Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Mathematics (Major)

Title of the Course: Calculus of Several Variable								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-6	BS-MT231T	03	00	03	45	30	70	100

Learning Objectives:

1. To compute partial derivatives of functions concerning each variable and interpret these derivatives in the context of the problem.
2. To apply the chain rule to compute derivatives of composite functions involving multiple variables.
3. To set up and evaluate double and triple integrals over various regions and understand the geometric interpretation of these integrals.
4. To apply change of variable's techniques to simplify integrals and compute Jacobian determinants.

Course Outcomes (Cos):

1. Calculate the limit and examine the continuity of a function at a point.
2. To understand the basic concept of derivative as a rate of change.
3. Compute double and triple integrals over various regions.
4. Apply change of variables in multiple integrals.
5. Understand the Jacobian determinant and its role in the change of variables.

Detailed Syllabus:

Unit I : Limits and Continuity (08 Hrs)

1.1 Functions of Several Variables- Functions of two variables.
1.2 Domain and Range.
1.3 Graphs, and Level Curves.
1.4 Functions of Three or More Variables.
1.5 Limits and Continuity.

Unit II : Partial Derivatives and Differentiability (12 Hrs)

2.1 Definition and examples.
2.2 Higher Derivatives, Clairaut's Theorem.
2.3 Partial Differential Equations, Laplace equation, Heat equation, Wave equation.
2.4 Differentiability.
2.5 Necessary and sufficient conditions for differentiability.
2.6 Differentials and approximations.

2.7 Chain Rule, Homogeneous Functions, Euler's theorem.
2.8 Directional derivatives.

Unit III : Extreme Values **(12 Hrs)**

3.1 Extreme values of functions of two variables.
3.2 Necessary conditions for extreme values.
3.3 Second Derivative Test.
3.4 Lagrange Multipliers.

Unit IV : Multiple Integrals **(13 Hrs)**

4.1 Iterated Integrals, Fubini's Theorem.
4.2 Double integral over general regions.
4.3 Change of order of integration for two variables.
4.4 Double integral in Polar coordinates.
4.5 Triple integrals, Evaluation of triple integrals.
4.6 Triple integrals in spherical coordinates.
4.7 Jacobians, Change of variables in multiple integrals.

Suggested Readings:

1. James Stewart, Brooks/Cole, Multivariable Calculus, Cengage Learning, 7th Edition, 2012.
2. J. E. Marsden, A. J. Tromba, A. Weinstein, Basic Multivariable Calculus, Springer, (Indian Edition), 2001.
3. Shanti Narayan, R.K. Mittal, A Text-book of Vector Calculus, S. Chand and Company, 2010.
4. D.V. Widder, Advanced Calculus (2nd Edition), Prentice Hall of India, New Delhi, 1944.
5. John Wiley, T.M. Apostol, Calculus Vol. II, New York, (2nd Edition), 1967.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)
Syllabus
B.Sc. Mathematics (Major)

Title of the Course: Numerical Methods								
Year: II				Semester: III				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-7	BS-MT232T	03	00	03	45	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 an understanding of common numerical methods.
2. Obtain approximate solutions to an 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
5. Solve the problems of interpolation, numerical integration, and ordinary differential equations.

Detailed Syllabus:

Unit I : Solution of Algebraic and Transcendental Equations (08 Hrs)

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

Unit II : Interpolation (14 Hrs)

2.1 Finite Difference Operators and their relations (Forward, Backward difference, and Shift operator).
2.2 Differences of a polynomial
2.3 Newton's Interpolation Formula (Forward and Backward Differences)

2.4 Lagrange Interpolation Formula.
2.5 Newton's Divided Difference Interpolation.

Unit III : Numerical Differentiation and Integration (10 Hrs)

3.1 Numerical Differentiation (Derivatives using Newton's forward difference formula).
3.2 Numerical Integration, The General quadrature formula.
3.3 Trapezoidal rule.
3.4 Simpson's 1/3rd rule.
3.5 Sampson's 3/8th rule.

Unit IV : Numerical solution of first-order ordinary differential equations. (12 Hrs)

4.1 Taylor's Series method.
4.2 Picard's method of successive approximations.
4.3 Euler's method.
4.4 Modified Euler's methods.
4.5 Runge - Kutta Methods.

