



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

**Predmet:** Kompleksna analiza  
**Course title:** Complex Analysis

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Izobraževalna matematika – enopredmetna, 2. Stopnja	Modul I2	1. ali 2.	1. ali 3.
Educational mathematics - single-major, 2 <sup>nd</sup> cycle	Module I2	1. or 2.	1. or 3.

**Vrsta predmeta / Course type**

izbirni/elective

**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
45		30			105	6

**Nosilec predmeta / Lecturer:**

Marko JAKOVAC

**Jeziki /**

**Languages:**

**Predavanja /**

**Lectures:**

SLOVENSKO/SLOVENE

**Vaje / Tutorial:**

SLOVENSKO/SLOVENE

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

Poznavanje analize in kompleksnih števil.

**Prerequisites:**

Knowledge of analysis and complex numbers.

**Vsebina:**

**Content (Syllabus outline):**

Funkcije kompleksne spremenljivke. Elementarne funkcije v kompleksnem: linearne funkcije, ulomljene linearne funkcije. Potenčne vrste v kompleksnem. Elementarne funkcije, definirane s potenčnimi vrstami. Logaritem in ciklotometrične funkcije.

Holomorfne funkcije. Cauchy – Riemannov izrek. Konformnost holomorfnih funkcij.

Integral funkcije kompleksne spremenljivke. Cauchyjev izrek in Cauchyjeve formule. Liouvilleov izrek. Taylorjeva vrsta.

Laurentova vrsta. Klasifikacija izoliranih singularnih točk. Obnašanje holomorfnih funkcij v okolici izoliranih singularnih točk. Casorati–Weierstrassov izrek. Mali in veliki Piccardov izrek. Izrek o residuumih. Uporaba pri računanju realnih integralov.

Functions of complex variable. Elementary functions: linear function, Möbius functions. Power series. Elementary functions defined by power series. Logarithm and cyclometric functions.

Holomorphic functions. Cauchy – Riemann theorem. Conformality of holomorphic mappings.

Complex line integrals. Cauchy's integral theorem and Cauchy's formulae. Liouville's theorem. Power series representation.

Laurent series. Classification of isolated singularities. The behaviour of holomorphic functions near isolated singularities. Casorati–Weierstrass theorem. Piccard's little and great theorem. Residui theorem. Applications to the calculations of definite real integrals and sums.

### Temeljni literatura in viri / Readings:

- L. Ahlfors: *Complex Analysis*, 3rd edition, McGraw-Hill, New York, 1979.
- R.B. Ash, W.P. Novinger: *Complex Variables*, 2nd edition, Dover Publications, New York, 2007.
- J.B. Conway: *Functions of One Complex Variable I*, 2nd edition, Springer, New York, 1995.
- S. G. Krantz: *Handbook of Complex Variables*, Birkhäuser, Boston, 1999.
- W. Rudin, *Real and Complex Analysis*, 3rd edition, McGraw-Hill Education, New York, 1986.

### Cilji in kompetence:

Študent poglobi znanje iz osnov teorije funkcij kompleksne spremenljivke ter poglobi znanje iz uporabnih aspektov te teorije, predvsem v povezavi s preslikovanji območij, pri računanju določenih integralov in seštevanju vrst.

### Objectives and competences:

Deepening the knowledge of concepts from the theory of functions of one complex variable. To deepen the knowledge of possible applications of this theory, specially in connection with transformations of the regions, calculating definite integrals and sums.

### Predvideni študijski rezultati:

Znanje in razumevanje:

- Študent razume pojem holomorfne funkcije pozna osnovne s tem povezane rezultate, posebej tiste, ki se nanašajo na integracijo in na integralno reprezentacijo ter reprezentacijo s potenčno vrsto.
- Študent razume koncept preslikovanja območij z uporabo ulomljenih linearnih in

### Intended learning outcomes:

Knowledge and Understanding:

- To understand the concept of holomorphic function and to know the basic results, especially those about line integrals and about the integral and the power series representation of holomorphic functions.
- To understand the concept of transforming plane regions using Möbius transformations

