#### card of course

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| Subject name | Discrete mathematics |

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; mgr Anna Karwat |

2. General characteristics of the subject

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| 2.1. Belonging to a subject group | Directional/Practical |
| 2.2. Number of ECTS | 4 |
| 2.3. Language of lectures | Polish |
| 2.4. Semesters in which the subject is taught | II |
| 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 introduce students to basic concepts of logic and set theory. |
| C2 | To familiarize students with the principle of mathematical induction and selected recursive problems. |
| C3 | To familiarize students with combinatorial methods, number theory and graph theory used to solve computer science problems. |
| C4 | Students acquire the ability to use selected areas of mathematics to solve computer science problems. |

* 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 | Basic topics in mathematical logic and set theory, including basic operations on sets, cardinality, the concept of relations and functions and their properties, and others | INF\_W02 | X |  |  | X |
| W2 | The principle of mathematical induction and its application, including in proof, and the method of definition by induction, including the method of recursive definition, knows the techniques for solving selected recursive problems and finding explicit forms for recursive dependencies | X |  |  | X |
| W3 | Basic combinatorial tools such as permutations, combinations, variations, inclusion and exclusion principles, and others, and knows how to apply them to solve combinatorial problems. | X |  |  | X |
| W4 | Basic concepts of graph theory and methods of algebraic representation of graphs, including the concept of a tree, a path in a graph, an Eulerian path, a Hamiltonian circuit, and an algorithm for determining the shortest path in a graph. | X |  |  | X |
| After passing the course, the student is **able** to: |
| U1 | Verify whether a binary relation is an equivalence relation and determine its quotient set, and for an established equivalence relation create an approximation space, determine the type of ordering of the set, determine the sets of lower and upper constraints and its distinguished elements for a subset of the ordered set. | INF\_U02INF\_U13 | X |  | X |  |
| U2 | Use the principle of mathematical induction to investigate the validity of algebraic formulas and to perform non-arithmetic evidential reasoning, notice facts about recursive problems, apply the idea of recursion to describe practical problems, and solve selected types of recursive equations. | X |  | X |  |
| U3 | In selected cases, determine the type of combinatorial model used in the analyzed problem and find a solution to this problem using various combinatorial tools. | X |  | X |  |
| U4 | Based on the concepts learned from graph theory, determine its algebraic representations in the form of an incidence and adjacency matrix, determine the number of paths of a fixed length between given vertices, and determine the shortest path in the graph. | X |  | X |  |
| After completing the course, the student is ready to take part in **social competences.** |
| K1 | Express yourself in a logical and precise manner, using basic concepts from discrete mathematics. | INF\_K04INF\_K06 | X |  | X |  |
| K2 | carrying out assigned tasks in an orderly manner, in accordance with the set priorities | 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** | 30 | 30 |  |  |  |  |  |  |  | 4 |
| **NST** |  | 15 |  |  |  |  |  | 10 |  | 4 |

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. | Elements of logic and set theory. Quantifier calculus. | W1, U1, K1, K2 | X |  |  | X |
| 2. | Relationships and functions. | W1, U1, K1, K2 | X |  |  | X |
| 3. | The principle of mathematical induction. Recursion. | W2, U2, K1, K2 | X |  |  | X |
| 4. | Elements of combinatorics. Counting sets and functions. | W3, U3, K1, K2 | X |  |  | X |
| 5. | Division algorithm, Euclidean algorithm. Remainder of division. Modulo congruence relation. | W2, W3, U2, U3, K1, K2 | X |  |  | X |
| 7. | Elements of graph theory. | W4, U4, K1, K2 | X |  |  | X |
| 8. | 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. | Set operations. Cartesian product. | W1, U1, K1, K2 | X |  | X |  |
| 2. | Equivalence relations and obstruction classes. Order and linear order relations. | W1, U1, K1, K2 | X |  | X |  |
| 3. | Functions. Bijections. Counting functions. | W1, U1, K1, K2 | X |  | X |  |
| 4. | Selected combinatorial tools. Dirichlet's pigeonhole principle. Stirling numbers. Bell numbers. Partitioning a set. Partitioning a number. | W3, U3, K1, K2 | X |  | X |  |
| 5. | Using mathematical induction in proofs of equality, inequality and divisibility. | W2, U2, K1, K2 | X |  | X |  |
| 6. | Recursion and various ways of determining the pattern of an explicit sequence. | W2, U2, K1, K2 | X |  | X |  |
| 7. | Determining the GCD by prime factorization and by the Euclidean algorithm. Remainder from division. Solving modular equations. | W2, W3, U2, U3, K1, K2 | X |  | X |  |
| 8. | Different ways of representing graphs. Selected graph algorithms. | W4, U4, K1, K2 | X |  | X |  |
| 9. | 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-W4 | solving tasks combined with discussion of the obtained results; group work; lecture combined with solving sample problems and discussion of the obtained results | Written exam including practical and theoretical tasks (passing lectures) | Exam sheet |
| SKILLS |
| U1-U4 | solving tasks combined with discussion of the obtained results; group work; lecture combined with solving sample problems and discussion of the obtained results | Colloquium covering practical (computational) tasks (passing exercises) | Colloquium sheet |
| SOCIAL COMPETENCES |
| K1-K2 | solving tasks combined with discussion of the obtained results; group work; lecture combined with solving sample problems and discussion of the obtained results | Colloquium covering practical (computational) tasks (passing exercises) | Colloquium 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. Recommended reading

**Basic**

1. Ross, Kenneth A., Matematyka dyskretna / Kenneth A. Ross, Charles R., B. Wright; z ang. przeł. E. Sepko-Guzicka, W. Guzicki, P. Zakrzewski. - Wyd. 5, 2 dodruk. Warszawa: Wydawnictwo Naukowe PWN, 2008.
2. Radev, Slavian. Matematyka dyskretna i logika / Slavian Radev. Siedlce: Collegium Mazovia Innowacyjna Szkoła Wyższa, 2010.

**Supplementary**

1. Helena Rasiowa, Wstęp do matematyki współczesnej, Wydawnictwo Naukowe PWN 2018.
2. Ronald L. Graham, Donald E. Knuth, Oren Patashnik, Matematyka konkretna, Wydawnictwo Naukowe PWN, 2019.

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** | **60** | **25** |
| Classes included in the study plan | 60 | 25 |
| **Student's own work** | **40** | **75** |
| Ongoing preparation for classes, preparation of project work/presentations/etc. | 20 | 35 |
| Preparation for passing classes | 20 | 40 |
| **TOTAL STUDENT HOURLY LOAD** | **100** | **100** |
| **Number of ECTS points** | **4** | **4** |

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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. |