Linear Algebra (MTH4021)

Programme: M.Sc. Year: 1st Year Semester: Even (2017-18)
Course: Core Credits: 4 (3L+T) Hours: 40 Lectures + Weekly tutorial

Course Context and Overview (100 words):
This course gives an introduction of Linear Algebra, where course emphasises the topics useful in other disciplines. Linear algebra is a branch of mathematics that studies systems of linear equations and the properties of matrices. The concepts of linear algebra are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Due to its broad range of applications, linear algebra is one of the most widely taught subjects in college-level mathematics.

Prerequisites Courses: Modern Algebra

Course outcomes (COs):

On completion of this course, the students will have the ability to:
CO1. Solve the System of Linear Equations.
C02. Explain the basic concepts of Vector Spaces and Linear transformation.
C03. Understand Linear Functionals, Dual Space and Inner Product space.
C04. Solve the eigenvalue problem by finding the eigenvalues and the corresponding eigenvectors. Determine whether a matrix A is diagonalizable
C05. Represent Canonical Form, Bilinear and Quadratic Forms.

Course Topics:

Topics	**Lecture Hours**
Unit I:	
Systems of linear equations, Row reduction and echelon forms, Matrix operations including inverses, Block matrices.	4
UNIT – II:	7
Vector Spaces, Subspaces, Span, Linear Dependence and Independence, Basis, Coordinates, Dimension, Ordered basis.	
UNIT – III:	7
Linear transformations, Algebra of linear transformations, Matrix representation of linear transformations, Null Space and the Range Space of a Linear Transformation, Rank-nullity theorem, isomorphism, Change of basis.	
Unit – IV:	
Linear Functionals, The Dual Space. Dual Basis, Subspace, Annihilators, Subspace Annihilators, The Double Dual, The Double Annihilator.	6
UNIT – V :	6
Inner product space: Definition, basic properties and examples, Orthogonality, Orthonormal basis, Gram-Schmidt process, Cauchy-Schwarz Inequality.	

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UNIT – VI:		
Eigenvalues and eigenvectors, Diagonalizability, Cayley-Hamilton theorem. Quadratic Forms, Minimal Polynomial, Canonical Forms, Triangular Form, Invariance, Invariant Direct-Sum Decompositions, Primary Decomposition, Nilpotent Operators, Jordan Canonical Form, Rational Canonical Form. Bilinear Forms, Bilinear Forms and Matrices, Symmetric Bilinear Forms, Quadratic Forms, Hermitian Forms.		10

Text Book:

1) K. Hoffman & R. Kunze, Linear Algebra, Prentice Hall 2nd Ed

Reference Books:

1) David C. Lay, Linear Algebra and its Applications, Pearson Education 3rd Ed, 2003
2) G. Strang, Linear Algebra and Its Applications, Thomson Brooks/Cole, 2007.
3) S. Kumaresan, Linear Algebra A Geometric Approach , Prentice Hall India
4) Seymour Lipschutz and Marc Lipson: SCHAUM'S OUTLINE OF LINEAR ALGEBRA, McGraw Hill Education; 3 edition

Additional Resources: NPTEL, MIT Video Lectures):

- NPTEL (By Dr. K.C. Sivakumar, IIT Madras) : http://nptel.ac.in/courses/111106051/
- MIT (By Professor Strang) https://ocw.mit.edu/courses/mathematics/18-06sc-linear-algebra-fall-2011/syllabus/

Evaluation Methods:

Method	Weightage (%)
Quiz	20%
Midterm	30%
Final Examination	50%

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