**SYLLABUS**

**regarding the qualification cycle FROM 2023TO 2024**

1. Basic Course/Module Information

|  |  |
| --- | --- |
| Course/Module title | discrete Mathematics |
| Course/Module code \* |  |
| Faculty (name of the unit offering the field of study) | *College of Natural Sciences* |
| Name of the unit running the course | *Institute of Mathematics* |
| Field of study | Mathematics |
| Qualification level | Second degree |
| Profile | *Academic* |
| Study mode | *Full-time* |
| Year and semester of studies | *2 Year, 1 semester* |
| Course type | *Basic* |
| Language of instruction | English |
| Coordinator | Ewa Rak, PhD |
| Course instructor | *Stanisława Kanas, PhD, DSc* |

\* - as agreed at the faculty

1.1.Learning format – number of hours and ECTS credits

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Semester  (n0.) | Lectures | Classes | Colloquia | Lab classes | Seminars | Practical classes | Internships | others | **ECTS credits** |
| 1 |  | 30 |  |  |  |  |  |  | 5 |

1.2. Course delivery methods

☒ conducted in a traditional way

☒ involving distance education methods and techniques

1.3. Course/Module assessment (exam, pass with a grade, pass without a grade)

Exam

2. Prerequisites

|  |
| --- |
| Basic knowledge of Calculus I, Linear Algebra and logic. |

3. Objectives, Learning Outcomes, Course Content, and Instructional Methods

3.1. Course/Module objectives

|  |  |
| --- | --- |
| O1 | Mathematical induction and methods of proof using induction method.  Introduction to the basic concepts of recursion, recurrence equations and methods of solving them. |
| O2 | Introduction to the basic methods of counting sets and functions. |
| O3 | Understanding the elements of number theory, modular arithmetic, performing modulo calculations. Applications in prime factorization, primality testing and encryption. RSA encryption and decryption method. The basics of graph theory and their applications. |

3.2. Course/Module Learning Outcomes (to be completed by the coordinator)

|  |  |  |
| --- | --- | --- |
| Learning Outcome | The description of the learning outcome  defined for the course/module | Relation to the degree programme outcomes |
| LO\_01 | Defines most of the classic concepts and formulates the basic theorems in discrete mathematics, has knowledge of the evidence methods used in discrete mathematics, has knowledge of computational techniques used in discrete mathematics. | K\_W01, K\_W02, K\_W03, K\_W04 |
| LO\_02 | Shows equality and inequality by means of mathematical induction, solves recursive equations, uses basic formulas and properties to count sets and functions, performs calculations in modular arithmetic, uses basic primality and ciphers tests, recognizes graphs, creates minimal spanning trees. | K\_U03; K\_U04; K\_U05; KU\_08 |
| LO\_o3 | Independently searches for information in the literature and correctly uses it, formulates opinions on the basic issues of discrete mathematics, finds its place in the group, understands the importance of discrete mathematics in mathematics, cryptology, cryptography and other areas of knowledge. | K\_K02; K\_K06 |

**3.3. Course content (to be completed by the coordinator)**

|  |
| --- |
| Content outline |
| Description the finite and infinite sums and products and multiple sums, manipulation of sum and products. Properties and use of the asymptotes and the O-Notation.  Definition of the floor and ceiling functions. Formulation of the principle of mathematical induction, minimum and maximum principle for the finite subsets of natural numbers. Strong and weak principle of mathematical induction, recursion, towers of Hanoi, recurrence equations and relation, iteration of recursive equations, recursion trees, theorem on universal recurrence. Application of the generating function. |
| Introduction of basics of number theory, the largest common divisor, Euclid's algorithm, extended Euclid's algorithm, congruence, Fermat's small theorem, Chinese rest theorem. Modular arithmetic, modular exponentiation. Introduction to cryptography, primality tests, factorization of numbers |
| Introduction to cryptography, linear codes, private and public key, RSA algorithm - construction and theoretical basis. |
| Basics of combinatorics, the enumeration, combination, and permutation of sets of elements and the mathematical relations that characterize these properties. congruence relation, basics of binomial and multinomial coefficients. Pascal’s triangle. |
| Introduction to graph theory. Basic graph properties, trees, minimal spanning tree, Eulerian graphs, Hermitian graphs - the traveling salesman problem, planar graphs, vertex coloring, bipartite graphs, directed graphs, flows in graphs. |

3.4. Methods of Instruction

e.g.

*Lecture: a problem-solving lecture/a lecture supported by a multimedia presentation/ distance learning*

*Classes: text analysis and discussion/project work (research project, implementation project, practical project)/ group work (problem solving, case study, discussion)/didactic games/ distance learning*

*Laboratory classes: designing and conducting experiments*

Classes: working in groups and individual - task solving and proving theorems.

4. Assessment techniques and criteria

4.1 Methods of evaluating learning outcomes

|  |  |  |
| --- | --- | --- |
| Learning outcome | Methods of assessment of learning outcomes (e.g. test, oral exam, written exam, project, report, observation during classes) | Learning format (lectures, classes,…) |
| LO-01 | oral exam | class |
| LO-02 | project, observation during classes | class |
| LO-03 | oral exam, discussion | class |

4.2 Course assessment criteria

|  |
| --- |
| students are Assessed regularly solving tasks writing.  The examination of students' knowledge in the oral form.  Grading score:  3.0 for 50 - 60%, 3.5 for 61 - 70 %, 4.0 for 71 – 80%, 4.5 for 81 – 90%; 5.0 for 91 – 100 % |

5. Total student workload needed to achieve the intended learning outcomes

– number of hours and ECTS credits

|  |  |
| --- | --- |
| Activity | Number of hours |
| Scheduled course contact hours | 30 |
| Non-contact hours - student's own work (preparation for classes or examinations, projects, etc.) | 70 |
| Total number of hours | 100 |
| Total number of ECTS credits | 5 ECTS |

\* One ECTS point corresponds to 25-30 hours of total student workload

6. Internships related to the course/module

|  |  |
| --- | --- |
| Number of hours |  |
| Internship regulations and procedures |  |

7. Instructional materials

|  |
| --- |
| Compulsory literature:   1. N.L.Biggs, *Discrete Mathematics*, Oxford University Press 1989. 2. B.Bollobas, *Modern Graph Theory*, Springer 1998. 3. Th.H.Cormen, Ch.E.Leiserson, R.L.Rivest, C.Stein, *Introduction to algorithms*, MIT Press (3th edition), 2009. 4. K. A. Ross, Ch. R. B. Wright, *Discrete Mathematics*, Prentice Hall Inc., 1992. |
| Complementary literature:   1. R.Diestel, *Graph Theory*, Springer 1997. 2. G.Polya, R.E.Tarjan, D.R.Woods, *Notes on Introductory Combinatorics*, Birkhauser 1983. 3. J.Riordan, *An Introduction to Combinatorial Analysis*, Princeton University Press 1978. 4. V. Bryant, *Aspects of combinatorics*, Cambridge University Press 1993 |

Approved by the Head of the Department or an authorised person