

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
<b>Predmet:</b>		Kombinatorika				
<b>Course title:</b>		Combinatorics				
<b>Študijski program in stopnja</b> Study programme and level		<b>Študijska smer</b> Study field		<b>Letnik</b> Academic year		<b>Semester</b> Semester
Magistrski študijski program Matematika		ni smeri		1 ali 2		prvi ali drugi
Master's study programme Mathematics		none		1 or 2		first or second
<b>Vrsta predmeta / Course type</b>				temeljni		
<b>Univerzitetna koda predmeta / University course code:</b>				M2214		
<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Vaje</b> Tutorial	<b>Klinične vaje</b> work	<b>Druge oblike študija</b>	<b>Samost. delo</b> Individ. work	<b>ECTS</b>
45		30			105	6
<b>Nosilec predmeta / Lecturer:</b>		prof. Marko Petkovšek, prof. Matjaž Konvalinka, prof. Sandi Klavžar				
<b>Jeziki / Languages:</b>		<b>Predavanja / Lectures:</b> slovenski/Slovene, angleški/English				
		<b>Vaje / Tutorial:</b> slovenski/Slovene, angleški/English				
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>				<b>Prerequisites:</b>		
<b>Vsebina:</b>				<b>Content (Syllabus outline):</b>		

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

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.

**Intended learning outcomes:**

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 structures.  
Transferable 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:**

predavanja, vaje, domače naloge, konzultacije

**Learning and teaching methods:**

lectures, exercises, homeworks, consultations

**Načini ocenjevanja:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):  
izpit iz vaj (2 kolokvija ali pisni izpit)

Delež (v %) /

Weight (in %)

**Assessment:**

Type (examination, oral, coursework, project):  
2 midterm exams instead of written exam, written exam

ustni izpit Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)		oral exam Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)
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#### 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]