



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

|                      |                |
|----------------------|----------------|
| <b>Predmet:</b>      | <b>Algebra</b> |
| <b>Course title:</b> | <b>Algebra</b> |

| Študijski program in stopnja<br>Study programme and level | Študijska smer<br>Study field | Letnik<br>Academic year | Semester<br>Semester |
|---|-------------------------------|-------------------------|----------------------|
| Matematika, 3. stopnja                                    |                               | 1.                      | 2.                   |
| Mathematics, 3 <sup>rd</sup> cycle                        |                               | 1 <sup>st</sup>         | 2 <sup>nd</sup>      |

Vrsta predmeta / Course type

obvezni ali izbirni/compulsory or  
elective

Univerzitetna koda predmeta / University course code:

| Predavanja<br>Lectures | Seminar<br>Seminar | Vaje<br>Tutorial | Klinične vaje<br>work | Druge oblike<br>študija | Samost. delo<br>Individ.<br>work | ECTS |
|------------------------|--------------------|------------------|-----------------------|-------------------------|----------------------------------|------|
| 45                     |                    |                  |                       |                         | 225                              | 9    |

Nosilec predmeta / Lecturer:

Matej Brešar

Jeziki /  
Languages:

Predavanja /  
Lectures: Slovenski jezik;  
Slovene  
Vaje / Tutorial:

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

Osnovno poznanje temeljnih algebrskih struktur: grup, vektorskih prostorov, kolobarjev in polj.

**Prerequisites:**

Basic knowledge of fundamental algebraic structures: groups, vector spaces, rings and fields.

**Vsebina:**

- Kategorije: osnovni pojmi in primeri.
- Grupe: osnovna teorija, struktura grup.
- Moduli: pomembni tipi modulov, verižni pogoji, tenzorski produkti.
- Komutativna algebra: razširitve polj in Galoisova teorija, komutativni kolobarji.
- Nekomutativna algebra: osnovna teorija, struktura nekomutativnih kolobarjev in algeber.
- Neasociativna algebra: osnovni pojmi in primeri.
- Nekatere izmed teh tem so obdelane podrobneje, druge pa le na osnovni ravni. Pri izboru se upoštevajo interesi in raziskovalne usmeritve študentov.

**Content (Syllabus outline):**

- Categories: basic concepts and examples.
- Groups: basic theory, the structure of groups.
- Modules: important types of modules, chain conditions, tensor products.
- Commutative algebra: field extensions and Galois theory, commutative rings.
- Noncommutative algebra: basic theory, the structure of noncommutative rings and algebras.
- Nonassociative algebra: basic concepts and examples.
- Some of these topics are treated in greater detail, and some of them only at a basic level. The selection depends on students' interests and their research orientation.

**Temeljni literatura in viri / Readings:**

- W. A. Adkins, S. H. Weintraub, Algebra. An approach via module theory. Springer-Verlag, 1999.
- Y. Bahturin, Basic structures of modern algebra, Kluwer AP, 1991.
- P. M. Cohn, Basic algebra. Groups, rings and fields, Springer-Verlag, 2003.
- P. A. Grillet, Abstract algebra, Springer-Verlag, 2007.
- T. W. Hungerford, Algebra, Springer-Verlag, 1980.
- I. M. Isaacs, Algebra. A graduate course, Brooks/Cole Publishing Company, 1994.
- A. W. Knap, Basic algebra, Springer-Verlag, 2006.
- S. Lang, Algebra, Springer-Verlag, 2002.

**Cilji in kompetence:**

- Doseči poglobljeno razumevanje teoretskih in metodoloških konceptov s področja Algebre
- Razviti sposobnost samostojnega razvijanja novega znanja s področja Algebre
- Razviti sposobnost za samostojno reševanje najzahtevnejših problemov iz Algebre
- Razviti sposobnost izboljševanja znanih in odkrivanja novih rezultatov s področja Algebre
- Zmožnost razvijanja kritične refleksije na področju Algebre
- Razviti zmožnost vodenja najzahtevnejših znanstvenoraziskovalnih projektov s širšega področja Algebre.