Suggested Readings:

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

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus

B.Sc. Mathematics (Major)

Title of the Course: Practical Based on Calculus of Several Variable								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-8	BS-MT233P	00	02	02	60	15	35	50

Learning Objectives:

1. Interpret derivatives as rates of change.
2. Apply derivatives to real-world problems.
3. Learn to sketch curves in Cartesian coordinates and understand polar coordinates.
4. Apply Lagrange multipliers to constrained optimization problems.
5. Learn techniques for computing double integrals over simple regions.

Course Outcomes (Cos):

1. Explore continuity in various types of functions using computer-based tools.
2. Utilize software to explore higher-order derivatives and their applications.
3. Apply computer tools to analyze and visualize curves more effectively
4. Utilize software to calculate volumes and solve three-dimensional optimization problems.
5. Use computational methods to handle intricate scenarios involving Jacobian determinants.

Detailed Syllabus:

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: Calculating Limits and Examining Continuity-I
Practical 2: Calculating Limits and Examining Continuity-II
Practical 3: Derivatives and Rate of Change-I
Practical 4: Derivatives and Rate of Change-II
Practical 5: Sketching Curves in Cartesian and Polar Coordinate Systems
Practical 6: Lagrange's Multipliers-I
Practical 7: Lagrange's Multipliers-II
Practical 8: Computing Double Integral -I
Practical 9: Computing Double Integrals-II
Practical 10: Computing Triple Integrals -I
Practical 11: Computing Triple Integrals -II

Practical 12: Change of Variables-I
Practical 13: Change of Variables -II
Practical 14: Jacobian Determinant-I
Practical 15: Jacobian Determinant-II

Suggested Readings:

1. Ranjan Goyal and Mansi Dhingra, Programming in SCILAB, Alpha Science International Ltd, September 2018.
2. Micha¨el Baudin, Programming in Scilab, The Scilab Consortium-Digiteo, September 2011.
3. Think Python, book by Allen B. Downey, published by O'Reilly Media, second edition.
4. Essential MATLAB for Scientists and Engineers, book by Brian D. Hahn, 8^{th} edition
5. Maple: A Primer, book by Bernard V Liengme, 2019
6. The Mathematica Book, by Stephen Wolfram, Fifth Edition, published by Wolfram Media

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus

B.Sc. Mathematics (Major)

Title of the Course: Practical Based on Numerical Methods									
Year: II				Semester: III					
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks			
		Theory	Practical			CIE	ESE	Total	
SEC-3	BS-MT234P	00	02	02	60	15	35	50	

Learning Objectives:

1. Develop a proficient understanding of numerical methods and algorithms for solving mathematical problems using Scilab.
2. Apply numerical techniques to solve a variety of mathematical problems, including root-finding, interpolation, and differential equations.
3. Understand the principles of error analysis in numerical computations and apply techniques to minimize errors.
4. Develop the ability to choose appropriate numerical methods based on problem characteristics.

Course Outcomes (Cos):

1. To write Scilab programs and develop a small application project.
2. To write Scilab programming of the Regula-Falsi Method and Newton-Raphson Method.
3. To solve numerical integration of given functions by Scilab programming.
4. Exhibit critical thinking by evaluating the efficiency, accuracy, and stability of numerical algorithms for informed decision-making.

Detailed Syllabus:

Practical 1: Introduction to Scilab and Rounding Off.
(Scilab Basics, Rounding Off, and Error Analysis).
Practical 2: Scilab Programming and Matrix Operations
(Matrix Operations, Linear Systems in Scilab).
Practical 3: Scilab programming: Newton-Raphson Method.
(Implementation and Error Analysis for Newton-Raphson Method).
Practical 4: Scilab programming: Newton's forward interpolation formula.
Practical 5: Scilab programming: Newton's backward interpolation formula.
Practical 6: Scilab programming: Interpolation Techniques
(Newton's Divided Difference Interpolation, Lagrange Interpolation

Formula).

Practical 7: Scilab programming: Numerical Differentiation and Integration (Numerical Differentiation, Numerical Integration).

Practical 8: Scilab programming: Euler’s Method and Modified Euler’s Methods (Euler’s Method Implementation, Modified Euler’s Method).

Practical 9: Scilab programming: Runge-Kutta Methods.

Practical 10: Scilab programming: Linear Differential Equations with Constant Coefficients (Homogeneous Equations and Characteristic Equations, Particular Solutions and Initial Value Problem).

Practical 11: Solution of Algebraic and Transcendental Equations.

Practical 12: Interpolation.

Practical 13: Numerical Differentiation and Integration.

Practical 14: Numerical solution of first-order ordinary differential Equations.

