#### card of course

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| Subject name | Mathematical analysis and linear algebra |

1. The placement of the subject in the study system

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| 1.1. Field of study | Computer science |
| 1.2. Form and path of study | Full-time/Part-time |
| 1.3. Level of education | First-cycle studies |
| 1.4. Study profile | Practical |

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| 1. 5. Specialty | - |
| 1.6. Subject Coordinator | Dr Kamil Powroźnik |

2. General characteristics of the subject

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| 2.1. Belonging to a subject group | Interdisciplinary/Practical |
| 2.2. Number of ECTS | 5 |
| 2.3. Language of lectures | English |
| 2.4. Semesters in which the subject is taught | I |
| 2.5.Criteria for selecting course participants | - |

1. Learning outcomes and course delivery
   1. Subject Objectives

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| No. | Subject Objectives |
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| C1 | To familiarize students with the concept of a function and its basic properties, including the concept of a function limit and the continuity of a function. To acquire the ability to efficiently calculate the limits of sequences. To familiarize students with the concept of a number series and various criteria for verifying its convergence. |
| C2 | To acquaint students with the elements of differential calculus of functions of one variable. To acquire by students the ability to efficiently calculate the derivative of a function and to apply differential calculus in various practical issues, including optimization problems. |
| C3 | To acquaint students with the basics of integral calculus and various methods of calculating integrals from functions. To acquire the ability to efficiently apply integrals in selected practical problems. |
| C4 | To familiarize students with the concept of a matrix and to help them acquire the ability to use matrices in various problems, e.g. in solving systems of linear equations. To familiarize students with the elements of vector calculus. |
| C5 | To familiarize students with the set of complex numbers and basic operations performed on complex numbers. |

* 1. Subject-specific learning outcomes, divided into knowledge , skills and competences , with reference to the directional learning outcomes

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| --- | --- | --- | --- | --- | --- | --- |
| No. | Description of subject  learning outcomes | Reference to  directional effects  learning (symbols) | Method of implementation (mark "X") | | | |
| ST | | NST | |
| Classes at the University | Activities on  the platform | Classes at the University | Activities on  the platform |
| After passing the course, the student knows and understands **the knowledge** | | | | | | |
| W1 | the concept of a set and definitions of operations performed on sets; the concept of a sequence and its limit; the concept of a function and its properties, including the issue of continuity of a function; the concept of a number series and the criteria for verifying its convergence; | INF\_W02 | x |  |  | x |
| W2 | the concept of the derivative of a function; methods of calculating the derivative and its most important applications (including the use of the derivative in optimization problems); | x |  |  | x |
| W3 | the concept of indefinite and definite integrals, the concept of antiderivatives; methods of calculating integrals and the use of integrals, e.g. for calculating areas between function graphs; | x |  |  | x |
| W4 | the concept of a matrix, determinant of a matrix, basic operations on matrices and the use of matrices to solve systems of linear equations; | x |  |  | x |
| W5 | the concept of a vector and basic operations performed on vectors, including the dot and vector product; | x |  |  | x |
| W6 | the concept of a complex number, different ways of representing complex numbers and basic operations with complex numbers; | x |  |  | x |
| After passing the course, the student is **able** to: | | | | | | |
| U1 | efficiently perform operations on sets; calculate the limits of sequences and functions; investigate the basic properties of functions; verify the convergence of number series; | INF\_U06  INF\_U13  INF\_U26 | x |  | x |  |
| U2 | calculate derivatives and apply differential calculus to selected practical problems, including solving optimization problems; | x |  | x |  |
| U3 | apply in practice various methods of solving integrals and use integrals to determine areas between graphs of functions; | x |  | x |  |
| U4 | perform basic operations on matrices and vectors and apply matrix and vector calculus to solve a variety of practical problems, including systems of linear equations; | x |  | x |  |
| U5 | perform basic operations with complex numbers; | x |  | x |  |
| After completing the course, the student is ready to take part in **social competences.** | | | | | | |
| K1 | understanding the limitations of your own knowledge and critically evaluating the results of your own work; | INF\_K01  INF\_K04 | x |  | x |  |
| K2 | appropriate setting of priorities for the implementation of specific tasks and effective organization of work | x |  | x |  |

