|  |  |
| --- | --- |
|  | **Course Syllabus** |

**1.** **Course Title:**

Discrete mathematics

**2. Academic Level:**

Bachelor

**3. ECTS Credits:**

6 ECTS

**4. Semester:**

1, autumn semester

**5. School/Department:**

Institute of Computer Technologies and Information Security

**6. Location:**

Building “И”, 2 Chekhov St., Taganrog

**7. Instructor:**

Associate Prof., Dr. Evgeniya Gerasimenko, email: egerasimenko@sfedu.ru

**8. Language of Instruction:**

English

**9. Course Description:**

The lecture part of the course is based on many examples of constructing mathematical models of problems and methods for proving identities based on the methods of set theory and graph theory, solving practical problems in computer science and computer technology. The course workshop includes elements of an interactive problem-oriented approach to learning by focusing students' attention on the analysis and resolution of specific problems, when it is important not only to solve the design problem, but also to correctly pose and formulate it. Independent students’ work includes supervised and extracurricular independent work of students, it is aimed at improving the quality of education, deepening and consolidating the student's knowledge, developing analytical skills on the issues of the academic discipline, enhancing students' educational and cognitive activity and reducing the classroom load.

**10. Course Aims:**

**11. Specific entry requirements (if any):**

* formation of a system of knowledge about the methodology of using mathematical tools of this course;
* teaching students to build models, methods and algorithms based on set theory, mathematical logic;
* study of the foundations of discrete mathematical methods, consideration of problems for the existence, efficient construction, enumeration and optimization of objects that depend on a large number of discrete variables.

**12. Course Content:**

**Module 1. Special sections of set theory. Foundations of algebra of sets.**

1.1. Algebra of sets: The concept of a set. Methods to define sets. Inclusion and family of sets. Set-theoretic operations on sets. Proofs of set equalities. Cartesian product of sets. Projection and set inversion. Composition of sets.

1.2. Correspondences, functions, relations: the concept of a correspondence. Operations on matches. Operations on correspondences. The image and the preimage of a set for a given correspondence. Contraction and extension of correspondences. Properties of correspondences. Functions. Morphisms. A concept of relation. Operations on relations. Properties of relations.

1.3. Fuzzy sets: Fuzzy sets. Fuzzy inclusion and equality of fuzzy sets. Fuzzy correspondences and relations. Intuitionistic fuzzy set.

**Module 2. Basics of mathematical and fuzzy logic**

2.1. Elements of logic: Logical statements. Logical operations. Proofs of the equalities of logical propositions. Construction of truth tables. Axioms and laws of the algebra of logic.

2.2. Binary logic. Boolean functions: Elements of the theory of Boolean functions. Boolean function classes. Functional completeness theorem for Boolean functions. Normal forms of Boolean functions. Minimization of Boolean functions in the classical basis: methods of Karnaugh maps, undefined coefficients, Quine-McCluskey. Minimization of Boolean functions in other bases.

2.3. Logical conclusions: The concept of a formal system. Propositional calculus. Formulas and axioms of the propositional calculus. A logical conclusion based on the principle of resolution. Predicate logic. Inference based on deduction, induction and analogy. Multi-valued logic. Fuzzy logic.

**Module 3. Elements of graph theory. Basics of combinatorics**

3.1. Elements of graph theory: The concept of a graph. Methods for defining graphs. Graph connectivity, chains, circuits and cycles. Flat graph. Graph metrics Euler and Hamiltonian graphs. Operations on graphs. Travelling Salesman Problem.

3.2. Basics of combinatorics: Sum rule and product rule. R-sampling concept. R-permutations and combinations with and without repetitions. Substitutions. Arrangement and filling. Recurrence relations

The level of English B1 and higher

**13. Intended Learning Outcomes:**

After studying this course, the student will receive the following knowledge skills and abilities:

*Knowledge:*bases of set theory, graph theory, Boolean algebra, elements of combinatorial analysis

*Skills:*usage of combinatorial configurations to solve problems, determine the type of binary relation and its properties, perform operations on sets, perform operations on graphs, build truth tables of Boolean functions, perform identical transformations, find PCNF, PDNF, determine minimal DNF.

*Abilities:*use of the basic tools of discrete mathematics for solving applied problems

**14. Learning and Teaching Methods:**

The discipline provides the following teaching methods and interactive forms of practical training:

– typical teaching methods: explanatory and illustrative; visualization of educational material; group work;

– interactive forms of education: group work.

Along with traditional educational technologies, e-learning and distance learning technologies can be used to implement the discipline. Lectures and other forms of student-teacher contact work can be conducted using the Microsoft Teams, Cisco, Moodle (BigBlueButton) and other platforms, which allows for online and offline interaction between the teacher and students within the discipline. The main methods of current control are electronic recording and control of students' educational achievements (using the means of the point-rating system service; maintaining an electronic progress log, conducting electronic testing and using other means of control using the e-learning system).

**15. Methods of Assessment/Final assessment information:**

Interim assessment: tests, interviews, final assessment – exam

**16. Reading List:**

1. Gerasimenko, E. Discrete mathematics : textbook / Е. М. Gerasimenko, V. M. Kureychik, А. V. Bozhenyuk ; Southern Federal University. – Rostov-on-Don ; Tagan-rog : Southern Federal University Press, 2020. – 122 p.
2. Gladkov L.A., Kureichik V.V., Kureichik V.M. Discrete Mathematics. Textbook. Eds V.M. Kureichik, approved by the UMO of Higher Education Institutions on University Polytechnic Education as a textbook for students of higher educational institutions studying in the areas of informatics and computer engineering and information systems-Moscow: Fizmat Lit, 2014. – 496p.
3. Gladkov L.A., Kureichik V.V., Kureichik V.M. Fundamentals of Discrete Mathematics. Textbook. - Taganrog: TTI SFEDU Press, 2011. – 312p. <http://ntb.tgn.sfedu.ru/UML/UML_1525084.pdf>
4. Gladkov L.A., Kureichik V.V., Kureichik V.M. Discrete Mathematics. Graph Theory: a textbook – Taganrog: TTI SFEDU Press, 2010. – 162p. <http://ntb.tgn.sfedu.ru/UML/UML_4576.pdf>
5. Redkin N.P. Discrete Mathematics: a textbook // Moscow: Fizmatlit, 2009, 263p. <http://biblioclub.ru/index.php?page=book_red&id=75709>