UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Diskretna matematika
Course title:	Discrete mathematics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Podatkovne znanosti, magistrski študijski program druge stopnje	-	Prvi	Drugi
The second cycle masters study programme Data Sciences	-	First	Second

Vrsta predmeta / Course type	Izbirni / Elective
Univerzitetna koda predmeta / University course code:	2-PZ-MAG-IP-DM-2020-06-30

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	-	30	-	-	90	5

Nosilec predmeta / Lecturer:	Prof. dr. Riste Škrekovski, izr. prof. dr. Borut Lužar

Jeziki / Languages:	**Predavanja / Lectures:**	Slovenski / Slovenian, Angleški / English
	Vaje / Tutorial:	Slovenski / Slovenian, Angleški / English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Specifičnih pogojev za vključitev v delo ni. Priporočeno je poznavanje osnovnih pojmov kombinatorike in teorije grafov (npr. znanje pridobljeno pri predmetu Matematika 2 na prvi stopnji programa). Pogoj za pristop k pisnemu izpitu je pravočasna oddaja in pozitivna ocena domačih nalog.	There are no specific requirements for this subject. Knowledge of basic notions from combinatorics and graph theory is recommended (e.g., knowledge obtained at Mathematics 2 from the first level of the programme). Student has to submit homework assignments within the due time. If the assignments are positively graded, he/she is allowed to write the exam.

Vsebina:	**Content (Syllabus outline):**

- Uvod v kombinatorična preštevanja (permutacije, variacije in kombinacije)
- Razbitja množic in razčlenitve števil (Lahova števila, Stirlingova števila prve in druge vrste, razčlenitve naravnih števil)
- Porazdelitve in barvanja
- Uvod v teorijo grup
- Delovanja grup in preštevanje orbit (permutacije, ciklični indeks, Izrek Redfielda in Polya)
- Rekurzivne enačbe (linearne enačbe s konstantnimi koeficienti, linearne nehomogene enačbe)
- Pregled pojmov iz teorije grafov
- Izomorfizmi grafov
- Barvanja grafov (Brooksov izrek, Izrek štirih barv)
- Dvodelni grafi in prirejanja (Kőnigov in Hallov izrek)
- Hiperkocke in Gray-evi kodi
- Kodi za odpravljanje napak
- Osnove Ramseyeve teorije

- Introduction to combinatorial countings (permutations, variations in combinations)
- Set splittings and number decompositions (Lah numbers, Stirling numbers of the first and the second kind, decompositions of natural numbers)
- Distributions and colorings
- Introduction to group theory
- Group actions and counting orbits (permutations, cyclic index, Redfield-Polya Theorem)
- Recurrence equations (linear equations with constant coefficients, linear non-homogeneous equations)
- Overview of graph theory notions
- Graph isomorphisms
- Graph colorings (Brooks' Theorem, Four Color Theorem, Vizing's Theorem)
- Bipartite graphs and matchings (Kőnig's and Hall's Theorems)
- Hypercubes and Gray codes
- Error-correcting codes
- Basics of Ramsey Theory

Temeljni literatura in viri / Readings:

- V. Batagelj, S. Klavžar: DS2, algebra in teorija grafov, naloge, DMFAS, Ljubljana, 2000.
- R. Diestel: Graph Theory, Springer-Verlag, Berlin Heidelberg, 2005.
- M. Juvan, P. Potočnik: Kombinatorika s teorijo grafov: primeri in rešene naloge, DMFAS, Ljubljana, 2000.
- J. H. van Lint, R. M. Wilson: A Course in Combinatorics, Cambridge University Press, Cambridge, 2001.
- P. Potočnik: Zapiski predavanj iz Diskretne matematike 1, Samozaložba, Ljubljana, 2011.
- R. J. Wilson, J. J. Watkins: Uvod v teorijo grafov, DMFAS, Ljubljana, 1997.

Cilji in kompetence:

Splošne kompetence:

- Sposobnost analitičnega in algoritmičnega razmišljanja.
- Sposobnost fleksibilne uporabe znanja v praksi.
- Obvladovanje sodobnih visoko zmogljivih orodij in specifične programske opreme za obdelavo podatkov.

Objectives and competences:

General competences:

- The ability of analytical and algorithmic thinking.
- The ability of flexible usage of knowledge in practice.
- Mastering cutting edge high performance tools and corresponding software for data processing.

