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**INU Peshawar**

**Department of Computer Science**

**Fall Semester 2020**

**Title of the Course: Linear Algebra**

**Credit Hours: 3**

**Prerequisites: Calculus I**

**Instructor: Mansoor Qadir**

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**Specific Objectives of course:**

Linear algebra is the study of vector spaces and linear transformations. The main objective of this course is to help students learn in rigorous manner, the tools and methods essential for studying the solution spaces of problems in mathematics, engineering, the natural sciences, and social sciences and develop mathematical skills needed to apply these to the problems arising within their field of study; and to various real world problems.

1. Matrices and their use in solving system of linear equations
2. Determinants and applying them in various geometrical and systems of linear equations problems
3. Echelon, Row Echelon form and Homogeneous System
4. Vector Algebra ,vector valued functions
5. Eigenvalues, Eigenvectors and Diagonalization

**Course Outline:**

System of Linear Equations: Representation in matrix form. Matrices. Operations on matrices. Echelon and reduced echelon form. Inverse of a matrix (by elementary row operations). Solution of linear system. Gauss-Jordan method. Gaussian elimination. Determinants: Permutations of order two and three and definitions of determinants of the same order. Computing of determinants. Definition of higher order determinants. Properties. Expansion of determinants. Vector Spaces: Definition and examples, subspaces. Linear combination and spanning set. Linearly Independent sets. Finitely generated vector spaces. Bases and dimension of a vector space. Operations on subspaces, Intersections, sums and direct sums of subspaces. Quotient Spaces. Linear mappings: Definition and examples. Kernel and image of a linear mapping. Rank and nullity. Reflections, projections, and homotheties. Change of basis. Eigen-values and eigenvectors. Theorem of Hamilton-Cayley. Inner product Spaces: Definition and examples. Properties, Projection. Cauchy inequality. Orthogonal and orthonormal basis. Gram Schmidt Process. Diagonalization.

**Course Learning Outcomes:**

1. Understanding of system of linear equations, matrices, calculus of vectors and several variables.
2. Improve students’ theoretical and analytical skills by going inside the depth of different applications of system of linear equations.
3. Can solve and understand the solutions of system of linear equations, understand the ideas of matrices and be able to work out problems.
4. Understand vector algebra, applying the concepts of Vector Algebra to derive equation of line and plane, and to find volume of parallelepiped.
5. The student has to have the ability to handle vector valued functions its derivative and integrals.
6. The student has to have the ability to handle function of several variables. Understand the Concept of Gradient and apply it for the applications in several variables.

**Text book:** Howard Anton, Chris Rorres - Elementary Linear Algebra with Applications-Wiley (2005)

**Recommended Books:**

1.Ch. W. Curtis, Linear Algebra, Springer 2004.

2.T. Apostol , Multi Variable Calculus and Linear Algebra,2nd ed., John Wiley and sons, 1997.

3.H. Anton, C. Rorres ,Elementary Linear Algebra: Applications Version, 10thEdition, John Wiley and sons, 2010.

4.S. Friedberg, A. Insel, Linear Algebra, 4thEdition,Pearson Education Canada, 2003.

5.S. I. Grossman, Elementary Linear Algebra, 5thEdition,Cengage Learning, 2004

**Useful on line material:**

1. <https://www.khanacademy.org/math/>
2. [www.mathworld.wolfram.com](http://www.mathworld.wolfram.com) › ... › Linear Algebra › General Linear Algebra
3. [www.sosmath.com/matrix/matrix.html](http://www.sosmath.com/matrix/matrix.html)
4. <http://www2.warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/content/ma106/elementary_linear_algebra_10th_edition.pdf> (Linear Algebra by H. Anton (Soft copy))
5. <https://ocw.mit.edu/courses/mathematics/18-022-calculus-of-several-variables-fall-2010/lecture-notes/>