 **National University** 

**Of Computer & Emerging Sciences**

**Karachi**

**Course Outlines of BS (CS) Degree Program**

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| **Course Instructor** | Ms. Alishba Tariq | **Semester** | Spring |
| **Batch/Section(s)** | Batch 2021 | **Year** | 2022 |
| **Course Title** | MT 1004-Linear Algebra | **Credit Hours** | 3 |
| **Prerequisite(s)** |  | **Course TA** | 1AZZZ |

**Text Book(s)**

**Title of book** Elementary Linear Algebra, 12th edition

**Author(s)** Howard Anton and Anton Kaul

**Reference Book(s)**

**Title of book** Linear Algebra and its Applications

**Author(s)** Gilbert Strang

**Title of book** Coding the Matrix: Linear Algebra through Applications to Computer Science

**Author(s)** Philip N Klein

**Course Description:**

Elementary operations on matrices, Gaussian and Gauss Jordan elimination, Elementary matrices and matrix factorization, determinants and their properties, vector spaces, subspaces and spanning sets, linear independence, dimensions, rank of a matrix, linear transformation, Eigenvalues and Eigenvectors, inner product and orthogonal basis, diagonalization and orthogonal diagonalization, application of linear algebra.

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| **S. No.** | **Course Learning Outcomes (CLO)** | **Domain** | **Taxonomy** | **PLO** |
| **Level** |
| 1. | Interpreting and finding the solutions of linear equations in detail. | Cognitive | **2**  **2** | 2 |
| 2. | Understanding the core concepts of Euclidean vector spaces and matrix transformations. | Cognitive | **2** | **2** |
| 3. | Applying the basic linear algebra concepts in computer science. | Cognitive | **3** |  |

**Tentative Weekly Lectures Schedule:**

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| **Week** | **Contents/Topics** | **Remarks** | **Exercises** | **CLO’s** | **Tools** |
| Week  1 | Introduction, System of Linear equations, Elementary row operation | **Assignment 1** | **1.1** (1-20) | **1** | A1, M1, F |
| Week  2 | **Solving system of Linear equations**:  Gaussian Elimination and Gauss Jordan methods  **Matrix Operations**  Elementary Matrices, Methods for finding Inverse |  | **1.2** (1-26)  **1.3** (1-20)  **1.5** (1-6, 11-18)  **1.6** (1-20) |
| Week  3 | Invertible Matrices,  Diagonal, triangular, and symmetric matrices,  Matrix Transformations |  | **1.7** (1-10, 19-28)  **1.8** (1-24, 27-41,  45-46) (CLO 2) |
| Week  4 | Matrix Transformation (contd...)  Application no 1:  Network Analysis |  | **1.9** (1-26) (CLO 2)  **1.10** (1-4) (CLO 3) |
| Week  5 | Determinants and their properties, Minors, Cofactors, Inverse using cofactors, Cramer’s Rule  Computer Graphics |  | **2.1** (1-32)  **2.2** (1-23)  **2.3**(1-29,31,32) |
| Week  6 | **1st Mid Term Exam** |  |  |  |  |
| Week  7 | General Vector Space,  Subspaces,  Spanning Sets,  Linear Independence, | **Assignment 2** | **4.1** (1-14)  **4.2** (1-16,19)  **4.3** (1-20)  **4.4** (1-21) | **2** | A2, A3, M2, F |
| Week  8 | Coordinates and Bases,  Dimensions  Change of basis |  | **4.5** (1-28)  **4.6** (1-20)  **4.7** (1-19) |
| Week  9 | Bases for row, column, and null spaces,  Rank and Nullity |  | **4.8** (1-31)  **4.9** (1-38) |
| Week  10 | Eigenvalues and Eigenvectors, Diagonalization | **Assignment 3**  **(5.4)** | **5.1** (1-16)  **5.2** (1-20) |
| Week  11 | **2nd Mid Term Exam** |  |  |  |  |
| Week  12 | Application no 2:  Markov Chains  Internet Search Engines | **Presentation** | **5.5** | 3 |  |
| Week  13 | Inner product spaces, Orthogonal and orthonormal bases, Gram-Schmidt Process; |  | **6.1** (1-26)  **6.2** (1-12, 17-19) | **2** | P, F |
| Week  14 | QR-Decomposition. Orthogonal Matrices |  | **6.3** (1-14, 27-31,  44-49)  **7.1** (1-6) (CLO 1) |
| Week  15 | Orthogonal Diagonalization, Quadratic Forms |  | **7.2** (1-18) (CLO 1)  **7.3** (1-8) (CLO 1) |
| Week  16 | Revision |  |  |  |  |

**Marks Distribution:**

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| --- | --- |
| **Particulars** | **% Marks** |
| 1. Assignments and Presentations | 20 |
| 2. First Mid Exam | 15 |
| 3. Second Mid Exam | 15 |
| 4. Final Exam | 50 |
| **Total:** | **100** |
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