

Course name: **Discrete Mathematics**

No. of ECTS: **6**

Aim:

- Introducing students to chosen methods of set theory;
- Introduction to basic issues of combinatorics;
- Introduction to elements of graph theory.

Course content:

- Propositional calculus, its rules and methods of examining propositional formulas. Set theory's basics and its main theorems;
- Methods of examining formulas in set theory. Propositional functions and quantifiers, basic theorems of predicate logic;
- Cartesian product, its features and methods of examining set theory formulas with it. A definition of relation and its basic types. Function as a specific type of relation. Equivalence relation and its features, abstraction rule. Approximated sets as a utilization of equivalence relation and their application in classifying objects;
- Natural numbers and mathematical Induction. Minimum and maximum rule. Structural induction. Cardinality. Partial and linear order. Upper and lower bounds sets of a subset of an ordered set, infimum and supremum, distinguished elements;
- Isomorphism of ordered sets and order types. Well ordered sets, ordinal numbers and their features;
- Functions counting issues – variations with and without repetitions and their features. Ordered distributions, permutations and combinations. Multiset, combinations with repetitions and permutations with repetitions. Pascal's and Newton's triangles – features and utilization in binary relations counting. Set divisions and Stirling's triangle – surjection counting;
- Perturbation method. First- and second-order recursive equations. Methods of determination of analytical form of a general principle of a sequence determined by recursion. Fibonacci sequence, Hanoi towers problem as an illustration of given issues;
- Three basic rules of combinatorics and their utilization samples;
- Graph definition, types of a graph and definitions directly related to it. Graph alteration matrix. Graphs isomorphism;
- Euler's and Hamilton's graphs – their basic features. Chosen graph algorithms, examples.

Skills:

- Recognition of basic definitions of set theory in phenomena, appropriate understanding and utilization;
- Recognition of a relation, including equivalence relation in a classification process and ordering relations, utilization in determining of bounds sets, distinguished elements etc. ;
- Recognition of basic combinatorial models and their features and noticing basic rules of combinatorics, facts concerning recursion issues, choosing techniques of solving recursion equations with appropriate understanding, using basic definitions of graph theory and their algebraic method of presentation e.g. the shortest way etc.;
- Specifying if a binary relation is an equivalence and determining its quotient set, being able to create an approximation space, determining a type of set's order, sets of lower and upper bounds and distinguished elements;
- Ability to compare cardinality for chosen cases, use a definition of isomorphism, define a type and ordinal number of a well ordered set;
- In simple cases, specifying a type of combinatorial model used in the analyzed issue and finding a solution, using three main rules of combinatorics, use recursion idea to describe practical issues and solving chosen types of recursive equations, determining algebraic representation of a graph – adjacency matrix – and other features concerning graph theory;
- Identifying of a constant need of education, giving inspiration and organizing an educational process of others, being aware of the importance of non-technical aspects and effects of engineering , including its effect on the environment and responsibility for decisions;
- Thinking and acting in a creative and venturesome way, cooperating and working in a group, adopting different roles in it, defining priorities which serve the purpose of realization of a task defined by themselves or others, identifying and solving problems related to their profession;
- Being aware of a social role of technical university graduate, understanding of a need of creating and conveying an information and opinion concerning technical achievements and other aspects of engineering; trying to convey such information in an understandable manner.

Form of teaching:

Lecture, classes