| **Course Instructor** | Ms. Alishba Tariq, Mr. Abdul Basit, Dr. Fahad Riaz, Ms. Javeria Iftikhar, Mr. Nadeem khan, Mr. Osama Bin Ajaz, Mr. Shahid Ashraf , Ms. Urooj. | **Semester** | Fall |
| --- | --- | --- | --- |
| **Batch/Section(s)** | Batch 2021 | **Year** | 2022 |
| **Course Title** | MT 1004-Linear Algebra | **Credit Hours** | 3 |
| **Prerequisite(s)** | No | **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 Application |
| **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 |

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

**Tentative Weekly Lectures Schedule:**

| **Weeks** | **Contents/Topics** | **Remarks** | **Exercises** | **CLO’s** | **Tools** |
| --- | --- | --- | --- | --- | --- |
| **Week 1** | Introduction, System of Linear equations, Elementary row operation |  | **1.1** (1-20) | **1** | Q1, A1, M1, F |
| **Week 2** | **Solving system of Linear equations**:  Gaussian Elimination and Gauss Jordan methods  **Matrix Operations**  Elementary Matrices, Methods for  finding Inverse, Invertible Matrices, | **Assignment 1** | **1.2** (1-26)  **1.5** (1-6, 11-18)  **1.6** (1-20) |
| **Week 3** | Diagonal, triangular, and symmetric matrices,  Matrix Transformations |  | **1.7** (1-10, 19-28)  **1.8** (1-24, 27-41)  (CLO 2) |
| **Week 4** | Application no 1:  Network Analysis  Determinants and their properties, Minors, Cofactors, Inverse using cofactors, Cramer’s Rule | **Quiz 1** | **1.10** (1-4)  (CLO 3)  **2.1** (1-32)  **2.2** (1-23)  **2.3**(1-29,31,32) |
| **Week 5** | General Vector Space  Subspaces |  | **4.1** (1,2,9,11, 12)  Example: 1-5,7  **4.2** (1-5, 19)  Example: 1-6,13 |
| **Week 6** | **1st Mid Term Exam** | | | | |
| **Week 7** | Spanning Sets  Linear Independence |  | **4.3** (1-20)  **4.4** (1-15) | **2** | Q2, A2, M2, F |
| **Week 8** | Coordinates and Bases  Dimensions  Change of basis | **Quiz 2** | **4.5** (1-22)  **4.6** (1-8,10,12-13,15-20)  **4.7** (1-19) |
| **Week 9** | Bases for row, column, and null spaces,  Rank and Nullity | **Assignment 2** | **4.8** (1-19,21-30)  **4.9** (1-14,19-36) |
| **Week 10** | Eigenvalues and Eigenvectors  Diagonalization |  | **5.1** (1-16)  **5.2** (1-20) |
| **Week 11** | **2nd Mid Term Exam** | | | | |
| **Week 12** | Inner product spaces, Orthogonal and orthonormal bases, Gram-Schmidt Process; | **Assignment 3** | **6.1** (1-26)  **6.2** (1-12, 17-19) | **2** | Q3, A3, P, F |
| **Week 13** | QR-Decomposition. Orthogonal Matrices |  | **6.3** (1-14, 27-31,  44-49)  **7.1** (1-6) (CLO 1) |
| **Week 14** | Orthogonal Diagonalization, Quadratic Forms | **Quiz 3** | **7.2** (1-18) (CLO 1)  **7.3** (1-8(CLO 1) |
| **Week 15** | Application no 2:  Single Value Decomposition  Markov Chains | **Presentation** | **9.4**  **5.5** | 3 |
| **Week 16** | Revision |  |  |  |  |

**Marks Distribution:**

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