Subject-specific competences:

Predmetno-specifične kompetence:	
• Poznavanje naprednih kombinatoričnih metod in njihova uporaba v praksi. • Poznavanje pojmov teorije grafov ter sposobnost njihove uporabe pri modeliranju realnih problemov. • Razumevanje formalnih matematičnih dokazov in poznavanje različnih pristopov dokazovanja.	• Knowledge of advanced combinatorial methods and their usage in practice. • Knowledge of graph theory notions and ability for their application in modelling real problems. • Understanding of formal mathematical proofs and knowledge of various proving approaches.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Študentje bodo spoznali zahtevnejše pojme in principe diskretne matematike. • Študentje bodo sposobni prepoznati praktične probleme in jih reševati z orodji diskretne matematike. • Poznali in razumeli bodo poglavitne izreke kombinatorike in teorije grafov. Prenosljive spretnosti: • Pridobljeno znanje bo prenosljivo na druga področja, predvsem v razvoj algoritmov in programskih rešitev.	Knowledge and understanding: • Students will get acquainted with advanced notions and principles of discrete mathematics. • Students will be able to recognize practical problems and solve them with discrete mathematics tools. • They will know and understand fundamental theorems of combinatorics and graph theory. Transferable skills: • Acquired knowledge will be transferable to other areas, mainly to development of algorithms and software solutions.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri). • Vaje (reševanje problemov).	• Lectures with active students' participation (explanations, discussion, questions, examples) • Exercises (problem solving).

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
• Domače naloge • Pisni izpit	30 % 70 %	• Homework assignments • Written exam

Reference nosilca / Lecturer's references:

- M. Knor, R. Škrekovski. On the minimum distance in a k-vertex set in a graph. Applied mathematics and computation 356 (2019), 99-104.

- Dross, B. Lužar, M. Maceková, R. Soták: Note on 3-choosability of planar graphs with maximum degree 4, Discrete Math. 342(11) (2019), 3123-3129.
- B. Lužar, M. Mockovčiaková, P. Ochem, A. Pinlou, R. Soták: On non-repetitive sequences of arithmetic progressions: the cases k ∈ {4,5,6,7,8}, Discrete Appl. Math. 279 (2020), 106-117.
- B. Lužar, R. Škrekovski. Counterexamples to a conjecture on injective colorings. Ars Math. Contemp. 8 (2015), 291-295.
- B. Lužar, M. Petruševski, R. Škrekovski, Odd edge coloring of graphs, Ars Math. Contemp. 9 (2015), 277-287.
- J. Kranjc, B. Lužar, M. Mockovčiaková, R. Soták, Note on Coloring of Double Disk Graphs, J. Global Optim. 60(4) (2014), 793-799.
- B. Lužar, M. Mockovčiaková, R. Soták, Riste Škrekovski, Peter Šugerek, l-facial edge colorings, Discrete Appl. Math. 181 (2015), 193-200.
- M. Knor, B. Lužar, R. Škrekovski, Sandwiching the (generalized) Randić index, Discrete Appl. Math. 181 (2015), 160-166.
- J. Kranjc, B. Lužar, M. Mockovčiaková, R. Soták, On a generalization of Thue sequences, Electron. J. Combin. 22(2) (2015), R33.
- L. Bezegová, B. Lužar, M. Mockovčiaková, R. Soták, R. Škrekovski, Star edge colorings of some classes of graphs, J. Graph Theory 81 (2016), 73-82.
- P. Gregor, B. Lužar, R. Soták, On incidence coloring conjecture in Cartesian products of graphs, Discrete Appl. Math. 213 (2016), 93-100.
- P. Gregor, B. Lužar, R. Soták, Note on incidence chromatic number of subquartic graphs, J. Combin. Optim. 34 (2017), 174-181.
- M. Bonamy, M. Knor, B. Lužar, A. Pinlou, R. Škrekovski, On the difference between the Szeged and the Wiener index, Appl. Math. Comput. 312 (2017), 202-213.
- B. Lužar, M. Petruševski, R. Škrekovski: On vertex-parity edge-colorings, J. Combin. Optim. 35 (2018), 373-388.
- V. Andova, B. Lidický, B. Lužar, R. Škrekovski: On facial unique-maximum (edge-) coloring, Discrete Appl. Math. 237 (2018), 26-32.
- B. Lužar, P. Ochem, A. Pinlou: On repetition thresholds of caterpillars and trees of bounded degree, Electron J. Combin. 25 (2018), #P1.61.
- B. Lužar, J. Przybyło, R. Soták: New bounds for locally irregular chromatic index of bipartite and subcubic graphs, J. Combin. Optim. 36(4) (2018), 1425-1438.
- B. Lužar, M. Mockovčiaková, R. Soták: Note on list star edge-coloring of subcubic graphs, J. Graph Theory 90(3) (2018), 304-310.