Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar

(Autonomous)

Syllabus

B.Sc. Mathematics (Minor)

Title of the Course: Linear Algebra								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
MNR-3	BS-MT301 T+P	02	01	03	60	30	70	100

Learning Objectives:

1. To study the concept of basis and dimensions of vector spaces.
2. Learn properties of linear transformation and matrices.
3. Obtain eigen values, eigen vectors and eigen spaces of linear transformation.
4. To learn required conditions for a transformation in order to be a linear transformation.
5. To learn when a transformation matrix can be written in the form of diagonal matrix.

Course Outcomes (Cos):

1. Understand the concepts of vector spaces, subspaces, bases, dimension and their properties.
2. Relate matrices and linear transformations.
3. Compute eigen values and eigen vectors of linear transformations.
4. Learn quadratic forms.
5. Obtain various variants of diagonalization of linear transformations.

Detailed Syllabus:

Unit 1: **Vector Spaces-I** (07 Hours)

1.1 Definitions and Examples.

1.2 Vector subspaces.

1.3 Linear Dependence .

1.4 Linear Independence.

Unit 2: **Vector Spaces-II** (07 Hours)

2.1 Basis.
2.2 Dimensions.
2.3 Row and column spaces.
2.4 Row rank and column rank.

Unit 3: **Linear Transformations** (10 Hours)

3.1 Definition and Examples.
3.2 Properties of Linear Transformation.
3.3 Linear transformation representation by a matrix .
3.4 Rank-Nullity Theorem .

Unit 4: **Eigen Values and Eigen Vectors** (06 Hours)

4.1 Eigen values and eigen vectors.
4.2 Eigen space.
4.3 Diagonalization.
4.4 Quadratic forms.

Suggested Readings:

1. Schaum's outlines Linear Algebra Seymour, Lipschutz fourth edition, 2015.
2. Elementary Linear Algebra with Applications, H. Anton and C. Rorres, seventh edition, Wiley, 1994.
3. Linear Algebra: A Geometric Approach, S. Kumaresan, Prentice Hall of India, 1999.
4. Introduction to Linear Algebra, S. Lang, Springer Verlag, second edition, 1999.
5. Linear Algebra, A. Ramchandra Rao and P. Bhimasankaran, Tata McGraw Hill, 1994.

List of Practicals:

Practical/Lab work to be performed in Computer Lab.

List of the practicals to be done using R/ Python/ Maxima/ Mathematica/ MATLAB/ Maple/ Scilab etc.

Pratical 1: Introduction to software.

Practical 2: Computation of Basic Arithmetic Operators, vector and matrix operations.

Practical 3: Computation of dimension, column space of matrices.

Practical 4: Computation of rank of matrices, null space and nullity of matrices.

Practical 5: Linear Transformation using software.

Practical 6:Determination of Linear Dependence or Independence of vectors.

Practical 7: Computation of Trace, Determinant and Inverse of matrices.

Practical 8: Computation of eigen values and eigen vectors and Diagonalization of matrices using software.

Practical 9: Theory practical on Vector Space-I and Vector Space-II.

Practical 10: Theory Practical on Linear Transformations and Eigen values and Eigen vectors.

Suggested Readings:

1. Think Python, book by Allen B. Downey, published by O'Reilly Media, second edition.
2. Linear Algebra and Optimization for Machine Learning, Charu C. Aggarwal
3. Essential MATLAB for Scientists and Engineers, book by Brian D. Hahn, 8th edition
4. Maple: A Primer, book by Bernard V Liengme, 2019
5. The Mathematica Book, by Stephen Wolfram, Fifth Edition, published by Wolfram Media

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Syllabus

B.Sc. Mathematics (Minor)

Title of the Course: Numerical Methods								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
MNR-4	BS-MT401 T+P	02	01	03	60	30	70	100

Learning Objectives:

1. Learn about different types of errors in numerical computation.
2. Understand the concept of approximation and its role in numerical methods.
3. Learn techniques for estimating values between known data points
4. Explore methods for approximating definite integrals.
5. Explore numerical techniques for solving initial value problems for ODEs.

Course Outcomes (Cos):

1. Demonstrate understanding of common numerical methods and how they are used.
2. Obtain approximate solutions to otherwise intractable mathematical problem.
3. Analyse and evaluate the accuracy of common numerical methods.
4. Apply numerical methods to obtain approximate solutions to mathematical problems and solve the problems of interpolation, numerical integration and ordinary differential equations
5. To understand the basic definition of Ordinary Differential Equations.

Detailed Syllabus:

Unit 1: **Algebraic and Transcendental Equations** (08 Hours)

1.1 Rounding off numbers to n significant digits to n decimal places.
1.2 Absolute, relative and percentage errors.
1.3 The method of False Position.
1.4 Newton-Raphson method.

Unit 2: **Interpolation** (10 Hours)

2.1 Finite Difference Operators and their relations. (Forward, Backward difference and Shift operator).
2.2 Newton's Divided Difference Interpolation.
2.3 Newton's Interpolation Formulae .(Forward and Backward Differences)
2.4 Lagrange Interpolation Formula.

Unit 3: **Numerical Integration** (06 Hours)

3.1 Numerical Integration: The General quadrature formula.
3.2 Trapezoidal rule.
3.3 Simpson's $1/3^{rd}$ rule.
3.4 Simpson's $3/8^{th}$ rule.

Unit 4: **Numerical solution of Ordinary Differential Equations** (06 Hours)

4.1 Picard's method of successive approximations.
4.2 Euler's method.
4.3 Runge - Kutta Methods.

Suggested Readings:

1. S.S. Sastry, Introductory Methods of Numerical Analysis, 5^{th} edition, Prentice Hall
2. William F Trench, Elementary Differential Equations with Boundary Value Problems, E book, 2013.
3. R.K. Jain and S.R.K. Iyenger, Numerical Methods, New Age International (P) Ltd, Publishers, 2009**.**
4. C.F. Gerald and O.P. Wheatley, Applied Numerical Analysis, Addison Wesley; 7^{th} edition (2003).
5. T. Sauer, Numerical analysis, 3^{rd} edition, Pearson, 2018.

List of Practicals:

Practical/Lab work to be performed in Computer Lab.

List of the practicals to be done using R/ Python/ Maxima/ Mathematica/ MATLAB/ Maple/ Scilab etc.

Practical 1: Introduction to software.
Practical 2: Regula Falsi Method.
Practical 3 :Newton-Raphson method.
Practical 4: Newton's Forward Interpolation formula.
Practical 5: Newton's Backward Interpolation formula.
Practical 6: Lagrange's Interpolation formula and Newton's Divided Difference formula.
Practical 7: Numerical Integration by Trapezoidal rule, Simpson's $1/3^{rd}$ rule, Simpson's $3/8^{th}$ rule.
Practical 8: Euler's method and Runge-Kutta Method to solve differential equation.
Practical 9: Theory practical on Algebraic and Transcendental Equations and Interpolation.
Practical 10: Theory practical on Numerical Integration and Numerical solution of Ordinary Differential Equations.

Suggested Readings:

1. Introduction to Scilab for Engineers and scientists, Sandeep Nagar, Apress
2. Scilab: A beginner's approach, Anil Kumar Verma, First Edition, 2018
3. Programming in Scilab, Rajan Goyal, Mansi Dhingra, Narosa Publication
4. Think Python, book by Allen B. Downey, published by O'Reilly Media, second edition