

M099	Elective 2 <sup>nd</sup> Year	<b>Vector Spaces</b>	L	P	S	ECTS 6
			2	2	0	

**Course objectives.** This course generalizes concepts and results the students have met in Linear Algebra courses. Through more abstract algebraic approach, followed by detailed proofs of given results related to the vector and inner spaces, our aim is to better and more clearly understand the material used in most modern mathematical disciplines.

**Prerequisites.** Linear Algebra I and II.

**Course content.**

1. Dual space, dual basis and dual operator. Canonical isomorphism between the vector space and its bidual space. Nilpotent operators, cyclic bases and elementary Jordan cells. Reduction of the nilpotent operators.
2. Semisimple operators. Polynomials of the operators. Relatively simple polynomials.
3. Hermitian and normal operators. Spectral theorems. Positive operators and isometries. Polar form.
4. Operators on complex and real vector spaces. Complexification of vector space and complexification of an operator. Operators on real unitary spaces. Operators on normed spaces.

**LEARNING OUTCOMES**

No.	LEARNING OUTCOMES
1.	Construct dual space and dual operator.
2.	Apply the properties of nilpotent operators.
3.	Construct the matrix of certain operators.
4.	Distinguish the basic properties of operators on inner spaces.
5.	Apply the spectral theorem.
6.	Analyze operators on real vector space and determine the corresponding complexification.

**RELATING THE LEARNING OUTCOMES, ORGANIZATION OF THE EDUCATIONAL PROCESS AND ASSESSMENT OF THE LEARNING OUTCOMES**

TEACHING ACTIVITY	ECTS	LEARNING OUTCOME **	STUDENT ACTIVITY*	EVALUATION METHOD	POINTS	
					min	max
Attending lectures and exercises	1	1-6	The presence at lectures, discussions, teamwork and independent work on assignments	Attendance lists, tracking activities	0	4
Written exam (preliminary exam)	2	1-6	Preparing for written exam.	Evaluation.	25	48
Final exam.	3	1-6	Repetition of the subject matter.	Oral exam.	25	48
Total	6				50	100

**Teaching methods and knowledge assessment.** Attending lectures and exercises is required. The exam consists of a written and oral part, and can be taken after the completion of lectures and exercises. During the semester students can take preliminary exams that replace the written examination.

**Can the course be taught in English:** Yes

**Basic literature:**

1. H. Kraljević, Vektorski prostori, reviewed materials available at the web pages of Department of mathematics, University of Osijek, 2008.

**Recommended literature:**

1. D. Bakić, Linearna algebra, Školska knjiga, Zagreb, 2008.
2. N. Bakić, A. Milas, Zbirka zadataka iz linearne algebre, PMF-Matematički odjel Sveučilišta u Zagrebu, 1995.
3. N. Elezović, A. Aglič, Linearna algebra: zbirka zadataka, Element, Zagreb, 1999.
4. S. Axler, Linear algebra done right, Springer, 2009.