



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

### OPIS PREDMETA / SUBJECT SPECIFICATION

|                       |                               |
|-----------------------|-------------------------------|
| <b>Predmet:</b>       | <b>Diskretna matematika I</b> |
| <b>Subject Title:</b> | Discrete Mathematics I        |

| <b>Študijski program</b><br>Study programme | <b>Študijska smer</b><br>Study field | <b>Letnik</b><br>Year | <b>Semester</b><br>Semester |
|---------------------------------------------|--------------------------------------|-----------------------|-----------------------------|
| Matematika / Mathematics                    |                                      | 2.                    | 3.                          |

Univerzitetna koda predmeta / University subject code:

| <b>Predavanja</b><br>Lectures | <b>Seminar</b><br>Seminar | <b>Sem. vaje</b><br>Tutorial | <b>Lab. vaje</b><br>Lab. work | <b>Teren. vaje</b><br>Field work | <b>Samost. delo</b><br>Individ.<br>work | <b>ECTS</b> |
|-------------------------------|---------------------------|------------------------------|-------------------------------|----------------------------------|-----------------------------------------|-------------|
| 45                            |                           | 45                           |                               |                                  | 120                                     | 7           |

Nosilec predmeta / Lecturer:

|                               |                                 |                   |
|-------------------------------|---------------------------------|-------------------|
| <b>Jeziki /</b><br>Languages: | <b>Predavanja /</b><br>Lecture: | SLOVENSKO/SLOVENE |
|                               | <b>Vaje / Tutorial:</b>         | SLOVENSKO/SLOVENE |

#### Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Vsaka izmed naštetih obveznosti v načinih ocenjevanja mora biti opravljena s pozitivno oceno.

Pozitivna ocena pri pisnem izpitu je pogoj pristop k teoretičnemu izpitu.

#### Vsebina:

Kombinatorično preštevaje: osnovna pravila preštevanja; urejene in neurejene izbire; binomska in multinomska števila; pravilo vključitev in izključitev; porazdelitve; linearna rekurzija; Stilingova števila prve in druge vrste; trdnjavski polinomi.

Teorija grafov: osnovni pojmi; sprehodi, poti in cikli; usmerjeni grafi; drevesa in razdalje; vpeta drevesa; Eulerjevi in Hamiltonovi grafi; ravninski grafi; barvanje grafov; povezanost; 2-povezani grafi; dvodelni grafi in prirejanja.

#### Prerequisites:

Each of the mentioned commitments must be assessed with a passing grade.

Passing grade of the written exam is required for taking the theoretical exam.

#### Contents (Syllabus outline):

Combinatorial counting: basic counting rules; ordered and unordered selections; binomial and multinomial numbers; inclusion-exclusion principle; distributions; linear recursion; Stirling numbers of the first and the second kind; rook polynomials.

Graph theory: basic concepts; walk, paths and cycles; digraphs; trees and distances; spanning trees; Euler and Hamilton graphs; planar graphs; graph colorings; connectedness; 2-connected graphs; bipartite graphs and matchings.

Teorija načrtov: načrti in  $t$ -načrti; ciklične konstrukcije načrtov; končne projektivne ravnine; Latinski kvadrati; ortogonalni Latinski kvadrati.

Design theory: designs and  $t$ -designs; cyclic constructions for designs; finite projective planes; Latin squares; orthogonal Latin squares.

### Temeljni študijski viri / Textbooks:

N. L. Biggs, Discrete Mathematics. Second Edition. The Clarendon Press, Oxford University Press, New York, 1989.

M. Juvan, P. Potočnik, Teorija grafov in kombinatorika, DMFA, Ljubljana, 2000.

S. Klavžar, P. Žigert, Izbrana poglavja uporabne matematike, Pedagoška fakulteta, Maribor, 2002.

### Dodatna literatura / Additional Readings:

J. Matoušek, J. Nešetřil, Invitation to Discrete Mathematics, Oxford University Press, Oxford, 1998.

D. B. West, Introduction to Graph Theory. Second Edition. Prentice Hall, Inc., Upper Saddle River, NJ, 2001.

R. J. Wilson, J. J. Watkins, Uvod v teorijo grafov, DMFA, Ljubljana, 1997.

### Cilji:

Spoznati temeljne koncepte in rezultate s področja diskretne matematike - kombinatorike, teorije grafov ter teorije načrtov.

### Objectives:

Know fundamental concepts and results from discrete mathematics – combinatorics, graph theory and design theory.

### Predvideni študijski rezultati:

Znanje in razumevanje:

- Razumevanje zahtevnejših principov diskretne matematike.
- Spoznati različne uporabe diskretne matematike.
- Prepoznati praktične probleme in njihovo modeliranje z orodji diskretne matematike.

