



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	<b>Linearna algebra</b>
<b>Course title:</b>	Linear Algebra

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Matematika		1.	2.
Mathematics		1.	2.

Vrsta predmeta / Course type

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
60		60			120	8

Nosilec predmeta / Lecturer:

<b>Jeziki / Languages:</b>	<b>Predavanja / Lectures:</b>	<input type="text" value="SLOVENSKO/SLOVENE"/>
	<b>Vaje / Tutorial:</b>	<input type="text" value="SLOVENSKO/SLOVENE"/>

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

**Prerequisites:**

**Vsebina:**

Vektorski prostori: prostori in podprostori; baza; dimenzija; vsote in direktne vsote.

Linearne preslikave: primeri in osnovne lastnosti; jedro in slika; prostori linearnih preslikav; izomorfizmi vektorskih prostorov.

Linearne preslikave in matrike: matriki prirejena preslikava; preslikavi prirejena matrika; sprememba baze in podobne matrike.

Lastne vrednosti in lastni vektorji: osnovne lastnosti; zgornje trikotne matrike; minimalni polinom; karakteristični polinom; Cayley-Hamiltonov izrek; diagonalizacija; Jordanova

**Content (Syllabus outline):**

Vector spaces: spaces and subspaces; base; dimension; sums and direct sums.

Linear transformations: examples and basic properties; kernel and image; spaces of linear transformations; isomorphisms.

Linear transformations and matrices: transformation of a matrix; matrix of a transformation; base change and similar matrices.

Eigenvalues and eigenvectors: basic properties; upper triangular matrices; minimal polynomial; characteristic polynomial; Cayley-Hamilton

kanonična forma.

Prostori s skalarnim produktom: Evklidski prostori; unitarni prostori; pravokotnost in ortogonalne baze; ortogonalni komplementi; dualni prostor in Rieszov izrek.

Preslikave v Evklidskih in unitarnih prostorih: adjungirane; normalne; sebi-adjungirane; ortogonalne in unitarne; pozitivno (semi)definitne.

V kolikor bo čas dopuščal, bomo obravnavali še

Bilinearne in kvadratne forme: bilinearne forme; predstavitev z matrikami; kvadratne forme in Sylvestrov vztrajnostni zakon.

theorem; diagonalization; Jordan canonical form.

Spaces with inner product: Euclidean spaces; unitary spaces; orthogonality and orthogonal bases; orthogonal complement; dual spaces and Riesz theorem.

Transformations in Euclidean and unitary spaces: adjoint; normal; self-adjoint; orthogonal and unitary; positive (semi)definite.

If time permits, we shall also consider

Bilinear and quadratic forms: bilinear forms; representations with matrices; quadratic forms and Sylvester's law of inertia.

### Temeljni literatura in viri / Readings:

T. Košir, Linearna algebra (spletna skripta) <http://www.fmf.uni-lj.si/~kosir/poucevanje/0607/linalg.html>

<http://www.fmf.uni-lj.si/~kosir/poucevanje/0809/alg1-fm.html>

M. Kolar, B. Zgrablič, Več kot nobena, a manj kot tisoč in ena rešena naloga iz linearne algebre, Pedagoška fakulteta Ljubljana, Ljubljana, 1996.

C. Scheiderer, Lineare Algebra I und II (spletna skripta)

<http://www.uni-duisburg.de/FB11/LEHRE/LINALG/LA.public.pdf>

M. Dobovišek, D. Kobal, B. Magajna, Naloge iz algebre I, DMFA založništvo, Ljubljana, 2005.

R. Kaye, R. Wilson, Linear Algebra, Oxford University Press, Oxford, 1998.

### Cilji in kompetence:

Temeljito spoznati vektorske prostore in linearne preslikave.

### Objectives and competences:

To know thoroughly vector spaces and linear transformation.

### Predvideni študijski rezultati:

Znanje in razumevanje:

- Razumevanje vektorskih prostorov in linearnih transformacij.
- Povezovanje teorije s predmetov »Vektorji in matrike«.

Prenesljive/ključne spretnosti in drugi atributi:

- Pridobljena znanja so podlaga za večino predmetov v nadaljevanju študija.

### Intended learning outcomes:

Knowledge and Understanding:

- Be able to understand vector spaces and linear transformations.
- Be able to connect the theory with the subject »Vectors and Matrices«.

Transferable/Key Skills and other attributes:

- The obtained knowledge is a basis for most of the later subjects.

<b>Metode poučevanja in učenja:</b>		<b>Learning and teaching methods:</b>	
<ul style="list-style-type: none"> <li>• Predavanja</li> <li>• Teoretične vaje</li> </ul>		<ul style="list-style-type: none"> <li>• Lectures</li> <li>• Theoretical exercises</li> </ul>	
<b>Načini ocenjevanja:</b>		<b>Assessment:</b>	
<p><u>Izpit:</u> 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> 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 repalced with two mid-term tests.</p>	
<b>Reference nosilca / Lecturer's references:</b>			
<p>1. EREMITA, Daniel. Functional identities of degree 2 in triangular rings revisited. <i>Linear and Multilinear Algebra</i>, ISSN 0308-1087, 2015, vol. 63, iss. 3, str. 534-553. <a href="http://dx.doi.org/10.1080/03081087.2013.877012">http://dx.doi.org/10.1080/03081087.2013.877012</a>. [COBISS.SI-ID <a href="#">17044057</a>]</p> <p>2. EREMITA, Daniel, GOGIĆ, Ilja, ILIŠEVIĆ, Dijana. Generalized skew derivations implemented by elementary operators. <i>Algebras and representation theory</i>, ISSN 1386-923X, 2014, vol. 17, iss. 3, str. 983-996. <a href="http://dx.doi.org/10.1007/s10468-013-9429-8">http://dx.doi.org/10.1007/s10468-013-9429-8</a>. [COBISS.SI-ID <a href="#">17043545</a>]</p> <p>3. EREMITA, Daniel. Functional identities of degree 2 in triangular rings. <i>Linear Algebra and its Applications</i>, ISSN 0024-3795. [Print ed.], 2013, vol. 438, iss 1, str. 584-597. <a href="http://dx.doi.org/10.1016/j.laa.2012.07.028">http://dx.doi.org/10.1016/j.laa.2012.07.028</a>. [COBISS.SI-ID <a href="#">16528217</a>]</p> <p>4. EREMITA, Daniel, ILIŠEVIĆ, Dijana. On (anti-)multiplicative generalized derivations. <i>Glasnik matematički. Serija 3</i>, ISSN 0017-095X, 2012, vol. 47, no. 1, str. 105-118. <a href="http://dx.doi.org/10.3336/gm.47.1.08">http://dx.doi.org/10.3336/gm.47.1.08</a>. [COBISS.SI-ID <a href="#">16341849</a>]</p> <p>5. BENKOVIČ, Dominik, EREMITA, Daniel. Multiplicative Lie n-derivations of triangular rings. <i>Linear Algebra and its Applications</i>, ISSN 0024-3795. [Print ed.], 2012, vol. 436, iss 11, str. 4223-4240. <a href="http://dx.doi.org/10.1016/j.laa.2012.01.022">http://dx.doi.org/10.1016/j.laa.2012.01.022</a>. [COBISS.SI-ID <a href="#">16278361</a>]</p>			