Practical 15: Linear Differential Equations with constant coefficients.

Suggested Readings:

1. Micha¨el Baudin, Programming in Scilab, The Scilab Consortium-Digiteo, September 2011.
2. Ranjan Goyal and Mansi Dhingra, Programming in SCILAB, Alpha Science International Ltd, September 2018.
3. Sandeep Nagar, Introduction to Scilab: For Engineers and Scientists, Apress Publication, 2017.
4. Anil Kumar Verma, SCILAB: A Beginner's Approach, Cengage Learning India Pvt. Ltd., First Edition, 2018.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus

B.Sc. Mathematics (Major)

Title of the Course: Python Programming I								
Year: II				**Semester: III**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
FP-01	BS-MT235P	00	02	02	60	15	35	50

Learning Objectives:

1. To understand why Python is a useful scripting language for developers.
2. To learn how to use lists, tuples, and dictionaries in Python programs.
3. To learn and understand Python looping, control statements, and string manipulations.
4. To acquire programming skills in core Python.

Course Outcomes (Cos):

1. The student will be able to explain the basic principles of the Python programming language.
2. Students will demonstrate proficiency in writing Python code by applying fundamental programming concepts.
3. Students will exhibit proficiency in using conditional statements to make decisions in their Python programs.
4. The student will implement Python concepts to solve Linear Algebra problems.

Detailed Syllabus:

Unit I: Introduction to Python (08 Hrs)

1.1 Installation of Python.

1.2 Values and types: int, float, and str.

1.3 The Print Function: Print basics.

1.4 Variables: assignment statements, printing variable values, types of variables.

1.5 Mathematical Operators, operands and precedence: +, -, /, *, **, % PEMDAS (Rules of precedence).

1.6 String operations: + : Concatenation, * : Repetition.

1.7 Boolean operator:

a. Comparison operators: ==, !=, >, =, <=
b. Logical operators: and, or, not

1.8 Mathematical functions from math, cmath modules, random module

1.9 Keyboard input: input() statement.

1.10 Sympy module, Differentiation, Integration, and Limits in Python.

Unit II: String, List, Tuple (08 Hrs)

- 2.1 Strings:
  - 2.1.1. Length (Len function)
  - 2.1.2. String traversal: Using while statement, Using for statement
  - 2.1.3. String slice
  - 2.1.4. Comparison operators (>, <, ==)
- 2.2 Lists:
  - 2.2.1. List operations
  - 2.2.2. Use of range function
  - 2.2.3. Accessing list elements
  - 2.2.4. List membership and for loop
  - 2.2.5. List operations
  - 2.2.6. Updating list: addition, removal or updating of elements of a list
- 2.3 Tuples:
  - 2.3.1. Defining a tuple
  - 2.3.2. Index operator
  - 2.3.3. Slice operator
  - 2.3.4. Tuple assignment
  - 2.3.5. Tuple as a return value

Unit III: Iterations and Conditional statements (08 Hrs)

- 3.1 Conditional and alternative statements, Chained and Nested Conditionals: if, if-else, if-elif-else, nested if, nested if-else
- 3.2 Looping statements such as while, for, etc, Tables using while.
- 3.3 Functions:
  - 3.3.1 Calling functions: type, id
  - 3.3.2 Type conversion: int, float, str
  - 3.3.3 Composition of functions, Returning values from functions
  - 3.3.4 User defined Functions, Parameters, and arguments

Unit IV: Linear Algebra (06 Hrs)

- 4.1 Matrix construct, eye(n), zeros(n,m) matrices
- 4.2 Addition, Subtraction, Multiplication of matrices, powers and inverse of a matrix.
- 4.3 Accessing Rows and Columns, Deleting and Inserting Rows and Columns
- 4.4 Determinant, reduced row echelon form,
- 4.5 Roots of Equations, Newton-Raphson Method, Trapezoidal Rule, Simpson's 1/3rd Rule, Simpson's 3/8th Rule

Practical/Lab work to be performed in the Computer Lab.

List of the Practicals to be done using Python IDLE or Jupyter editor.

Practical 1: Introduction to Python and Python Data Types-I.
Practical 2: Python string operations, comparison operators and logical operators.
Practical 3: Problems on cmath modules, random modules and input functions.
Practical 4: Sympy module, Differentiation, Integration and Limits in Python.
Practical 5: Operations on Python Strings, List and Tuples.
Practical 6: User defined functions in Python.
Practical 7: Control statements in Python If-Else and Elif.
Practical 8: Control statements in Python for-loop and while-loop.
Practical 9: Use of control statements in Strings, List andTuple.
Practical 10: Matrices in Python and basic operations on it.
Practical 11: Determinants, row echelon form,
Practical 12: Application in finding Roots of equations and Numerical integration.

