



# FORMAN CHRISTIAN COLLEGE, LAHORE

(A Chartered University)

Computational Linear Algebra- CSCS202 (B)

Spring 2023

## **Instructor Information:**

Dr Farheen Ibraheem

Assistant Professor

Office: S 113 (Armacost Science Building)

Office hours: Wednesday & Friday: 12:00pm-2:00pm

Tuesday & Thursday: 2:00pm-3:30pm

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## **Course Information:**

**Course Title:** Computational Linear Algebra      **Course Code:** CSCS202

**Class Room:** S316      **Prerequisite:** Math 101/A-level/ Intermediate Math

**Timings:** M W F @ 2:00pm – 2:50 pm

## **Recommended Text:**

1. Elementary Linear Algebra with supplemented Applications, Eleventh Edition, by Howard Anton/Chris Rorres,
2. MATLAB Linear Algebra by Cesar Lopez, Springer.

## **Reference Text:**

3. Linear Algebra Ideas and Applications by Richard C. Penny, Fourth Edition.
4. Linear Algebra with Applications, by 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 will be 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 Requirement:**

Students are expected to attend every class. Student whose attendance is less than 70% won't 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. Course assessment will be through **class participation & attendance, quizzes, assignments, midterm and final exam**. There is **no make up** for missed quizzes but **best 3 out of 4** will be counted. Make up for midterm and final exam is possible only under extreme cases if student provides strong documentary evidence. In case of makeup exam there will be a 0-20% deduction in marks depending upon case to case basis. Academic dishonesty or cheating will result in zero points and will be referred to AIC (Academic Integrity Committee) at FCC for necessary action.

### **Course Evaluation:**

Assignments	10%
Class Participation & Attendance	05%
Midterm Exam	30%
Final Exam	40%
Quizzes	15%

<b><u>Grades</u></b>	<b><u>Quality Points</u></b>	<b><u>Numerical Value</u></b>	<b><u>Meaning</u></b>
A	4.00	93-100	Superior
A-	3.70	90-92	
B+	3.30	87-89	
B	3.00	83-86	Good
B-	2.70	80-82	
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

## Course Outline:

<b>Week #</b>	<b>Topics Covered</b>	
1	Introduction to Linear Algebra. Linear equation, System of linear Equations, Consistent and Inconsistent System. Homogenous and Non Homogenous System.	
	Solution of Linear System: Algebraic and Graphical Solution.	
	MATLAB Introduction and Working Environment. Windows and Command Prompt. Variables and Assignment Statements. Operators and Precedence. Built-in Functions. MALAB Help.	
2	Matrices and Matrix Operations. Dot product & matrix multiplication. Algebraic Properties of Matrices.	
	Problem Solving Using Matrix Operations.	
	Matrices in MATLAB. Matrices as images and vice versa. Image processing using Algebra of Matrices.	
3	System of Linear Equation and Matrices. Solutions of linear system of Equations. Elementary Row Operations.	<b>Quiz-1</b>
	Elementary row operations. Gauss Jordan Elimination. Gaussian Elimination. Homogeneous Systems.	
	Application of Linear System: Network Analysis (Traffic Flow)	
4	Application of Linear System(Continued): Polynomial Interpolation.	
	Elementary Matrices. Inversion Algorithm.	
	Matrix transformations Matrix transformation using MATLAB	
5	Determinants and their properties.	<b>Quiz-2</b>
	Determinant by Row Reduction.	
	Cramer's rule to solve system of linear equations.	
6	Vectors in 2-Space, 3-Space and n-Space	<b>Assignment 1</b>
	Norm, Dot Product and Distance in $R^n$	
	Orthogonal Vectors Cross Product	
7	Real Vector Spaces	
8	Subspaces.	<b>Quiz-3</b>
	Linear Independence	
	Coordinates and Basis	

9	Coordinates and Basis (Continued)	<b>Midterm</b>
10	Dimension Change of Basis	
11	Basic Matrix Transformation in R2. Properties of Matrix Transformation. Application: Geometry of Matrix Operator in R2	
12	Application: Geometry of Matrix Operator in R2 (Continued)	<b>Quiz-4</b>
13	Matrix transformation using MATLAB Eigen value and eigenvectors.	<b>Assignment 2</b>
14	Eigen space, basis of Eigen space. Diagonalization.	
15	General Linear Transformation.	
16	Compositions and Inverse Transformations. Matrices for General Linear Transformations.	
<b>FINAL EXAM IS FROM ENTIRE SYLLABUS.</b>		