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:	**Prerequisits:**
Pogojev ni.	None.
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 Konnigsbergških 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 marrriage theorem,
- Planar graphs: graph drawings, maps, graph dual, Euler's formula,
- Colourings of graphs: vertex colourings, Brooks' theorem, edge colourings, map colourings, 4 colour theorem, modern colouring concepts.
- Eulerian and hamiltonian graphs: bridges of Konnigsberg 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.

Temeljni literatura in viri / Readings:

- D.B. West: *Introduction to Graph Theory,* Prentice Hall, New Jersey, 2001.
- R. J. Wilson, J. J. Watkins: *Uvod v teorijo grafov*, DMFA, Ljubljana, 1997.
- 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:	Transferable/Key Skills and other attributes:
• *Spretnosti komuniciranja*: ustno izražanje in javni nastop pri seminarju, ustno in pisno izražanje na izpitih • *Reševanje problemov:* reševanje kombinatoričnih in ekstremalnih problemov v teoriji grafov.	• *Communication skills:* public performance at seminar presentation, manner of expression at exams. • *Problem solving:* solving combinatorial and extremal problems in graph theory.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja • Seminarske vaje • Seminar • Individualno delo	• Lectures • Tutorial • Seminar • Individual work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Seminar	**30%**	Seminar
Pisni izpit (naloge)	**30%**	Written exam (exercises)
Izpit (teorija)	**40%**	Exam (theory)
Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.		Each of the mentioned commitments must be assessed with a passing grade.
Pisni izpit – naloge se lahko nadomesti s sprotnim ocenjevanjem (delni testi).		Written exam – problems can be replaced by mid-term tests
Pozitivni oceni pri seminarju in pisnem izpitu sta pogoja za pristop k izpitu iz teorije		Passing grade of the seminar and of the written exam are required for taking the exam.

Reference nosilca / Lecturer's references:

1. BREŠAR, Boštjan, GASTINEAU, Nicolas, GOLOGRANC, Tanja. On a vertex-edge marking game on graphs. *Annals of combinatorics*, ISSN 0218-0006, Mar. 2021, vol. 25, iss. 1, str. 179-194. https://link.springer.com/article/10.1007/s00026-021-00524-9, doi: 10.1007/s00026-021-00524-9. [COBISS.SI-ID 56924419].

2. BREŠAR, Boštjan, JAKOVAC, Marko, ŠTESL, Daša. Indicated coloring game on Cartesian products of graphs. *Discrete applied mathematics*, ISSN 0166-218X. [Print ed.], Jan. 2021, vol. 289, str. 320-326. https://www.sciencedirect.com/science/article/pii/S0166218X2030500X, doi: 10.1016/j.dam.2020.11.007. [COBISS.SI-ID 41803267].

3. BREŠAR, Boštjan, BUJTÁS, Csilla, GOLOGRANC, Tanja, KLAVŽAR, Sandi, KOŠMRLJ, Gašper, MARC, Tilen, PATKÓS, Balázs, TUZA, Zsolt, VIZER, Máté. On Grundy total domination number in product graphs. *Discussiones mathematicae, Graph theory*, ISSN 1234-3099, 2021, vol. 41, no. 1, str. 225-247, ilustr. https://www.dmgt.uz.zgora.pl/publish/view_pdf.php?ID=42026, doi: 10.7151/dmgt.2184. [COBISS.SI-ID 36071939].

4. BREŠAR, Boštjan, HARTNELL, Bert L., HENNING, Michael A., KUENZEL, Kirsti, RALL, Douglas F. A new framework to approach Vizing's conjecture. *Discussiones mathematicae, Graph theory*, ISSN 1234-3099, 2021, vol. 41, no. 3, str. 749-762, ilustr. https://www.dmgt.uz.zgora.pl/publish/bbl_view_pdf.php?ID=48407, doi: 10.7151/dmgt.2293. [COBISS.SI-ID 52166915].

5. BREŠAR, Boštjan, GASTINEAU, Nicolas, TOGNI, Olivier. Packing colorings of subcubic outerplanar graphs. *Aequationes mathematicae*, ISSN 0001-9054, Oct. 2020, vol. 94, iss. 5, 945-967. https://doi.org/10.1007/s00010-020-00721-6, doi: 10.1007/s00010-020-00721-6. [COBISS.SI-ID 27467011].