



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Mathematics [N1Mech2>MAT1]

### Course

Field of study  
Mechatronics

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  
part-time

Requirements  
compulsory

### Number of hours

Lecture  
16

Laboratory classes  
0

Other  
0

Tutorials  
16

Projects/seminars  
0

### Number of credit points

5,00

### Coordinators

### 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 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 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 materials and technologies for automotive industry.

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 automotive 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 materials and technologies for automotive industry, 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:

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 published on the eKursy platform.

Tutorials:

- assessment of knowledge and skills at the short written tests (at the beginning of tutorial); the date of test will be announced with at least a one-week in advance

- passing threshold: 50% of points

## Programme content

Complex numbers

Sequences and infinite series

Differential and integral calculus of functions of a single variable

## Course topics

### 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

### 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 respect to x axis
- Definition of region with respect to y axis
- Application of definite integral: (area of a region, arc length, area of surface of revolution, volume of surface of revolution)

#### IMPROPER INTEGRAL (OPTIONAL)

- first type (infinite interval)
- second type (discontinuous integrand)

#### INFINITE SERIES

- Definition of an infinite series
- Summing an infinite series
- Necessary condition of convergence of an infinite series
- Convergence tests (comparison test, ratio test, root test)

### 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	125	5,00
Classes requiring direct contact with the teacher	34	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	91	3,50