Centre for High Energy Physics
Faculty of Science
University of the Punjab, Lahore

Course Outline

Program	BSCP	Course Code	CPHY 203	Credit Hours	3
Course Title	**Linear Algebra**				

Course Introduction

This course is about linear combinations. It involves vectors, matrices, vector spaces, matrix spaces, sets of linear equations and linear transformations involved in the spaces. It involves solving system of linear equations by using vector and matrix properties. It has many applications such as in artificial intelligence, error correcting algorithms, search engine algorithms, etc.

Learning Outcomes

Following objectives are expected at the end of this course:

1. Learning the concepts of system of linear equations and matrices.
2. Learning the working principles in Euclidean vector spaces
3. Learning the methodology of general vector spaces
4. Having the grip of understanding eigen value problems
5. Understanding linear transformations in general way
6. Learning the concepts of similarity transformations

Course Content

Week 1	Course Introduction involving its scope and applications, etc.
	System of Linear equations and matrices: Introduction, Gaussian elimination method
Week 2	Matrices and Matrix operations
	Inverse of Matrix, Algebraic properties of matrices
Week 3	Elementary matrices, and methods of finding inverse
	Diagonal, triangular, and symmetric matrices
Week 4	Applications of linear systems
	Determinants by Cofactor expansion
Week 5	Evaluating determinant by row reduction
	Properties of determinants
Week 6	Cramer's rule
	Euclidean vector spaces: vector in 2D, 3D, nD space
Week 7	Euclidean vector spaces: Norm, Dot product and distance in R^n
	Cross product
Week 8	General Vector Spaces: Real vector spaces

	Subspaces
Week 9	Linear independence
	Coordinates and basis, Dimension
Week 10	Change of basis
	Linear operators
Week 11	matrix representation of linear operators
	Matrix Transformations from R^n to R^m
Week 12	Eigen values and eigen vectors: Definitions
	Diagonalization
Week 13	Complex vector spaces
	Inner Product Spaces: Inner product
Week 14	Inner Product Spaces: Gram-Schmidt process; QR Decomposition
	Inner Product Spaces: Orthogonal Matrices
Week 15	Inner Product Spaces: Diagonalization of orthogonal matrices
	General linear transformations
Week 16	Matrices for general linear transformation
	Similarity transformation

Textbooks and Reading Material

Recommended Books:

1. Elementary Linear Algebra (11^{th}edition), Howard Anton, *John Wiley & Sons* (2013).
2. Foundations of Mathematical Physics, Sadri Hassani, *Prentice-Hall International* (1991).
3. Linear Algebra, G. Hadley, *Addison-Wesley* (1987).
4. Elements of Modern Algebra (8^{th}edition), L. Gilbert and G. Gilbert, *Cengage Learning* (2014).

Teaching Learning Strategies

1. Instructor will provide mathematical details of linear algebra concepts so that students can better grip the concepts involved.
2. Instructor can use the software and multimedia technology to better highlight the linear algebra concepts.
3. Students will learn the concepts by practicing the mathematical details and then will solve the exercise problems assigned by the instructor.
4. Students can use software technology to better understand the linear algebra concepts.

Assignments: Types and Number with Calendar

At least two assignments and two quizzes. A course project may also be assigned.

Assessment

Sr. No.	Elements	Weightage	Details

1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3.	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.