### Intended learning outcomes:

Knowledge and Understanding:

- Be able to understand more demanding principals of discrete mathematics.
- To know a variety of applications of discrete mathematics.
- To recognize practical problems and their modeling with discrete mathematics tools.

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Prenesljive/ključne spretnosti in drugi atributi: <ul style="list-style-type: none"> <li>Prenos znanja metod diskretne matematike na druga področja (računalništvo, kemija, biologija, optimizacija, ...)</li> </ul> | Transferable/Key Skills and other attributes: <ul style="list-style-type: none"> <li>Knowledge transfer of methods of discrete mathematics into other fields (computer science, chemistry, biology, optimization, ...)</li> </ul> |
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|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>Metode poučevanja in učenja:</b> <ul style="list-style-type: none"> <li>Predavanja</li> <li>Teoretične vaje</li> </ul> | <b>Learning and teaching methods:</b> <ul style="list-style-type: none"> <li>Lectures</li> <li>Theoretical exercises</li> </ul> |
|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|

| Načini ocenjevanja: | Delež (v %) /<br>Weight (in %) | Assessment:      |
|---------------------|--------------------------------|------------------|
| Pisni izpit         | 50%                            | Written exam     |
| Teoretični izpit    | 50%                            | Theoretical exam |

#### Opombe:

Pisni izpit se lahko nadomesti s sprotnim ocenjevanjem (kolokviji) v enakem deležu (50%).

#### Comments:

Written exam can be replaced by midterm examination in the same weight (50%).

#### Reference nosilca / Lecturer's references:

- BREŠAR, Boštjan, DRAVEC, Tanja, HEDŽET, Jaka, SAMADI, Babak. Induced matching vs edge open packing: trees and product graphs. *Discrete mathematics*. [Print ed.]. Jul. 2025, vol. 348, iss. 7, [article no.] 114458, 19 str., graf. prikazi. ISSN 0012-365X. <https://www.sciencedirect.com/science/article/pii/S0012365X25000664>, DiRROS - Digitalni repozitorij raziskovalnih organizacij Slovenije, DOI: [10.1016/j.disc.2025.114458](https://doi.org/10.1016/j.disc.2025.114458). [COBISS.SI-ID [228279299](https://cobiss.si/id/228279299)]
- BREŠAR, Boštjan, FERME, Jasmina, HOLUB, Přemysl, JAKOVAC, Marko, MELICHAROVÁ, Petra. SS-packing colorings of distance graphs with distance sets of cardinality 22. *Applied mathematics and computation*. [Print ed.]. Apr. 2025, vol. 490, [article no.] 129200, 13 str. ISSN 0096-3003. <https://www.sciencedirect.com/science/article/pii/S0096300324006611>, DiRROS - Digitalni repozitorij raziskovalnih organizacij Slovenije, DOI: [10.1016/j.amc.2024.129200](https://doi.org/10.1016/j.amc.2024.129200). [COBISS.SI-ID [216160771](https://cobiss.si/id/216160771)]
- BREŠAR, Boštjan, HENNING, Michael A. Best possible upper bounds on the restrained domination number of cubic graphs. *Journal of graph theory*. Aug. 2024, vol. 106, iss. 4, str. 763–815, graf. prikazi. ISSN 0364-9024. <https://onlinelibrary.wiley.com/doi/10.1002/jgt.23095>, DiRROS - Digitalni repozitorij raziskovalnih organizacij Slovenije, DOI: [10.1002/jgt.23095](https://doi.org/10.1002/jgt.23095). [COBISS.SI-ID [199137795](https://cobiss.si/id/199137795)]
- BREŠAR, Boštjan, HEDŽET, Jaka. Bootstrap percolation in strong products of graphs. *The Electronic journal of combinatorics*. [Online ed.]. 2024, vol. 31, iss. 4, article no. p4.35, 22 str.

ISSN 1077-

8926. <https://www.combinatorics.org/ojs/index.php/eljc/article/view/v31i4p35>, DiRROS - Digitalni repozitorij raziskovalnih organizacij Slovenije, DOI: [10.37236/11826](https://doi.org/10.37236/11826). [COBISS.SI-ID [215693827](https://cobiss.si/id/215693827)]

5. BREŠAR, Boštjan, CORNET, María Gracia, DRAVEC, Tanja, HENNING, Michael A. Bounds on zero forcing using (upper) total domination and minimum degree. *Bulletin of the Malaysian Mathematical Sciences Society*. Sep. 2024, vol. 47, iss. 5, [article no.] 143, 18 str. ISSN 0126-6705. <https://link.springer.com/article/10.1007/s40840-024-01744-x>, DOI: [10.1007/s40840-024-01744-x](https://doi.org/10.1007/s40840-024-01744-x). [COBISS.SI-ID [205078531](https://cobiss.si/id/205078531)]