

Course Name : Linear Algebra							
Course Code	Course Type	Regular Semester	Lecture (hours/week)	Seminar (hours/week)	Lab. (hours/week)	Credits	ECTS
CMP 112	A	Spring	3.00	1.00	0.00	3.50	5.00
Lecturer		Artur Koci, PhD					
Assistant		Vladimir Muka, Msc					
Course language		Albanian					
Course level		Bachelor					
Description		Applications of Linear algebra continue to spread to more and more fields. Largely due to the computer revolution of the last 75 years, linear algebra has risen to a role of prominence in the mathematical curriculum rivaling that of calculus. Modern software has also made it possible to dramatically improve the way the course is taught. The main concepts addressed in the linear algebra course are: Systems of Linear Equations. Euclidean Space. Matrices. Subspaces. Determinants. Eigenvalues and Eigenvectors. Vector Spaces. Linear Transformations					
Objectives		One of the important goals of a course in linear algebra is to establish the intricate thread of relationships between systems of linear equations, matrices, determinants and eigenvalues, vectors, vector spaces, linear transformations.					
Core Concepts		Systems of Linear Equations, Gaussian Elimination and Gauss-Jordan Elimination. Applications of Systems of Linear Equations Vectors in R^n . Spanning Sets and Linear Independence. Basis and Dimension. Rank of a Matrix and Systems of Linear Equations. Matrices. Operations with Matrices, Properties of Matrix Operations, The Inverse of a Matrix, Elementary Matrices. The Determinant of a Matrix. Determinants and Elementary Operations. Properties of Determinants. Eigenvalues and Eigenvectors. Vector Spaces. Subspaces of Vector Spaces. Spanning Sets and Linear Independence. Basis and Dimension. Rank of a Matrix and Systems of Linear Equations. Linear Transformations. Introduction to Linear Transformations. The Kernel and Range of a Linear Transformation. Matrices for Linear Transformations . Applications of Linear Transformations					
Course Outline							
Week	Topic						
1	Systems of linear equations. Triangular linear Systems. Echelon Systems. Matrices and the Augmented Matrix. Elementary row transformation. Variable elimination method for solving the system. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 3-16 Recommended literature Robert Blitzer (2018). College algebra. Miami Dade College, page 542-591 Mark Dugopolski, (2009) Algebra for College Students, fifth Edition, page 225-255 Steven J. Leon and Lisette G. de Pillis (2021)/ Linear Algebra with Applications / Tenth edition, page 15-41 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 3-35 Jeffrey Holt (2013)/ Linear algebra with applications / Second edition, page 1-28						
2	Solving linear system. Gaussian elimination for solving system. Gauss-Jordan elimination for solving system. Homogeneous linear systems. Applications of linear systems. Existence of solutions of system of linear equations. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 17-32 Recommended literature Robert Blitzer (2018). College algebra. Miami Dade College, page 620-670 Mark Dugopolski, (2009) Algebra for College Students, fifth Edition, page 256-265 Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 5-33 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 35-50 Jeffrey Holt (2013)/ Linear algebra with applications / Second edition, page 29-47						

3	Geometry of vectors in plane and three-dimensional space. Operations with vectors in plane and three-dimensional space. Vector analytic concept. Linear combination of vectors. Vectors and systems of equations. Span concept. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 33-49 Recommended literature Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 36-45 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 56-80 Jeffrey Holt (2013)/ Linear algebra with applications / Second edition, page 47-56 Larry E. Knop (2008). - Linear Algebra, A First Course with Applications, page 53-145
4	Matrix-vector product. Matrix equation $Ax=b$. Linear independence of vectors. Span and linear independence of vectors. Relation between linear system and corresponding homogeneous linear system. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 50-64 Recommended literature David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 56-81 Jeffrey Holt (2013)/ Linear algebra with applications / Second edition, page 57-80 Bernard Kolman and David R. Hill (2008)/ Elementary linear algebra with applications / Ninth edition, page 34-47
5	Matrix algebra. Properties of matrix algebra. The identity matrix. Transpose of a matrix. Powers of a matrix. Triangular matrices. Partitioned matrices. Matrix inverse. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 65-79 Recommended literature Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 109-132 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 118-162 Bernard Kolman and David R. Hill (2008)/ Elementary linear algebra with applications / Ninth edition, page 47-68, 130-139
6	The determinant of a square matrix. Cofactor expansion. Properties of the determinant. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 80-96 Recommended literature Steven J. Leon and Lisette G. de Pillis (2021)/ Linear Algebra with Applications / Tenth edition page 101-115 Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 163-178 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 101-120 Otto Bretscher, (2013)/ Linear algebra with applications / Fifth edition, page 265-290
7	Applications of the determinant. Kramer's rules for solving systems of linear equations. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 97-106 Recommended literature Steven J. Leon and Lisette G. de Pillis (2021)/ Linear Algebra with Applications / Tenth edition page 115-125 Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 178-188 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 101-120 Otto Bretscher, (2013)/ Linear algebra with applications / Fifth edition, page 291-310
8	Semi-final exam
9	Subspaces. Row and column spaces of a matrix. Rank of a matrix. The nullity of a matrix. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 107-115 Recommended literature Jeffrey Holt (2013)/ Linear algebra with applications / Second edition, page 172-180 Bernard Kolman and David R. Hill (2008)/ Elementary linear algebra with applications / Ninth edition, page 283-300 Larry E. Knop (2008). - Linear Algebra, A First Course with Applications, page 213-298
10	Inverses from determinants. Matrix equations. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 115-128 Recommended literature Steven J. Leon and Lisette G. de Pillis (2021)/ Linear Algebra with Applications / Tenth edition page 308-350 Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 188-200 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 179-189. Otto Bretscher, (2013)/ Linear algebra with applications / Fifth edition, page 310-320 Bernard Kolman and David R. Hill (2008)/ Elementary linear algebra with applications / Ninth edition, page 449-460
11	Eigenvalues, eigenvectors and eigenspaces. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 128-143 Recommended literature Steven J. Leon and Lisette G. de Pillis (2021)/ Linear Algebra with Applications / Tenth edition page 308-350 Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 188-200 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 267-297 Otto Bretscher, (2013)/ Linear algebra with applications / Fifth edition, page 320-347 Bernard Kolman and David R. Hill (2008)/ Elementary linear algebra with applications / Ninth edition, page 460-466

