

UČNI NAČRT PREDMETA / COURSE SYLLABUS						
<b>Predmet:</b>		Teorija grup in polgrup				
<b>Course title:</b>		Theory of semigroups and groups				
<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 Finančna matematika		ni smeri		1 ali 2	prvi ali drugi	
Master's study programme Financial Mathematics		none		1 or 2	first or second	
<b>Vrsta predmeta / Course type</b>				izbirni		
<b>Univerzitetna koda predmeta / University course code:</b>				M2212		
<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. Jakob Cimprič, prof. Primož Moravec, prof. Primož Potočnik, prof. Tomaž Košir				
<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>		
I. Teorija polgrup  Osnovni pojmi teorije polgrup, primeri polgrup.				I. Semigroup theory  basic notions and examples		

<p>Greenove relacije.</p> <p>Regularne polgrupe, polgrupe z obrati.</p> <p>Enostavne polgrupe, povsem enostavne polgrupe.</p> <p>II. Teorija grup</p> <p>Ponovitev osnovnih pojmov teorije grup.</p> <p>Kompozicijska vrsta in Jordan-Hölderjev izrek. Rešljive grupe. Hallov izrek za rešljive grupe. Nilpotentne grupe, p-grupe.</p> <p>Razcepne in nerazcepne razširitve grup, semidirektni produkt grup, Schur-Zassenhausov izrek.</p> <p>Končne enostavne grupe in problem njihove klasifikacije. Klasične grupe (splošne linearne, simplektične, unitarne in ortogonalne) ter pripadajoče enostavne grupe.</p> <p>Osnove teorije upodobitev končnih grup. Teorija karakterjev.</p>	<p>Green relations</p> <p>Regular semigroups, inverse semigroups.</p> <p>Simple semigroups, completely simple semigroups.</p> <p>II. Group theory</p> <p>Basic notions</p> <p>Composition series, Jordan-Hölder theorem. Solvable groups, Hall's theorem. Nilpotent groups, p-groups.</p> <p>Split and non-split extensions of groups, semidirect product, Schur-Zassenhaus theorem.</p> <p>Finite simple groups and the classification problem. Classical groups (general linear, symplectic, unitary and orthogonal) and the corresponding simple groups.</p> <p>Fundamentals of representation theory of finite groups. Character theory.</p>
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### Temeljni literatura in viri / Readings:

J. M. Howie: Fundamentals of semigroup theory, Oxford University Press, Oxford, 1995.  
P. M. Higgins: Techniques of semigroup theory, Oxford University Press, Oxford, 1992.  
J. J. Rotman: An introduction to the theory of groups, 4. izd., Springer New York 1995.  
D. J. S. Robinson: A course in the theory of groups, 2. izd., Springer New York, 1996.

### Cilji in kompetence:

Študent spozna osnovne pojme iz teorije polgrup in grup ter njihovo povezanost z drugimi področji matematike.

### Objectives and competences:

Students get acquainted with basic notions of group theory and semigroup theory. They get familiar with connections between these two theories and other areas of mathematics.

**Predvideni študijski rezultati:**

## Znanje in razumevanje:

Poznavanje osnovnih pojmov in izrekov teorije polgrup in grup in njihovo prepoznavanje v drugih vejah matematike.

## Uporaba:

Teorija polgrup in grup spada med temeljne matematične predmete. Uči nas prepoznavati simetrije v naravi. Uporablja se zlasti v fiziki in kemiji (na primer kristalografija). Znotraj matematike je uporabna v geometriji, asociativni algebri, funkcionalni analizi in teoriji števil.

## Refleksija:

Razumevanje teorije na podlagi primerov in uporabe.

Prenosljive spretnosti – niso vezane le na en predmet:

Formulacija problemov v primernem jeziku, reševanje in analiza doseženega na primerih, prepoznavanje grup v geometriji in analizi.

**Intended learning outcomes:**

## Knowledge and understanding:

Basic notions of group theory and semigroup theory, applications in other areas of mathematics.

## Application:

Group theory and semigroup theory are classical mathematical disciplines. They teach us how to recognize symmetries. They have immense applications in physics and chemistry (crystallography). Within mathematics, they play an important role in geometry, associative algebra, functional analysis, and number theory.

