



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Osnove teorije grafov
Course title:	Basic Graph Theory

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Enovit magistrski študijski program druge stopnje Predmetni učitelj	/	4.	7.
Five-year master's degree program Subject Teacher	/		

Vrsta predmeta / Course type

Obvezni / Compulsory

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
15	15	15			45	3

Nosilec predmeta / Lecturer:

Boštjan BREŠAR

Jeziki /

Predavanja / Lectures: slovenski/Slovenian

Languages:

Vaje / Tutorial: slovenski/Slovenian

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

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

Pozitivni oceni pri seminarju in pisnem izpitu sta pogoja za pristop k teoretičnemu izpitu.

Prerequisites:

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

Passing grades of the seminar and of the written exam are required for taking the theoretical exam.

Vsebina:

Content (Syllabus outline):

• Osnovni pojmi in primeri: graf, stopnja, izomorfizem grafov, podgrafi, povezanost, poti in cikli, dvodelni grafi, drevesa, tetivni grafi. • Prirejanja: prirejanja in pokritja, prirejanja v dvodelnih grafih, prirejanja v splošnih grafih, Hallov poročni izrek. • Ravninski grafi: risbe grafov, zemljevidi, dualni graf, Eulerjeva formula. • Barvanja grafov: barvanja vozlišč, Brooksov izrek, barvanja povezav, barvanja zemljevidov, izrek 4 barv, sodobni koncepti barvanj. • Eulerjevi in Hamiltonovi grafi: problem Konigsbergških mostov in Eulerjev izrek, Fleuryjev postopek, Hamiltonovi cikli in poti, potrebni in zadostni pogoji za hamiltonskost, usmerjeni grafi in turnirji, problem trgovskega potnika, problem kitajskega poštarja. Del snovi bo prilagojen interesom in pobudam študentov ali sproti se porajajočim trendom v teoriji grafov in razvedrilni diskretni matematiki.	• Basic concepts and examples: graph, degree, graph isomorphism, subgraphs, paths and cycles, trees, bipartite graphs, chordal graphs. • Matchings: matchings and covers, matchings in bipartite graphs, matchings in general graphs, Hall's marriage theorem, • Planar graphs: graph drawings, maps, graph dual, Euler's formula, • Colorings of graphs: vertex colorings, Brooks' theorem, edge colorings, map colorings, 4 colour theorem, modern coloring concepts. • Eulerian and hamiltonian graphs: bridges of Konigsberg problem and Euler's theorem, Fleury's procedure, Hamilton cycles and paths, necessary and sufficient conditions for hamiltonicity, digraphs and tournaments, traveling salesman problem, Chinese postman problem. A part of the contents will be adjusted to interests and initiative of students or to newly appearing trends in graph theory and recreational discrete mathematics.
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Temeljni literatura in viri / Readings:

- R. J. Wilson, J. J. Watkins: *Uvod v teorijo grafov*, DMFA, Ljubljana, 1997.
- D.B. West: *Introduction to Graph Theory*, Prentice Hall, New Jersey, 2001.

Dodatna literatura /Additional Readings:

- D. A. Marcus, *Graph Theory: A problem oriented approach*, Washington, MAA, 2008
- J.A. Bondy and U.S.R. Murty: *Graph Theory*, Springer, London, 2008.

Cilji in kompetence:

Cilj predmeta je seznaniti študente z najpomembnejšimi koncepti teorije grafov in njene uporabe. V okviru seminarja se študent samostojno nauči izbrano snov in pripravi seminarsko predstavitev. Poseben poudarek je namenjen razvoju refleksije pridobljenega znanja in njegovega prenosa v didaktično prakso.

Objectives and competences:

The objective of this course is to acquaint students with the most important concepts in graph theory and its application. For the seminar a student self-reliantly learns a chosen topic and prepares a presentation. A special emphasis is given to the reflection of acquired knowledge and its transfer to didactical practice.

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben izkazati razumevanje osnov teorije grafov, reševati probleme, ki se v teoriji grafov pojavljajo ter pridobljeno znanje uporabljati.

Intended learning outcomes:

Knowledge and Understanding:

On completion of this course the student will be able to demonstrate understanding of graph theory basics, solve problems that appear in graph theory and apply the obtained knowledge.

Prenesljive/ključne spretnosti in drugi atributi: • <i>Spretnosti komuniciranja</i>: ustno izražanje in javni nastop pri seminarju, ustno in pisno izražanje na izpitih • <i>Reševanje problemov</i>: reševanje kombinatoričnih in ekstremalnih problemov v teoriji grafov.	Transferable/Key Skills and other attributes: • <i>Communication skills</i>: public performance at seminar presentation, manner of expression at exams. • <i>Problem solving</i>: solving combinatorial and extremal problems in graph theory.
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Metode poučevanja in učenja:

- Predavanja
- Seminarske vaje
- Seminar
- Individualno delo

Learning and teaching methods:

- Lectures
- Tutorial
- Seminar
- Individual work

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Seminar	30%	Seminar
Pisni izpit	30%	Written exam
Teoretični izpit	40%	Theoretical exam

Opombe:

Pisni izpit se lahko nadomesti s sprotim ocenjevanjem v enakem deležu (30%).

Comments:

Written exam can be replaced by midterm examination in the same weight (30%).

Reference nosilca / Lecturer's references:

1. 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)]
2. 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)]
3. 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/199137795)]

4. 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/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/205078531)]