12	Vector spaces. Examples of vector spaces. Vector subspaces. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 144-159 Recommended literature Steven J. Leon and Lisette G. de Pillis (2021)/ Linear Algebra with Applications / Tenth edition, page 126-185 Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 213-237 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 191-200 Larry E. Knop (2008). - Linear Algebra, A First Course with Applications, page 145-171
13	Span and linear independence of vectors of a vector space. The basis and dimension of a vector space. The basis and dimension of a vector subspace. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 160-182 Recommended literature Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 110-165 David C. Lay, Steven R. Lay, Judi J. McDonald, (2016). Linear algebra and its applications / Fifth edition, page 201-240 Jeffrey Holt (2013)/ Linear algebra with applications / Second edition, page 286-302 Larry E. Knop (2008). - Linear Algebra, A First Course with Applications, page 303-377
14	Linear transformations of vector spaces. Properties of linear transformations. Image, kernel and range of a linear transformation. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 183-194 Recommended literature Steven J. Leon and Lisette G. de Pillis (2021)/ Linear Algebra with Applications / Tenth edition page 188-220 Gareth Williams, (2019)/ Linear algebra with applications / Ninth edition, page 237-300 Otto Bretscher, (2013)/ Linear algebra with applications / Fifth edition, page 41-110 Bernard Kolman and David R. Hill (2008)/ Elementary linear algebra with applications / Ninth edition, page 69-76 Larry E. Knop (2008). - Linear Algebra, A First Course with Applications page 435-462
15	Isomorphism of vector spaces. Isomorphism based on the dimensions of vector spaces. Inverse linear transformations. Basic literature Adapted lectures in Albanian: Linear Algebra. Vladimir Muka page 195-210 Recommended literature Otto Bretscher, (2013)/ Linear algebra with applications / Fifth edition page 166-200 Jeffrey Holt (2013)/ Linear algebra with applications / Second edition page 349-378 Bernard Kolman and David R. Hill (2008)/ Elementary linear algebra with applications / Ninth edition, page 266-282 Larry E. Knop (2008). - Linear Algebra, A First Course with Applications, page 391-434
16	Final Exam
Prerequisites	The student must attend the course at a minimum rate of 75%.
Literature	• Leksione te pershtatura ne shqip: Algjebra lineare-Vladimir Muka
References	• Mark Dugopolski, (2009) Algebra for College Students, fifth Edition • Robert Blitzer (2018). College algebra. Miami Dade College • Gareth Williams (2019) Linear Algebra with Applications- nine Edition • Steven Leon, Lisette de Pillis (2021) Linear Algebra with Applications, tenth edition • Lay, David C. Lay, Steven R. McDonald, Judith (2016) Linear Algebra and Its Applications • Larry E. Knop - Linear Algebra, (2008). A First Course with Applications • Howard Anton, Cris Rorres (2008). Elementary Linear Algebra with Applications nine Edition • Jeffrey Holt (2013) Linear Algebra with Applications • Thomas S. Shores (2007) Applied Linear Algebra and Matrix Analysis • Bernard Kolman, David Hill (2007) Elementary Linear Algebra with Applications, nine Edition
Course Outcome	
1	Studentet te dine te modelojme matematikisht situata profesionale qe cojne ne sisteme ekuacionesh lineare

Course Evaluation			
In-term Studies	Quantity	Percentage	
Midterms	1	30	
Quizzes	0	0	
Projects	0	0	
Term Projects	0	0	
Laboratory	0	0	
Class Participation	1	20	
Total in-term evaluation percent			50
Final exam percent			50
Total			100
ECTS Workload (Based on Student Workload)			
Activities	Quantity	Duration (hours)	Total (hours)
Course duration (Including the exam week: 16x Total hours of the course)	16	4	64
Study hours outside the classroom (Preparation, Practice, etc.)	14	4	56
Duties	0	0	0
Midterms	1	2	2
Final Exam	1	2	2
Other	1	1	1
Total Work Load			125
Total Work Load / 25 (hours)			5.00
ECTS			5.00