COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematics [S1Mech1>MAT2]

Course

Field of study
Mechatronics

Year/Semester
1/2

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
30

Laboratory classes
0

Other (e.g. online)
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Student possesses mathematical knowledge at basic level from secondary school. Student has logical reasoning skills

Course objective

The acquirement of knowledge and computational skills in single variable differential and integral calculus, linear algebra, analytical geometry and complex numbers that are necessary to handle engineering problems.

Course-related learning outcomes

Knowledge:
1. Student has extended and in-depth knowledge of selected mathematic fields, including complex numbers, linear algebra, analytical geometry and single variable differential and integral calculus.
2. Student has a systematized knowledge in the field of mathematics, useful in formulating and solving complex problems in the area of mechatronics.

Skills:

1. Student is able to obtain information from literature, databases and other properly selected sources, including information in English; is able to combine the obtained information, to interpret and critically assess it, to draw conclusions and to formulate opinions and provide exhaustive justifications for them
2. Student is able to use the known methods and mathematical models – and, if necessary, modify them - for the analysis and design of components of mechatronic systems.
3. Student is able to develop, evaluate and use existing analytical, simulational and experimental methods to solve complex engineering tasks in the field of mechatronics, including non-typical tasks that contain a research component.
4. Student has the ability to learn independently, mainly in order to improve professional skills; is able to identify areas of detailed technical knowledge necessary to implement a specific engineering task and acquire them independently as well as present them

Social competences

1. Student understands the need of lifelong learning
2. Student is able to cooperate and work in a team, and take different roles in it
3. Student is able to define priorities which serve the implementation of a task assigned by him -/herself or by others

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Lectures:

assessment of knowledge and skills at the written exam checking knowledge of concepts and the ability to solve short practical tasks

passing threshold: 50% of points; exam issues, on the basis of which questions are prepared, will be sent to students by e-mail using the university e-mail system.

Tutorials:

assessment of knowledge and skills at the short written tests (at the beginning of every tutorial)

passing threshold: 50% of points

Programme content

COMPLEX NUMBERS

Modulus, argument, principal argument
Form: geometric, rectangular, polar (complex plane)
Square root of complex number
Quadratic equation on complex domain
Derivation polar form from rectangular form
de Moivre"s formula
formula for the n-th root of complex number
formula for multiplication and division of two complex numbers that are in polar form
Euler"s formula for complex numbers

LINEAR ALGEBRA

Definition of a cartesian product
Definition of a matrix
Matrix calculus (addition, multiplication matrix by scalar, multiplication matrix by matrix, transpose of matrix)
Definition of a determinant
Methods for calculation of a determinant:
o Sarrus" rule
o Laplace expansion
Definition of an inverse matrix
Finding an inverse of a matrix (from definition, Gaussian elimination)
Definition of a rank of a matrix
Properties of a rank of a matrix
Cramer’s rule
Kronecker-Capelli theorem
Homogeneous system of linear equations

- Gaussian elimination
- Eigenproblem (eigenvalues and eigenvectors)

ELEMENTS OF ANALITYCAL GEOMETRY IN 3D

- Coordinates of a vector
- Length of a vector
- Vector calculus (addiction, multiplication vector by scalar, dot product, cross product, mixed product)
- Definition of a dot product of two vectors
- Definition of a cross product of two vectors
- Parallel and perpendicular vectors
- Formula for an area of the parallelogram/triangle spanned by two nonparallel vectors
- Formula for an area of the parallelepiped/tetrahedron spanned by three nonplanar vectors
- Angle between two vectors

SEQUENCES

- Definition of a sequence
- Monotonicity of a sequence
- Definition of a limit of a sequence
- Properties of limits of convergent sequences
- Squeeze theorem
- Definition and properties of Euler’s number
- Indeterminate symbols

FUNCTION OF A SINGLE VARIABLE

- Definition of function, injection, surjection
- Explicit, implicit and parametric relations
- Definition of an one-to-one function, a monotonic function, an inverse function, a composite function
- Trigonometric functions, inverse trigonometric functions, hyperbolic functions, inverse hyperbolic functions
- Definition of limit of a function
- Definition of continuity of a function
- Asymptote of a function
- L"Hospital"s rule
- Definition of a derivative of a function and its geometric interpretation
- Properties of derivation of functions
- Formulas for derivatives of sums, products, differences and quotients
- Definition of exact differential and its geometric interpretation
- Inverse function theorem
- Derivative of a parametrically defined function
- Logarithmic derivative
- Higher order derivative
- Chain rule
- Mean value theorem
- Extreme values of functions (necessary and sufficient conditions)
- Monotonicity of a function
- Inflection points (necessary and sufficient conditions)
- Concavity and convexity of a function

INDEFINITE INTEGRAL

- Definition of indefinite integral and anti-derivative
- Properties of indefinite integrals
- Integration by substitution
- Integration by parts

DEFINITE INTEGRAL

- Definition of definite integral
- Properties of definite integral
- Integration by substitution
- Integration by parts
- Geometric interpretation of definite integral
- Definition of region with repect to x axis
- Definition of region with respect to y axis
- Application of definite integral:

o area of a region
o arc length
o area of surface of revolution
o volume of surface of revolution
IMPROPER INTEGRAL
first type (infinite interval)
second type (discontinuous integrand)

Course topics

none

Teaching methods

Lectures:
lecture is conducted in an interactive way with formulating questions for a group of students or for selected students
student activity during classes is taken into account when the final grade is considered
Tutorials:
sample tasks are solved on the blackboard
detailed discussion of solved tasks

Bibliography

Basic
1. W. Żakowski, Matematyka, T.1 i T.2, WNT, Warszawa 2003.
2. M. Gewert, Z. Skoczylas, Analiza matematyczna 1 (Definicje, twierdzenia, wzory), GiS, Wrocław 2011.
3. M. Gewert, Z. Skoczylas, Analiza matematyczna 1 (Przykłady i zadania), GiS, Wrocław 2011.
4. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna 1, (Definicje, twierdzenia, wzory), GiS, Wrocław 2007.
5. T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna 1, (Przykłady i zadania), GiS, Wrocław 2007.
Additional
1. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, T.1, T.2, PWN, Warszawa 2011.
2. M. Grzesiak, Liczby zespolone i algebra liniowa, Wydawnictwo PP, Poznań 1999.

Breakdown of average student's workload

	Hours	ECTS
Total workload	150	6,00
Classes requiring direct contact with the teacher	65	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	85	3,50