis of determinants)
2. ELEMENTS OF ANALITYCAL GEOMETRY
• vectors in three dimensions
• vector calculus (addition, multiplication by scalar, dot product, cross product, mixed product)
• parallel and perpendicular vectors
• area formulas for parallelogram/triangle and parallelepiped/tetrahedron spanned by vectors
• angle between two vectors
3. FUNCTIONS AND THEIR PROPORTIES
• definition of function, domain and range of function, graph of function
• bounded function, increasing and decreasing functions, periodic function, even and odd functions, function composition
• surjection, injection, inverse function
• natural logarithm, cyclometric functions, hyperbolic function, area functions
• implicit function, parametric representation of curve, curves in polar coordinates
4. SEQUENCES
• definition of sequence
• bounded sequence, monotone sequence
• limit of sequence (including Euler’s number), convergent and divergent sequences
• theorems of sequences (including arithmetic rule, the squeeze theorem)
5. LIMITS AND CONTINUITY OF FUNCTIONS
• definitions of limits
• properties of limits, theorems on limits (including arithmetic rule, the squeeze theorem)
• indeterminate forms
• continuous functions and their properties (including Weierstrass theorem and Darboux’s theorem)
• discontinuous functions

6. DERIVATIVE OF FUNCTION
• definition of derivative, geometric interpretation of derivative, right and left-hand derivatives, theorems of derivatives, properties and rules for funding derivatives
• tangent and normal lines
• increments and differentials
• L'Hospital's rule
• higher order derivatives
• horizontal and vertical asymptotes
• ekstrema of functions
• the first derivative test
• concavity and the secound derivative test
• applications of extrema
7. INDEFINITE INTEGRALS
• antiderivative of function, properties of integration (including integration by parts, change of variable)
• integration of rational function, method of partial fractions
• trigonometric substitutions, integration of some irrational functions
8. DEFINITE AND IMPROPER INTEGRALS
• definition of definite integral, Riemann sum, geometric interpretation of definite integral, fundamental theorem of integral calculus
• properties of the definite integral (including integration by parts, change of variable)
• applications of the definite integral (including area, volume and surface area of solids of revolution, length of curve)
• improper integrals (integrals with infinite limits of integration, integrals with discontinuous integrands)
9. COMPLEX NUMBERS
• modulus, argument, principal argument
• forms: geometric, rectangular, polar (complex plane)
• square root of complex number
• quadratic equation in the complex domain
• deriving polar form from rectangular form
• de Moivre's formula
• formula for the n-th root of a complex number
• multiplication and division of complex numbers in polar form
• Euler's formula for complex numbers
10. INFINITE SERIES AND POWER SERIES
• definition of infinite series, sum of the series, necessary condition for convergence, convergent or divegent infinite series
• convergence tests (integral test, comparison test, alternating series test, ratio test, root test)
• absolute and conditional convergence
• power series, radius of convergence, interval of convergence
• power series representations of functions
• Taylor and Maclaurin series and applications
Tutorials:
1. LINEAR ALGEBRA
• matrix operations (addition, subtraction, scalar multiplication, transposition, matrix multiplication, matrix inverse)
• determinants (Sarrus' rule, Laplace expansion, propertis of determinants)
2. ELEMENTS OF ANALITYCAL GEOMETRY
• vectors in three dimensions
• vector calculus (addition, multiplication by scalar, dot product, cross product, mixed product)
• parallel and perpendicular vectors
• area formulas for parallelogram/triangle and parallelepiped/tetrahedron spanned by vectors
• angle between two vectors
3. FUNCTIONS AND THEIR PROPORTIES
• domain and range of function, graph of function
• bounded function, increasing and decreasing functions, periodic function, even and odd functions, function composition
• inverse function
• natural logarithm, cyclometric functions, hyperbolic function, area functions
4. SEQUENCES
• bounded sequence, monotone sequence

• limit of sequence (including Euler’s number), convergent and divergent sequences
• theorems of sequences (including arithmetic rule, the squeeze theorem)
5. LIMITS AND CONTINUITY OF FUNCTIONS
• properties of limits, theorems on limits (including arithmetic rule, the squeeze theorem)
• indeterminate forms
• continuous functions and their properties
6. DERIVATIVE OF FUNCTION
• definition of derivative, theorems of derivatives, properties and rules for funding derivatives
• tangent and normal lines
• increments and differentials
• L'Hospital’s rule
• higher order derivatives
• horizontal and vertical asymptotes
• ekstrema of functions
• the first derivative test
• concavity and the secound derivative test
• applications of extrema
7. INDEFINITE INTEGRALS
• antiderivative of function, properties of integration (including integration by parts, change of variable)
• integration of rational function, method of partial fractions
• trigonometric substitutions
8. DEFINITE INTEGRALS
• fundamental theorem of integral calculus
• properties of the definite integral (including integration by parts, change of variable)
• applications of the definite integral (including area)

Teaching methods

Lecture: mulimedia presentation accompanied with examples presented on the blackboard and with questions to the group of students
Tutorials: solving problems on the board, initiating discassion about the solutions

Bibliography

Basic:
1. M. Gewert, Z. Skoczylas, Analiza Matematyczna 1 i 2, Definicje, twierdzenia i wzory, Oficyna Wydawnicza GiS, Wrocław 2019.
2. M. Gewert, Z. Skoczylas, Analiza Matematyczna 1 i 2, Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2018.
3. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach cz. I, Wydawnictwo Naukowe PWN, Warszawa 2015.
4. W. Żakowski, W. Kołodziej, Matematyka cz. II, Analiza matematyczna, WNT, Warszawa 2017.
5. W. Żakowski, G. Decewicz, Matematyka cz. I, Analiza matematyczna, WNT, Warszawa 2017.
6. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 1, Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2002.
7. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 1, Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2006.

Additional:
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Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	77	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	48	2,00