**Objectives and competences:**

- To achieve a deeper understanding of theoretical and methodological concepts of Algebra
- To develop the ability to independently develop new knowledge in the field of Algebra
- To develop the ability for solving the most challenging problems in Algebra
- To develop the ability of improving known results as well as obtaining new results in Algebra
- Ability to develop critical reflection in Algebra
- To develop the ability to lead the most challenging scientific research projects in the wider field of Algebra

**Predvideni študijski rezultati:****Znanje in razumevanje:**

- poznavanje temeljnih algebrskih področij;
- razumevanje zahtevnejših algebrskih pojmov.

**Prenesljive/ključne spretnosti in drugi atributi:**

- podlaga za raziskovalno delo na področju algebre;
- pridobljeno znanje za uporabo algebre na drugih matematičnih področjih.

**Intended learning outcomes:****Knowledge and understanding:**

- knowledge of fundamental topics in algebra;
- understanding complex algebraic concepts.

**Transferable/Key Skills and other attributes:**

- a basis for research in algebra;
- knowledge needed for applying algebra to other mathematical areas.

**Metode poučevanja in učenja:**

- predavanja;
- priprava seminarja;
- konzultacije;
- samostojni študij.

**Learning and teaching methods:**

- lectures;
- seminar work;
- consultations;
- self-study.

Delež (v %) /

**Načini ocenjevanja:**

Weight (in %)

**Assessment:**

| Način (pisni izpit, ustno izpraševanje, naloge, projekt): |            | Type (examination, oral, coursework, project): |
|---|------------|--|
| Seminarsko predavanje                                     | <b>20%</b> | Seminar talk                                   |
| Pisni izdelek   | <b>30%</b> | Written work                                   |
| Ustni izpit   | <b>50%</b> | Oral Examination                               |

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

1. BREŠAR, Matej, GOGIĆ, Ilja. Centrally stable algebras. *Journal of algebra*. Nov. 2019, vol. 537, str. 79-97. ISSN 0021-8693. <https://doi.org/10.1016/j.jalgebra.2019.06.041>, DOI: [10.1016/j.jalgebra.2019.06.041](https://doi.org/10.1016/j.jalgebra.2019.06.041). [COBISS.SI-ID [18706009](https://doi.org/10.1016/j.jalgebra.2019.06.041)], [JCR]  
kategorija: 1A3
2. BREŠAR, Matej, ŠEMRL, Peter. Continuous commuting functions on matrix algebras. *Linear algebra and its applications*. [Print ed.]. May 2019, vol. 568, str. 29-38. ISSN 0024-3795. <https://doi.org/10.1016/j.laa.2018.03.032>, DOI: [10.1016/j.laa.2018.03.032](https://doi.org/10.1016/j.laa.2018.03.032). [COBISS.SI-ID [18584409](https://doi.org/10.1016/j.laa.2018.03.032)], [JCR]  
kategorija: 1A2
3. BREŠAR, Matej. Automorphisms and derivations of finite-dimensional algebras. *Journal of algebra*. June 2022, vol. 599, str. 104-121. ISSN 0021-8693. <https://www.sciencedirect.com/science/article/pii/S0021869322000746>, DOI: [10.1016/j.jalgebra.2022.02.010](https://doi.org/10.1016/j.jalgebra.2022.02.010). [COBISS.SI-ID [100274435](https://doi.org/10.1016/j.jalgebra.2022.02.010)], [JCR]  
kategorija: 1A3
4. BREŠAR, Matej, ŠEMRL, Peter. The Waring problem for matrix algebras. *Israel journal of mathematics*. Mar. 2023, vol. 253, iss. 1, str. 381-405. ISSN 0021-2172. <https://link.springer.com/article/10.1007/s11856-022-2366-7>, DOI: [10.1007/s11856-022-2366-7](https://doi.org/10.1007/s11856-022-2366-7). [COBISS.SI-ID [149854467](https://doi.org/10.1007/s11856-022-2366-7)], [JCR]  
kategorija: 1A2
5. BREŠAR, Matej, SHULMAN, Victor S. On, around, and beyond Frobenius' theorem on division algebras. *Linear and Multilinear Algebra*. 2022, vol. 70, iss. 7, str. 1369-1381. ISSN 0308-1087. <https://www.tandfonline.com/doi/full/10.1080/03081087.2020.1761281>, DOI: [10.1080/03081087.2020.1761281](https://doi.org/10.1080/03081087.2020.1761281). [COBISS.SI-ID [106388227](https://doi.org/10.1080/03081087.2020.1761281)], [JCR]  
kategorija: 1A2