CM-301

COURSE DESCRIPTION

Course code number	CM-301	Course Title	Introduction to Linear Algrbra
Semester hours	3 hours	No. of Credit Units	3
Prerequisite	None	Course Coordinator	

Course Description

This course covers matrix operations, systems of linear equations, Gaussian elimination, determinants, basic properties of vector spaces, basis and orthogonality, and eigenvalues and eigenvectors. Calculators and computer software such as MATLAB will be used in this course.

Course Outcomes

Students who complete the course will

- Understand fundamental properties of matrices including inverse matrices, eigenvalues and linear transformations.

- understand a matrix as a linear transformations relative to a basis of a vector space.

- understand the concept of orthogonality of vectors and its use in projecting vectors into subspaces and decomposing vectors into components.

- be able to solve linear systems of equations

- be able to solve over constrained systems using the method of least squares.

Major Topics Covered in the Course

- Introduction to Vectors

- Solving Linear Equations

- Vector Spaces and Subspaces

- Orthogonality

- Determinants

- Eigenvalues and Eigenvectors

- Linear Transformations

- Complex Vectors and Matrices

- Numerical Linear Algebra

Assessment Plan for the Course

Attendance   -   10%
Quizzes   -   10%
Assignment   -   20 %
Test   -   10%
Final Exam   -   50%

Grading System

UCSY follows a letter grade system comprising of grades A, A-, B+, B, B-, C+, C, C-, D and F. All marks obtained by students during the semester will be used in the grading process. A grade of "D" is considered a passing grade for undergraduate courses. For undergraduate students, a grade of "C" or better is required in this course because it is a prerequisite for other courses in the program. **The student who gets the grade point less than 2 must do Re-Exam.**

The grading scale for this course is:

Marks obtained	Letter Grade	Grade Point
>=90	A	4
85 – 89	A-	3.75
80 – 84	B+	3.25
75 – 79	B	3
70 – 74	B-	2.75
65 – 69	C+	2.25
60 – 64	C	2
55 – 59	C-	1.75
50 – 54	D	1
0 – 49	F	0

Fail Grade and Re-Exam: C-,D,F (Grade point <2)

Tentative Lesson

No	Topics	Week	Remark
1	**1 Introduction to Vectors** Vectors and Linear Combinations		
2	Lengths and Dot Products		
3	Matrices		
4	**2 Solving Linear Equations** Vectors and Linear Equations		
5	The Idea of Elimination		
6	Elimination Using Matrices		
7	Rules for Matrix Operations		
8	Inverse Matrices		
9	Elimination = Factorization: $A = LU$		
10	Transposes and Permutations		
11	**3 Vector Spaces and Subspaces** Spaces of Vectors		
12	The Nullspace of A: Solving $Ax = 0$ and $Rx = 0$		
13	The Complete Solution to $Ax = b$		
14	Independence, Basis and Dimension		
15	Dimensions of the Four Subspaces		
16	**4 Orthogonality** Orthogonality of the Four Subspaces		
17	Projections		
18	Least Squares Approximations		
19	Orthonormal Bases and Gram-Schmidt		
20	**5 Determinants** The Properties of Determinants		
21	Permutations and Cofactors		
22	Cramer's Rule, Inverses, and Volumes		
23	**6 Eigenvalues and Eigenvectors** Introduction to Eigenvalues		
24	Diagonalizing a Matrix		
25	Systems of Differential Equations		
26	Symmetric Matrices		

27	Positive Definite Matrices		
28	**7 The Singular Value Decomposition (SVD)** Image Processing by Linear Algebra		
29	Bases and Matrices in the SVD		
30	Principal Component Analysis (PCA by the SVD)		
31	The Geometry of the SVD		
32	**8 Linear Transformations** The Idea of a Linear Transformation		
33	The Matrix of a Linear Transformation		
34	The Search for a Good Basis		
35	**9 Complex Vectors and Matrices** Complex Numbers		
36	Hermitian and Unitary Matrices		
37	The Fast Fourier Transform		
38	**11 Numerical Linear Algebra** Gaussian Elimination in Practice		
39	Norms and Condition Numbers		
40	Iterative Methods and Pre conditioners		

Textbook: Introduction to Linear Algebra, Fifth Edition, Gilbert Strang