## 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 |

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| **Lecturer** | Sofokli Garo, 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** | Equations of the first degree with two variables and graphic representation; systems of linear equations and Gauss-Jordan method; implementation in electric network situations; matrx equations and their applicaion in solving linear equation systems. |

## Course Outline

| Week | Topic |
|---|---|
| **1** | Systems of linear equations, Augmented Matrix. Row reduction and echelon forms, The Solving systems using Gauss elimination. Solving a system using Gauss-Jordan elimination. System of homogeneous linear equation. Mark Dugopolski, (2009) Algebra for College Students, fifth Edition, page 256-275 Robert Blitzer (2018). College algebra, page 542-678. Bernard Kolman, David Hill (2007) Elementary Linear Algebra with Applications, nine Edition, page 14-99 Lay, David C. Lay, Steven R. McDonald, Judith (2016) Linear Algebra and Its Applications, page 1-24 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **2** | Introduction to vectors (geometric). Properties of Vector Operations. Vector equations, Solution sets of linear systems, Parametric Vector Form, Applications of linear systems, Lay, David C. Lay, Steven R. McDonald, Judith (2016) Linear Algebra and Its Applications, page 25-63 Howard Anton, Cris Rorres (2008). Elementary Linear Algebra with Applications nine Edition,page 184-253 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **3** | Linear independence of vectors. Linear Independence of Matrix Columns. Introduction to linear transformations. The matrix of a linear transformation. Geometric Linear Transformations of R2. Lay, David C. Lay, Steven R. McDonald, Judith (2016) Linear Algebra and Its Applications, page 56-81 Howard Anton, Cris Rorres (2008). Elementary Linear Algebra with Applications nine Edition page, 257-278 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **4** | Matrices. Matrix Operations. Matrix Multiplication. Algebraic Properties of Matrix Operations. Elementary Matrices. Equivalent Matrices. Bernard Kolman, David Hill (2007) Elementary Linear Algebra with Applications, nine Edition, page 24-62, 130-143 Gareth Williams (2019) Linear Algebra with Applications- nine Edition, page 69-102 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |

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| **5** | Special Matrices and Transposes. Matrix Inverses. Finding A–1. Partitioned matrices. Solve systems using matrix equations. Dimension and rank Robert Blitzer (2018). College algebra, faqe 620-670 Mark Dugopolski, (2009) Algebra for College Students, fifth Edition, faqe 226-255 Thomas S. Shores (2007) Applied Linear Algebra and Matrix Analysis, page 86-106 Lay, David C. Lay, Steven R. McDonald, Judith (2016) Linear Algebra and Its Applications, page 118-162 Steven Leon, Lisette de Pillis (2021) Linear Algebra with Applications, tenth edition, page 41-85 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **6** | The determinant of a matrix. Properties of determinants, Cofactor expansion, Application to computing areas, Inverse of a matrix, Other applications of determinants. Steven Leon, Lisette de Pillis (2021) Linear Algebra with Applications, tenth edition, page 101-120 Bernard Kolman, David Hill (2007) Elementary Linear Algebra with Applications, nine Edition, page 154-185 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **7** | Cramer's Rule, volume, and linear transformations, Eigenvectors and eigenvalues, The characteristic equation, Diagonalization, Eigenvectors and linear transformations Robert Blitzer (2018). College algebra. Miami Dade College, faqe 670-678 Mark Dugopolski, (2009) Algebra for College Students, fifth Edition, faqe 256-275 Lay, David C. Lay, Steven R. McDonald, Judith (2016) Linear Algebra and Its Applications page 179-189, 267-297 Larry E. Knop - Linear Algebra, (2008). A First Course with Applications, page 597-615 Steven Leon, Lisette de Pillis (2021) Linear Algebra with Applications, tenth edition, page 308-353 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **8** | Semi-final exam |
| **9** | Euclidean vector spaces. Vector space axioms. The Vector Space Rmn. Vector spaces of functions Pn. Steven Leon, Lisette de Pillis (2021) Linear Algebra with Applications, tenth edition, page 126-147 Howard Anton, Cris Rorres (2008). Elementary Linear Algebra with Applications nine Edition, page 257-368 Bernard Kolman, David Hill (2007) Elementary Linear Algebra with Applications, nine Edition, page 190-221 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **10** | Linear Independence. Subspaces. The span of a set of vectors. Basis and dimension. Change of Basis. Row space and column space of matrix. Steven Leon, Lisette de Pillis (2021) Linear Algebra with Applications, tenth edition, page 148-186 Bernard Kolman, David Hill (2007) Elementary Linear Algebra with Applications, nine Edition, page 222-257 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **11** | Linear transformations from Rn to Rm. Properties of linear transformations from Rn to Rm. Linear transformations and polynomials. One-to-One and Onto Linear Transformations. Isomorphisms. Howard Anton, Cris Rorres (2008). Elementary Linear Algebra with Applications nine Edition, page 279-593 Jeffrey Holt (2013) Linear Algebra with Applications, page 353-364 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **12** | Kernel and Range of a linear transformation. Inverse linear transformations. Similarity. Introduction to Homogeneous Coordinates. Gareth Williams (2019) Linear Algebra with Applications- nine Edition, page 272-296 Howard Anton, Cris Rorres (2008). Elementary Linear Algebra with Applications nine Edition, page 574-661 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **13** | Coordinate Vectors. Matrix Representations of Linear Transformations. Relations Between Matrix Representations. Quadratic Form. Gareth Williams (2019) Linear Algebra with Applications- nine Edition, page 299-346 Bernard Kolman, David Hill (2007) Elementary Linear Algebra with Applications, nine Edition, page 266-388 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **14** | Inner Product Spaces. Non-Euclidean Geometry and Special Relativity. Approximation of Functions and Coding Theory. Least Squares Solutions. Applications of Inner Products. Gareth Williams (2019) Linear Algebra with Applications- nine Edition page 349-383 Jeffrey Holt (2013) Linear Algebra with Applications, page 379-398 Adapted lectures in Albanian: Linear Algebra. Vladimir Muka |
| **15** | Review |
| **16** | Final Exam |

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| **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<br>• Robert Blitzer (2018). College algebra. Miami Dade College<br>• Gareth Williams (2019) Linear Algebra with Applications- nine Edition<br>• Steven Leon, Lisette de Pillis (2021) Linear Algebra with Applications, tenth edition<br>• Lay, David C. Lay, Steven R. McDonald, Judith (2016) Linear Algebra and Its Applications<br>• Larry E. Knop - Linear Algebra, (2008). A First Course with Applications<br>• Howard Anton, Cris Rorres (2008). Elementary Linear Algebra with Applications nine Edition<br>• Jeffrey Holt (2013) Linear Algebra with Applications<br>• Thomas S. Shores (2007) Applied Linear Algebra and Matrix Analysis<br>• Bernard Kolman, David Hill (2007) Elementary Linear Algebra with Applications, nine Edition |

## Course Outcome

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|---|---|
| **1** | Students know how to mathematically model professional situations that lead to systems of linear equations |

## Course Evaluation

| In-term Studies | Quantity | Percentage |
|---|---|---|
| Midterms | 1 | 35 |
| Quizzes | 2 | 14 |
| Projects | 0 | 0 |
| Term Projects | 0 | 0 |
| Laboratory | 0 | 0 |
| Class Participation | 1 | 1 |
| **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 | 0 | 0 |
| Final Exam | 1 | 5 | 5 |
| Other | 0 | 0 | 0 |
| **Total Work Load** | | | **125** |
| **Total Work Load / 25 (hours)** | | | **5.00** |
| **ECTS** | | | **5.00** |