M102	**Combinatorics and Discrete mathematics**	L	S	E	ECTS
		2	0	2	6

The aim of the course. Adoption and understanding of basic methods for counting elements of sets and multisets. Capability of solving reccurence relations and introducing the students to model with reccurences. Adoption of the concept of generating functions and understanding the methods for solving combinatorial problems with the help of generating functions. Overcoming the basic concepts of graph theory and knowing some of their applications.

Prerequisities. Elementary Mathematics.

Course content.

1. Weak, strong and general form of Dirichlet's Box Principle. Ramsey's theorem. Basic counting principles. Counting the number of functions and subsets. Permutations of sets. Cyclic permutations. Estimating factorials. Combinations of sets. Permutations and combinations of multisets. Binomial and multinomial coefficients and their properties. Binomial and multinomial theorem.
2. The concept of reccurence relations. Modeling with reccurence relations. Fibonacci numbers. Linear reccurences with constant coefficients. Methods for solving linear homogeneous and nonhomogeneous reccurences with constant coefficients. Examples of linear reccurences. Some nonlinear reccurences.
   Inclusion-Exclusion formula and its applications. Derangement problem.
3. Generating functions and their properties. Calculating with generating functions and applications. Reccurences and generating functions.
4. Basic concepts of graph theory. Graphs and matrices. Walks, paths and conectivity in graphs. Cycles and trees. Digraphs. The concept of transportation network. Eulerian and Hamiltonian graphs. Graph colouring. Planar graphs.

Learing outcomes

No.	**Learning outcomes**
1.	Derive proof of the arrangement existence by using Dirichlet's Box Principle.
2.	Distinguish basic counting principles.
3.	Recognize and implement permutations and combinations of sets and multisets in combinatorial problems.
4.	Distinguish properties of binomial and multinomial coefficients.
5.	Analyze, model and solve problems by using reccurence relations.
6.	Use Inclusion-Exclusion formula to solve counting problems.
7.	Describe methods for solving combinatorial problems by using generating functions.
8.	Explain basic concepts of graph theory.
9.	Recognize and solve problems by using basic tools from graph theory.

Relating the learning outcomes, organization of the educational process and estimation of the learning outcomes

Organization of the educational process	ECTS	Learning outcomes **	Student activities*	The method of estimate	Points	
					min	max
Lecture attendance	1	1-9	Lecture attendance, discussion, team work and independent work on given tasks.	Attendance sheets, tracking activities	0	4
Written exam. (colloquium)	2	1-9	Prepairing for written exam.	Evaluation.	25	48
Final exam.	3	1-9	Repetition of the subject matter.	Oral exam.	25	48
Total	6				50	100

Teaching and evaluation of knowledge. Attendance at lectures and exercises is required. The exam consists of written and oral part, and can be taken after completion of lectures and exercises. During the semester students can take colloquiums that replace the written examination.

Can the course be taught in English: Yes

Basic literature:

1. D. Veljan, Kombinatorna i diskretna matematika, Algoritam, Zagreb, 2001.

Additional literature:

1. D. Veljan, Kombinatorika s teorijom grafova, Školska knjiga, Zagreb, 1989.
2. J. Anderson, J. Bell, Discrete Mathematics with Combinatorics, Prentice hall, New York, 2000.
3. J. Matoušek, J. Nešetril, Invitation to Discrete Mathematics, Oxford University Press, 1998.
4. M. Cvitković, Kombinatorika : zbirka zadataka, Element, Zagreb, 1998.