UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Kombinatorika
Course title:	Combinatorics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Magistrski študijski program Finančna matematika	ni smeri	1 ali 2	prvi ali drugi
Master's study programme Financial Mathematics	none	1 or 2	first or second

Vrsta predmeta / Course type	izbirni

Univerzitetna koda predmeta / University course code:	M2214

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work		ECTS
45		30			105		6

Nosilec predmeta / Lecturer:	prof. Marko Petkovšek, prof. Matjaž Konvalinka, prof. Sandi Klavžar

Jeziki / Languages:	Predavanja / Lectures:	slovenski/Slovene, angleški/English
	Vaje / Tutorial:	slovenski/Slovene, angleški/English

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

Vsebina:	Content (Syllabus outline):

Dvanajstera pot (binomski koeficienti, Stirlingova števila 1. in 2. vrste, Lahova števila, razčlenitve ..., z rodovnimi funkcijami)	Twelvefold way (binomial coefficients, Stirling numbers of the first and second kind, Lah numbers, partitions etc., using generating functions)
Običajne in eksponentne rodovne funkcije: kombinatorični pomen operacij vsote, produkta, odvoda, kompozicije (eksponentna formula)	Ordinary and exponential generating functions: combinatorial meaning of sum, product, derivative, composition (exponential formula)
Formalne potenčne in Laurentove vrste, Lagrangeeva inverzija	Formal power series, formal Laurent series, Lagrange inversion
Druge uporabe rodovnih funkcij (računanje povprečij in varianc, asimptotika koeficientov ...)	Other applications of generating functions (computing the mean and variance, asymptotics of coefficients, etc.)
Pólyeva teorija	Pólya theory
Načelo vključitev in izključitev, incidenčna algebra, Möbiusova funkcija, Möbiusova inverzija	Principle of inclusion and exclusion, incidence algebra, Möbius function, Möbius inversion
Reducirane algebre, Dirichletova rodovna funkcija	Reduced algebras, Dirichlet generating function
Predavatelj izbere še eno izmed naslednjih tem: politopi, incidenčne strukture, simetrične funkcije, diskretna geometrija, upodobitve simetrične grupe	Instructor chooses an additional topic from the following list: polytopes, incidence structures, symmetric functions, discrete geometry, representations of the symmetric group

Temeljni literatura in viri / Readings:

Richard P. Stanley: Enumerative Combinatorics, Vol. 1, Cambridge University Press, New York-Cambridge, 2011.

Richard P. Stanley: Enumerative Combinatorics, Vol. 2, Cambridge University Press, New York-Cambridge, 1999.

Francois Bergeron, Gilbert Labelle, Pierre Leroux: Combinatorial Species and Tree-like Structures, Cambridge University Press, Cambridge-New York-Melbourne, 1998.

Jack H. van Lint, Robin J. Wilson: A Course in Combinatorics, Cambridge University Press, Cambridge, 2001.

Cilji in kompetence:	Objectives and competences:

Študent spozna glavne tehnike kombinatornega preštevanja.	The student learns the main techniques of enumerative combinatorics.

Predvideni študijski rezultati: | **Intended learning outcomes:**

Znanje in razumevanje: Študentje poznajo in razumejo vlogo rodovnih funkcij in algebrskih struktur pri študiranju kombinatornih problemov. Uporaba: Študentje znajo uporabljati teorijo rodovnih funkcij in algebrskih struktur za reševanje kombinatornih problemov.Refleksija: Študentje spoznajo povezavo med strukturo kombinatornega problema in algebraično naravo pripadajočih rodovnih funkcij oziroma drugih struktur.Prenosljive spretnosti – niso vezane le na en predmet: Uporaba rodovnih funkcij v verjetnosti, poglobljeno razumevanje klasične Möbiusove funkcije, delovanje grup na množici.	Knowledge and understanding: Students understand the role of generating functions and algebraic structures in the study of combinatorial problems.Application: Students know how to use generating functions and algebraic structures to solve combinatorial problems.Reflection: The students learn the connection between the structure of the combinatorial problem and the algebraic nature of the corresponding generating functions and other structuresTransferable skills: Applications of generating functions in probability, a deeper understanding of the classical Möbius function, action of a group on a set.

Metode poučevanja in učenja: | **Learning and teaching methods:**

predavanja, vaje, domače naloge, konzultacije	lectures, exercises, homeworks, consultations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): izpit iz vaj (2 kolokvija ali pisni izpit)	50% 50%	Type (examination, oral, coursework, project): 2 midterm exams instead of written exam, written exam

ustni izpitOcene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)		oral examGrading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

Sandi Klavžar:

– FRONČEK, Dalibor, JEREBIC, Janja, KLAVŽAR, Sandi, KOVÁŘ, Petr. Strong isometric dimension, biclique coverings, and Sperner's theorem. Combinatorics, probability &; computing, ISSN 0963-5483, 2007, vol. 16, iss. 2, str. 271-275 [COBISS.SI-ID 14286425]

– KLAVŽAR, Sandi, SHPECTOROV, Sergey. Asymptotic number of isometric generalized Fibonacci cubes. European journal of combinatorics, ISSN 0195-6698, 2012, vol. 33, no. 2, str. 220-226 [COBISS.SI-ID 16055641]

– ILIĆ, Aleksandar, KLAVŽAR, Sandi, RHO, Yoomi. The index of a binary word. Theoretical computer science, ISSN 0304-3975, 2012, vol. 452, str. 100-106 [COBISS.SI-ID 16340057]

Matjaž Konvalinka:

– KONVALINKA, Matjaž. Divisibility of generalized Catalan numbers. Journal of combinatorial theory. Series A, ISSN 0097-3165, 2007, vol. 114, iss. 6, str. 1089-1100 [COBISS.SI-ID 14354265]

– KONVALINKA, Matjaž. Skew quantum Murnaghan-Nakayama rule. Journal of algebraic combinatorics, ISSN 0925-9899, 2012, vol. 35, no. 4, str. 519-545 [COBISS.SI-ID 16250713]

– KONVALINKA, Matjaž, PAK, Igor. Triangulations of Cayley and Tutte polytopes. Advances in mathematics, ISSN 0001-8708, 2013, vol. 245, str. 1-33 [COBISS.SI-ID 16706905]

Marko Petkovšek:

– PETKOVŠEK, Marko, WILF, Herbert S., ZEILBERGER, Doron. A=B. Wellesley (Massachusetts): A. K. Peters, cop. 1996. VII, 212 str. ISBN 1-56881-063-6 [COBISS.SI-ID 4085337]

– PETKOVŠEK, Marko. Counting Young tableaux when rows are cosets. Ars combinatoria, ISSN 0381-7032, 1994, let. 37, str. 87-95 [COBISS.SI-ID 8048473]

– PETKOVŠEK, Marko. Letter graphs and well-quasi-order by induced subgraphs. Discrete Mathematics, ISSN 0012-365X. [Print ed.], 2002, vol. 244, no. 1-3, str. 375-388 [COBISS.SI-ID 11414873]