Suggested Readings:

1. Allen Downey, Think Python, How to Think Like a Computer Scientist, Green Tea Press, Needham, Massachusetts, 2015.
2. Lambert K. A., Fundamentals of Python - First Programs, Cengage Learning India, 2015.
3. Guzdial, M. J., Introduction to Computing and Programming in Python, Pearson India.
4. Perkovic, L., Introduction to Computing Using Python, 2/e, John Wiley, 2015.
5. Sandro Tosi, Matplotlib for Python Developers, Packt Publishing Ltd. (2009) BIRMINGHAM – MUMBAI. (Use for 2D and 3D plots and also use Lambert K. A book).
6. Python: Notes for Professionals, Goalkicker.com, Free Programming books.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus

B.Sc. Mathematics (Major)

Title of the Course: Linear Algebra								
Year: II				**Semester: IV**				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-09	BS-MT241 T	03	00	03	45	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 an orthonormal basis using Gram Schmidt orthogonalization process.
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 a 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 eigenvalues and eigenvectors of linear transformations.
4. Learn properties of inner product spaces and determine orthogonality in inner product spaces.
5. Obtain various variants of diagonalization of linear transformations.

Detailed Syllabus:

Unit I : Vector Spaces (14 Hrs)

1.1 Definitions and Examples.
1.2 Vector subspaces.
1.3 Linear Dependence and Independence.
1.4 Basis and Dimensions.
1.5 Row and column spaces.
1.6 Row rank and column rank.

Unit II : Linear Transformations (10 Hrs)

2.1 Definition and Examples.
2.2 Properties of Linear Transformation.
2.3 Linear transformation representation by a matrix.
2.4 Rank-Nullity Theorem.

Unit III : Inner Product Spaces (15 Hrs)

3.1 Definitions and Examples.
3.2 Norm and distance of vector.
3.3 Orthonormal Basis.
3.4 Gram Schmidt process of orthogonalization.

Unit IV : EigenValues and EigenVectors (06 Hrs)

4.1 Eigenvalues and eigenvectors.
4.2 Eigenspace.
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.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus

B.Sc. Mathematics (Major)

Title of the Course: Mathematical Transforms								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-10	BS-MT242 T	03	00	03	45	30	70	100

Learning Objectives:

1. Understand the motivation behind using Laplace and Fourier transforms in solving differential equations.
2. Learn the basic properties of the Laplace transform.
3. Compute the Laplace transforms of elementary functions.
4. Learn techniques for finding the inverse Laplace transform of a given function.
5. Understand the fundamental concepts of differential equations using Transforms.

Course Outcomes (Cos):

1. Solve a variety of linear ordinary differential equations using Laplace transforms.
2. Analyse the behaviour of linear time-invariant systems using Laplace transforms.
3. Compute inverse Laplace transforms to obtain time-domain solutions from Laplace domain representations.
4. Formulate and solve partial differential equations to model and analyse real-world

Detailed Syllabus:

Unit I : Laplace Transform (10 Hrs)

1.1 Definition – conditions for existence
1.2 Transforms of elementary functions
1.3 Properties of Laplace transforms – (Linearity property, first shifting property, second shifting property, transforms of functions multiplied by, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives)
1.4 Evaluation of integrals by using Laplace transform
1.5 Transforms of some special functions-periodic function, Heaviside-unit step function, Dirac delta function.

Unit II : Inverse Laplace Transform (10 Hrs)

2.1 Introductory remarks
2.2 Inverse transforms of some elementary functions
2.3 General methods of finding inverse transforms

2.4 Partial fraction method and Convolution Theorem for finding inverse Laplace transform

Unit III : The solution of differential equations using Laplace transforms (12 Hrs)

3.1 Procedure to solve differential equations by using Laplace transforms
3.2 Worked problems on solving Differential equations using Laplace transforms
3.3 Procedure to solve Simultaneous differential equations using Laplace transforms
3.4 Worked problems on solving Simultaneous differential equations by using Laplace transforms

Unit IV : Fourier Transform (13 Hrs)

4.1 Definitions – integral transforms.
4.2 Fourier integral theorem.
4.3 Fourier sine and cosine integrals.
4.4 A complex form of Fourier integrals.
4.5 Fourier sine and cosine transforms.
4.6 Properties of Fourier transforms.
4.7 Parseval's identity for Fourier Transforms.

