Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Diskretna matematika 2**
Course title:	**Discrete Mathematics 2**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Matematika, 2. stopnja		**1.**	**2.**
Mathematics, 2nd cycle		**1.**	**2.**

Vrsta predmeta / Course type obvezni/compulsory

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
60	**15**	**30**			**195**	**10**

Nosilec predmeta / Lecturer: Boštjan Brešar

Jeziki / Languages:	**Predavanja / Lectures:**	SLOVENSKO/SLOVENE
	Vaje / Tutorial:	SLOVENSKO/SLOVENE

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Poznavanje teorije grafov.	Knowledge of graph theory.

Vsebina:	**Content (Syllabus outline):**
Algebraična kombinatorika: rodovne funkcije; uporabe rodovnih funkcij (Catalanova števila, število particij naravnega števila); ciklični indeks; teorija Polya; linearna algebra v diskretni matematiki (načrti in Fisherjeva neenakost; pokritja s polnimi dvodelni grafi; prostori ciklov, kroženja in prerezi; uporabe lastnih vrednosti).	Algebraic combinatorics; generating functions; applications of generating functions (Catalan numbers, partitions of a positive integer); cyclic index; Polya theory; linear algebra in discrete mathematics (designs and Fisher's inequality; coverings with complete bipartite graphs; cycle space, circulations and cuts; applications of eigenvalues).

Kode za popravljanje napak: osnovni pojmi; linearne kode; konstrukcije linearnih kod; popravljanje napak; ciklične kode; klasifikacija cikličnih kod. Teorija grafov: dodatna poglavja iz barvanja grafov (dokaz Brooksovega izreka, kritični grafi, krožna barvanja); k-povezani grafi (dokaz Mengerjevega izreka); omrežja in pretoki v omrežjih; dokaz izreka Kuratowskega; neodvisne in dominirajoče množice. Kombinatorika delno urejenih množic: linearne razširitve; dimenzija delne urejenosti; Dilworthov izrek; Spernerjev izrek. Schnyderjev izrek. Ramseyeva teorija: število monokromatičnih trikotnikov; Ramseyev izrek; Ramseyeva števila; uporabe izreka, grafovska Ramseyeva števila.	Error-correcting codes: basic concepts; linear codes; constructions of linear codes; correcting errors; cyclic codes; classification of cyclic codes. Graph theory: additional graph coloring topics (proof of Brooks theorem, critical graphs, circular colorings); k-connected graphs (proof of Menger's theorem); networks and flows in networks; proof of Kuratowski theorem; independent and dominating sets. Combinatorics of partially ordered sets: linear extensions; dimension of a partial order; Dilworth's theorem; Sperner's theorem. Schnyder's theorem. Ramsey theory: number of monochromatic triangles; Ramsey theorem; Ramsey numbers; applications of the theorem, graph Ramsey numbers.

Temeljni literatura in viri / Readings:

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

M. Aigner, Discrete Mathematics, *American Mathematical Society, Providence RI*, 2007.

R. Diestel, Graph Theory, *Springer-Verlag, Berlin Heidelberg*, 2005.

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

J. H. van Lint, R. M. Wilson, A Course in Combinatorics, *Cambridge University Press, Cambridge*, 2001.

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

Cilji in kompetence:	**Objectives and competences:**
Poglobiti zahtevnejša področja sodobne diskretne matematike in njene uporabe: algebraično kombinatoriko, kode za popravljanje napak, dodatna poglavja iz teorije grafov, kombinatoriko delno urejenih množic, metode linearne algebre v diskretni matematiki in Ramseyevo teorijo.	To deepen the knowledge of more demanding areas of temporary discrete mathematics and its applications: algebraic combinatorics, error-correcting codes, additional topics from graph theory, combinatorics of partially ordered sets, tools from linear algebra in discrete mathematics, and Ramsey theory. To develop research capabilities of students.

Razvijati raziskovalne sposobnosti študentov.	

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Razumevanje zahtevnejših principov diskretne matematike. • Poglobiti netrivialne uporabe diskretne matematike. • Povezati diskretno matematiko z drugimi matematičnimi področji. Prenosljive/ključne spretnosti in drugi atributi: • *Prenos* zahtevnejšega znanja metod diskretne matematike na druga področja (računalništvo, kemija, biologija, optimizacija, ...) • *Spretnosti komuniciranja*: ustno izražanje in javni nastop pri seminarju, ustno in pisno izražanje na izpitih • *Reševanje problemov:* reševanje zahtevnih problemov v diskretni matematiki.	Knowledge and Understanding: • Be able to understand more demanding principals of discrete mathematics. • To deepen the knowledge of nontrivial applications of discrete mathematics. • To connect discrete mathematics with other fields of mathematics. Transferable/Key Skills and other attributes: • *Knowledge transfer* of more demanding methods of discrete mathematics into other fields (computer science, chemistry, biology, optimization, …) • *Communication skills:* public performance at seminar presentation, manner of expression at exams. • *Problem solving:* solving of demanding problems in discrete mathematics.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja • Seminarske vaje	• Lectures • Tutorial

Načini ocenjevanja:		**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt):	Delež (v %) / Weight (in %)	Type (examination, oral, coursework, project):
- Seminarska naloga - Pisni testi - Ustni izpit	25% 25% 50%	- Seminar exercise - Written tests - Oral exam
Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.		Each of the mentioned commitments must be assessed with a passing grade.
Pozitivna ocena pri seminarski nalogi in pisnih testih sta pogoja za pristop k ustnemu izpitu.		Passing grade of the seminar and of written tests are required for taking the oral exam.

Reference nosilca / Lecturer's references:

1. BREŠAR, Boštjan, KOS, Tim, KRIVOŠ-BELLUŠ, Rastislav, SEMANIŠIN, Gabriel. Hitting subgraphs in P4-tidy graphs. *Applied mathematics and computation*, ISSN 0096-3003. [Print ed.], July 2019, vol. 352, str. 211-219. https://doi.org/10.1016/j.amc.2019.01.074, doi: 10.1016/j.amc.2019.01.074.

2. BREŠAR, Boštjan, VALENCIA-PABON, Mario. Independence number of products of Kneser graphs. *Discrete Mathematics*, ISSN 0012-365X. [Print ed.], April 2019, vol. 342, iss. 4, str. 1017-1027. https://doi.org/10.1016/j.disc.2018.12.017, doi: 10.1016/j.disc.2018.12.017.

3. BREŠAR, Boštjan, KLAVŽAR, Sandi, RALL, Douglas F., WASH, Kirsti. Packing chromatic number versus chromatic and clique number. *Aequationes mathematicae*, ISSN 0001-9054, 2018, vol. 92, iss. 3, str. 497-513. https://doi.org/10.1007/s00010-017-0520-9.

4. BREŠAR, Boštjan, FERME, Jasmina. Packing coloring of Sierpiński-type graphs. *Aequationes mathematicae*, ISSN 0001-9054, Dec. 2018, vol. 92, iss. 6, str. 1091-1118. https://doi.org/10.1007/s00010-018-0561-8, doi: 10.1007/s00010-018-0561-8.

5. BONOMO, Flavia, BREŠAR, Boštjan, GRIPPO, Luciano, MILANIČ, Martin, SAFE, Martin Dario. Domination parameters with number 2 : interrelations and algorithmic consequences. *Discrete applied mathematics*, ISSN 0166-218X. [Print ed.], Jan. 2018, vol. 235, str. 23-50.