<p>drugih preprostejših elementarnih funkcij v kompleksnem.</p> <ul style="list-style-type: none"> <li>• Študent razume pojem izolirane singularne točke in pozna uporabno vrednost izreka o residuumih.</li> </ul> <p>Prenesljive/ključne spretnosti in drugi atributi:</p> <ul style="list-style-type: none"> <li>• Ilustracija dejstva, da nam teorija, na videz oddaljena od realnosti, lahko ponudi mnoge praktično uporabne rezultate.</li> </ul>	<p>and other basic elementary functions.</p> <ul style="list-style-type: none"> <li>• To understand the concept of an isolated singularity and to be aware of the importance of the residui theorem.</li> </ul> <p>Transferable/Key Skills and other attributes:</p> <ul style="list-style-type: none"> <li>• An illustration of the fact, that a more abstract theory can give us many nice results with useful practical applications.</li> </ul>	
<p><b>Metode poučevanja in učenja:</b></p>	<p><b>Learning and teaching methods:</b></p>	
<ul style="list-style-type: none"> <li>• Predavanja</li> <li>• Seminarske vaje</li> </ul>	<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Tutorial</li> </ul>	
<p><b>Načini ocenjevanja:</b></p>	<p><b>Assessment:</b></p>	
<p><u>Izpit:</u></p> <p>Pisni izpit – problemi Ustni izpit – teorija</p> <p>Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.</p> <p>Opravljen pisni izpit – problemi je pogoj za pristop k ustnemu izpitu – teorija.</p> <p>Pisni izpit – problemi se lahko nadomesti z dvema delnima testoma (sprotne obveznosti).</p>	<p>Delež (v %) / Weight (in %)</p> <p>50% 50%</p>	<p><u>Exams:</u></p> <p>Written exam – problems Oral exam – theory</p> <p>Each of the mentioned assessments must be assessed with a passing grade.</p> <p>Passing grade of written exam – problems is required to take the oral exam – theory.</p> <p>Written exam – problems can be replaced with two mid-term tests.</p>
<p><b>Reference nosilca / Lecturer's references:</b></p>		
<p>1. JAKOVAC, Marko. Relating the annihilation number and the 2-domination number of block graphs. <i>Discrete applied mathematics</i>, ISSN 0166-218X, 2019, vol. 260, str. 178-187, doi: <a href="https://doi.org/10.1016/j.dam.2019.01.020">10.1016/j.dam.2019.01.020</a>.</p> <p>2. BUJTÁS, Csilla, JAKOVAC, Marko. Relating the total domination number and the annihilation number of cactus graphs and block graphs. <i>Ars mathematica contemporanea</i>, ISSN 1855-3966, 2019, vol. 16, no. 1, str. 183-202, doi: <a href="https://doi.org/10.26493/1855-3974.1378.11d">10.26493/1855-3974.1378.11d</a>.</p> <p>3. JAKOVAC, Marko, PETERIN, Iztok. The b-chromatic number : a survey. <i>Discrete applied mathematics</i>, ISSN 0166-218X, 2018, vol. 235, str. 184-201.</p>		

<http://dx.doi.org/10.1016/j.dam.2017.08.008>, doi: [10.1016/j.dam.2017.08.008](https://doi.org/10.1016/j.dam.2017.08.008).

4. GOLOGRANC, Tanja, JAKOVAC, Marko, PETERIN, Iztok. The security number of lexicographic products. *Quaestiones mathematicae*, ISSN 1607-3606, 2018, vol. 41, iss. 5, str. 601-613.

<https://doi.org/10.2989/16073606.2017.1393705>, doi: [10.2989/16073606.2017.1393705](https://doi.org/10.2989/16073606.2017.1393705).

5. YERO, Ismael G., JAKOVAC, Marko, KUZIAK, Dorota. The security number of strong grid-like graphs. *Theoretical computer science*, ISSN 0304-3975, 2016, vol. 653, str. 1-14, doi:

[10.1016/j.tcs.2016.09.013](https://doi.org/10.1016/j.tcs.2016.09.013).