3.3. Forms of teaching and their number of hours - Full-time studies (ST), Part-time studies (NST)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Path | Lecture | Exercises | Design | Workshop | Laboratory | Seminar | Lecturer | Classes conducted using distance learning methods and techniques in the form of a lecture | Other | **ECTS points** |
| **ST** | 15 | 30 |  |  |  |  |  |  |  | 5 |
| **NST** |  | 15 |  |  |  |  |  | 10 |  | 5 |

3.4. Content of education (separately for each form of classes: (W, ĆW, PROJ, WAR, LAB, LEK, OTHER). It should be marked (X) how the given content will be implemented (classes at the university or classes on the e-learning platform conducted using distance learning methods and techniques)

TYPE OF CLASS: LECTURE

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| --- | --- | --- | --- | --- | --- | --- |
| No. | Content of the course | Reference to subject-specific learning outcomes | Method of implementation (mark "X") | | | |
| ST | | NST | |
| **Classes at the University** | **Activities on  the platform** | **Classes at the University** | **Activities on  the platform** |
| 1. | Number sets and operations on sets. Cartesian product of sets. | **W1, U1, K1, K2** | x |  |  | x |
| 2. | Definition of relations and functions. Elementary functions. Selected types of functions. Composition of functions. Limit of a function at a point. Continuity of a function. | **W1, U1, K1, K2** | x |  |  | x |
| 3. | Sequences and methods of describing sequences. Limits of sequences. | **W1, U1, K1, K2** | x |  |  | x |
| 4. | Number series. Criteria for convergence of number series. | **W1, U1, K1, K2** | x |  |  | x |
| 5. | Definition of the difference quotient and derivative of a function at a point. Methods of calculating derivatives. | **W2, U2, K1, K2** | x |  |  | x |
| 6. | The concept of an antiderivative. Indefinite integral. Definite integral. Fundamental theorems of integral calculus. Selected methods of calculating integrals. | **W3, U3, K1, K2** | x |  |  | x |
| 7. | Matrices and vectors, basic operations on matrices and vectors, determinant of a matrix. Inverse matrix. | **W4, W5, U4, K1, K2** | x |  |  | x |
| 8. | Complex numbers - selected topics. | **W6, U5, K1, K2** | x |  |  | x |
| 9. | Summary of classes and discussion of grades. |  | x |  |  | x |

TYPE OF CLASSES: EXERCISES

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| --- | --- | --- | --- | --- | --- | --- |
| No. | Content of the course | Reference to subject-specific learning outcomes | Method of implementation (mark "X") | | | |
| ST | | NST | |
| **Classes at the University** | **Activities on  the platform** | **Classes at the University** | **Activities on  the platform** |
| 1. | Limits of sequences, including the sequence theorem. | **W1, U1, K1, K2** | x |  | x |  |
| 2. | Basic properties of functions. Monotone functions. Even and odd functions. One-to-one, onto and bijection functions. Inverse function. Continuity of a function at a point and in its domain. | **W1, U1, K1, K2** | x |  | x |  |
| 3. | Derivative of a function. Selected applications of the derivative of a function, including determining extrema, intervals of monotonicity, tangent to the graph of a function, the largest and smallest value in a closed interval. Optimization problem. | **W2, U2, K1, K2** | x |  | x |  |
| 4. | The integral of a function and its use in calculating areas between graphs of functions. Various methods of evaluating integrals, including the substitution method and the method of integration by parts. | **W3, U3, K1, K2** | x |  | x |  |
| 5. | Matrices. Determinant of a matrix. Inverse matrix. Using matrices to solve systems of linear equations. Vectors. Dot and vector product and their applications. | **W4, W5, U4, K1, K2** | x |  | x |  |
| 6. | Introduction to complex numbers. Methods of presenting complex numbers. Operations on complex numbers. | **W6, U5, K1, K2** | x |  | x |  |
| 7. | Summary of classes and discussion of grades. |  | x |  | x |  |