## Reflection:

Understanding theory based on examples and applications.

## Transferable skills:

Formulation of problems, solving problems and analysis of results using examples, applying groups in geometry and analysis.

**Metode poučevanja in učenja:**

predavanja, vaje, domače naloge, konzultacije

**Learning and teaching methods:**

Lectures, exercises, homeworks, consultations

Delež (v %) /

**Načini ocenjevanja:**

Weight (in %)

**Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt):

50%

Type (examination, oral, coursework, project):

izpit iz vaj (2 kolokvija ali pisni izpit)		2 midterm exams instead of written exam, written exam
ustni izpit		oral exam
Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	50%	Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

#### Reference nosilca / Lecturer's references:

Jakob Cimprič:

- CIMPRIČ, Jaka. On homomorphisms from semigroups onto cyclic groups. Semigroup forum, ISSN 0037-1912, 1999, let. 59, št. 2, str. 183-189 [COBISS.SI-ID 8951641]
- CIMPRIČ, Jaka. Preorderings on semigroups and semirings of right quotients. Semigroup forum, ISSN 0037-1912, 2000, vol. 60, no. 3, str. 396-404 [COBISS.SI-ID 9568857]
- CIMPRIČ, Jaka. Real spectra of quantum groups. Journal of algebra, ISSN 0021-8693, 2004, vol. 277, no. 1, str. 282-297 [COBISS.SI-ID 13108569]

Tomaž Košir:

- KOŠIR, Tomaž, OMLADIČ, Matjaž, RADJAVI, Heydar. Maximal semigroups dominated by 0-1 matrices. Semigroup forum, ISSN 0037-1912, 1997, let. 54, št. 2, str. 175-189 [COBISS.SI-ID 7306329]
- GRUNENFELDER, Luzius, KOŠIR, Tomaž, OMLADIČ, Matjaž, RADJAVI, Heydar. On groups generated by elements of prime order. Geometriae dedicata, ISSN 0046-5755, 1999, let. 75, št. 3, str. 317-332 [COBISS.SI-ID 8849241]
- BERNIK, Janez, DRNOVŠEK, Roman, KOŠIR, Tomaž, OMLADIČ, Matjaž, RADJAVI, Heydar. Irreducible semigroups of matrices with eigenvalue one. Semigroup forum, ISSN 0037-1912, 2003, vol. 67, no. 2, str. 271-287 [COBISS.SI-ID 12583257]

Primož Moravec:

- MORAVEC, Primož. Completely simple semigroups with nilpotent structure groups. Semigroup forum, ISSN 0037-1912, 2008, vol. 77, no. 2, str. 316-324 [COBISS.SI-ID 14768473]
- MORAVEC, Primož. On the Schur multipliers of finite p-groups of given coclass. Israel journal of mathematics, ISSN 0021-2172, 2011, vol. 185, no. 1, str. 189-205 [COBISS.SI-ID 16311129]
- MORAVEC, Primož. Unramified Brauer groups of finite and infinite groups. American journal of mathematics, ISSN 0002-9327, 2012, vol. 134, no. 6, str. 1679-1704 [COBISS.SI-ID 16521305]

Primož Potočnik:

- POTOČNIK, Primož. B-groups of order a product of two distinct primes. *Mathematica slovacica*, ISSN 0139-9918, 2001, vol. 51, no. 1, str. 63-67 [COBISS.SI-ID 10617433]
- POTOČNIK, Primož. Edge-colourings of cubic graphs admitting a solvable vertex-transitive group of automorphisms. *Journal of combinatorial theory. Series B*, ISSN 0095-8956, 2004, vol. 91, no. 2, str. 289-300 [COBISS.SI-ID 13087321]
- MALNIČ, Aleksander, MARUŠIČ, Dragan, POTOČNIK, Primož. On cubic graphs admitting an edge-transitive solvable group. *Journal of algebraic combinatorics*, ISSN 0925-9899, 2004, vol. 20, no. 1, str. 99-113 [COBISS.SI-ID 13267033]