Forman Christian College, Lahore

(A Chartered University)
SPRING 2023

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Office Hours: Mon, Wed: **11:00 a.m. - 12:30 p.m.**
Fri: **11:00 a.m. – 01:00 p.m.**
Tues, Thurs: **11:30 a.m. - 12:30 p.m.**

Course Information: Computational Linear Algebra   CSCS 202 (A)
Prerequisite: MATH 111   **Credit Hours:** 3
Classroom: S-313   **Class Timings:** 12:30 p.m. -01:45 p.m. (Tue, Thu)

Recommended Text:
Elementary Linear Algebra with supplemental applications, Howard Anton/Chris Rorres, eleventh Edition.
MATLAB Linear Algebra, Cesar Lopez, Springer.

Reference Text:
Linear Algebra Ideas and Applications, Richard C. Penny, Fourth Edition.
Linear Algebra with Applications, Steven J. Leon, Eighth Edition.

Course Contents:

This course introduces concepts that are crucial to many areas of Computer Science, including computer graphics, image processing and computer vision. Topics include matrices, vectors, vector spaces, linear independence, linear transformations, eigenvalues & eigenvectors, solution of system of linear systems and singular value decomposition. Software package MATLAB is used to implement various algorithms.

Course Objectives:

Once the course is successfully completed, the students will be able to:
- ➢ Analyze and solve a linear system of equations.
- ➢ Understand fundamental properties of matrices including rank, determinant, inverse matrices, matrix factorization, eigenvalues and linear transformation.
- ➢ Comprehend important concepts of vector spaces such as independence, basis, dimensions, orthogonality, etc.
- ➢ Implement the MATLAB software package by solving linear algebra problems.

Course Requirements:

- **Attendance:** Students are expected to attend every class. Student whose attendance is less than 70% will not be allowed to take the final exam. Students must arrive at class on time, should remain in class for the entire class period and mobile phone should be switched off or on silent mode. Note that there is **5 marks for attendance, behavior, and class participation**, if a student arrives more than **10 minutes late** or **leaves class during lecture** or **uses mobile in class**, he/she will be marked **absent** for that day.
- **Assessments:** Course assessment will be through **quizzes, attendance and behavior, assignments, midterm, and final exam**. There is no make up for missed quizzes. Make up for quizzes, midterm and final exam is possible only under extremes cases if student provides strong documentary evidence within three days. In case of makeup exam, there will be a 0-20% deduction in marks depending upon case-to-case basis.
- **Academic dishonesty or cheating:** Students are expected to present their own work, failure to do this will result in zero points and will be referred to AIC (Academic Integrity Committee) at FCC for necessary action.

Course Evaluation:

Grading will be based on following criteria:

- ❖ **Quizzes** (3 best quizzes out of 4 will be selected)   **15 %**
- ❖ **Attendance, class participation and behavior**   **05 %**
- ❖ **Assignments** (two assignments and each having 5% weightage)   **10 %**
- ❖ **Mid-term Exam**   **30 %**
- ❖ **Final Exam**   **40 %**

Grading Criteria:

Grades	Quality Points	Numerical Value	Meaning
A	4.00	93 - 100	Superior
A-	3.70	90 - 92	
B+	3.30	87 - 89	Good
B	3.00	83 - 86	
B-	2.70	80 - 82	Fair
C+	2.30	77 - 79	
C	2.00	73 - 76	Satisfactory
C-	1.70	70 - 72	
D+	1.30	67 - 69	
D	1.00	60 - 66	Passing
F	0.00	59 or below	Failing

Weekly Lesson Plan:

Weeks	Topics	Assessments
1	Discussion of course plan: Course introduction, policies, requirements, and grading criteria. Review of linear equations, System of linear equations and their solutions. MATLAB introduction and working environment.	
2	Matrices and matrix operations, Algebraic properties of matrices, Matrices in MATLAB, Image processing using algebra of matrices	
3	System of linear equations and matrices, Elementary row operations, Gaussian elimination, Gauss Jordan elimination, Homogeneous systems	
4	Elementary matrices, Inversion algorithm, Applications of linear systems	**Quiz 1**
5	Determinants and their properties, Determinants by row reduction	
6	Vectors in 2-Space, 3-Space, and n-Space, Norm, dot and cross Product, Distance in Rn	**Assignment 1**
7	Real vector spaces, Subspaces	**Quiz 2**
8	Linear independence, Basis	
9	Dimension, Row space, Column space	**Mid Term**
10	Null space, Rank, Nullity	
11	Basic Matrix Transformations in R2, Properties of Matrix Transformations	

12	Application: Geometry of Matrix Operators on R2	**Quiz 3**
13	Eigen values and Eigen vectors, Diagonalization.	
14	Inner Product, Angle and Orthogonality in Inner Product Spaces, Gram Schmidt Process	**Assignment 2**
15	General linear transformations,	
16	Matrices for general linear transformations	
17	Singular Value Decomposition Revision and problems' discussion	**Quiz 4**
June 12 – June 21	Final examination will be conducted as per official schedule. Final examination period is from June 12 – June 21.	**Final Exam**