3.5. Methods of verifying learning outcomes (indication and description of methods of conducting classes and verification of achievement of learning outcomes and method of documentation)

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| --- | --- | --- | --- |
| Subject Effects | Teaching methods | Methods of verifying learning outcomes | Documentation methods |
| KNOWLEDGE | | | |
| W1-W6 | solving tasks combined with discussion of the results obtained; group work; | Colloquium (exercises) and exam (lecture) verifying acquired knowledge, skills and competences | Colloquium sheet  Examination sheet |
| SKILLS | | | |
| U1-U5 | solving tasks combined with discussion of the results obtained; group work; | Colloquium (exercises) and exam (lecture) verifying acquired knowledge, skills and competences | Colloquium sheet  Examination sheet |
| SOCIAL COMPETENCES | | | |
| K1-K2 | solving tasks combined with discussion of the results obtained; group work; | Colloquium (exercises) and exam (lecture) verifying acquired knowledge, skills and competences | Colloquium sheet  Examination sheet |

3.6. Assessment criteria for the achieved learning outcomes

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| Learning effect | For a grade of 3 or "pass."  the student knows and understands/is able to/is ready to | For a grade of 3.5, the student knows and understands/is able to/is ready to | For a grade of 4, the student knows and understands/is able to/is ready to | For a grade of 4.5, the student knows and understands/is able to/is ready to | For a grade of 5, the student knows and understands/is able to/is ready to |
| W | 51-60% of knowledge indicated in learning outcomes | 61-70% of knowledge indicated in learning outcomes | 71-80% of knowledge indicated in learning outcomes | 81-90% of knowledge indicated in learning outcomes | 91-100% of knowledge indicated in learning outcomes |
| U | 51-60% of skills indicated in learning outcomes | 61-70% of skills indicated in learning outcomes | 71-80% of skills indicated in learning outcomes | 81-90% of skills indicated in learning outcomes | 91-100% of skills indicated in learning outcomes |
| K | 51-60% of skills indicated in learning outcomes | 61-70% of skills indicated in learning outcomes | 71-80% of skills indicated in learning outcomes | 81-90% of skills indicated in learning outcomes | 91-100% of skills indicated in learning outcomes |

3.7. Literature

**Basic**

* + 1. Smoluk A., Algebra liniowa, Wyd. Uniwersytetu Ekonomicznego, Wrocław, 2017
    2. Ptak M., Gryszka K., Hejmej B., Algebra liniowa - notatki do wykładu, OMEGA, Kraków, 2019
    3. M. Gewert, Z. Skoczylas, Analiza matematyczna 1, Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS, Wrocław 2004.
    4. M. Gewert, Z. Skoczylas, Analiza matematyczna 1, Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2004.
    5. T. Jurlewicz, Z. Skoczylas, Algebra liniowa 1, Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2006

**Supplementary**

* + 1. W. Krysicki, L. Włodarski, Analiza matematyczna w zadaniach, Część I i II, PWN, Wydawnictwo Naukowe PWN, Warszawa 2006.
    2. W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, PWN, Warszawa 2001.

4. Student workload - ECTS points balance

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| **Types of student activity** | **Student Load** | |
| **ST** | **NST** |
| **Classes requiring direct contact between the student and the academic teacher at the university premises** | **45** | **25** |
| Classes included in the study plan | 45 | 25 |
| **Student's own work** | **80** | **100** |
| Ongoing preparation for classes, preparation of project work/presentations/etc. | 40 | 50 |
| Preparation for passing classes | 40 | 50 |
| **TOTAL STUDENT HOURLY LOAD** | **125** | **125** |
| **Number of ECTS points** | **5** | **5** |

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| Last change date | 30/09/2024 |
| The changes were introduced | INF Education Quality Team |
| The changes were approved | Arkadiusz Gwarda, M.A. |