Suggested Readings:

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
6. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar (Autonomous)

Syllabus

B.Sc. Mathematics (Major)

Title of the Course: Practical based on Linear Algebra								
Year: II			**Semester: IV**					
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
DSC-11	BS-MT 243P	00	02	02	60	15	35	50

Learning Objectives:

1. Learn Free and Open Source Software (FOSS) tools for computer programming.
2. Solve problems on Linear algebra by using FOSS softwares.
3. Acquire knowledge of applications of linear algebra through FOSS.
4. Knowledge of application of mathematics

Course Outcomes (Cos):

1. Learn Mathematical software.
2. Problem solved on linear algebra by using software.
3. Knowledge of application of mathematics.
4. Develop the short programs by using software.

Detailed Syllabus:

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: 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 Inner product of vectors

Practical 8: Computation of norm and normalized vectors

Practical 9: Computation of Trace, Determinant and Inverse of matrices

Practical 10: Computation of eigenvalues and eigenvectors

Practical 11: Diagonalization of matrices using software

Practical 12 : Vector Spaces
Practical 13: Linear Transformations
Practical 14: Inner Product Spaces
Practical 15: Eigenvalues and Eigenvectors

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, 8^{th} edition
4. Maple: A Primer, book by Bernard V Liengme, 2019
5. The Mathematica Book, by Stephen Wolfram, Fifth Edition, published by Wolfram Media

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's
New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Mathematics (Major)

Title of the Course: Practical based on Mathematical Transforms using SageMath								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
VSC-2	BS-MT 244P	00	02	02	60	15	35	50

Learning Objectives:

1. Develop a fundamental understanding of Laplace transforms, including the definition, properties, and applications in solving linear ordinary differential equations (ODEs).
2. Acquire the ability to apply Laplace transforms to solve differential equations with a focus on practical problem-solving skills.
3. Explore the properties and applications of special functions within the context of Laplace transforms, including the use of transform tables for efficient problem-solving.
4. Gain proficiency in finding inverse Laplace transforms for elementary functions, understanding the importance of this skill in solving real-world problems.

Course Outcomes (Cos):

1. Laplace transforms effectively for solving linear ODEs and related problems, demonstrating strong analytical and problem-solving skills.
2. Understand the properties and applications of special functions within Laplace transforms, enabling the handling of complex mathematical scenarios.
3. Find inverse Laplace transforms for various elementary functions, effectively reversing the transformation process to obtain original functions.
4. Solve a variety of differential equations using Laplace transforms, translating real-world problems into mathematical models and solutions.

Practical/Lab work to be performed in the Computer Lab.

List of the Practicals to be done on SageMath.

Practical 1: Introduction to SageMath
Practical 2: Laplace Transform
Practical 3: Properties of Laplace transforms
Practical 4: Special Functions
Practical 5: Inverse transforms of some elementary functions
Practical 6: Partial Fractions-I

Practical 7: Partial Fractions-II
Practical 8: Solution of differential equations-I
Practical 9: Solution of differential equations-II
Practical 10: Solving Simultaneous differential equations-I
Practical 11: Solving Simultaneous differential equations-II
Practical 12: Fourier sine integrals
Practical 13: Fourier cosine integrals
Practical 14: Fourier sine transforms
Practical 15: Fourier cosine transform

Suggested Readings:

1. William Granville and David Joyner. Differential Calculus and Sage. CreateSpace, 2009.
2. William Stein and others. Sage Tutorial. CreateSpace, 2009.
3. Craig Finch. Sage Beginner's Guide. Packt Publishing, 2011.
4. David Joyner and Marshall Hampton. Introduction to Differential Equations Using Sage. Johns Hopkins University Press, 2012.
5. Gregory V. Bard. Sage for Undergraduates. American Mathematical Society, 2014.

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

New Arts, Commerce and Science College, Ahmednagar
(Autonomous)
Syllabus
B.Sc. Mathematics (Major)

Title of the Course: Python Programming II								
Year: II				Semester: IV				
Course Type	Course Code	Credit Distribution		Credits	Allotted Hours	Allotted Marks		
		Theory	Practical			CIE	ESE	Total
CFP-01	BS-MT245P	00	02	02	60	15	35	50

Learning Objectives:
1. To learn and understand Python programming basics and paradigms.
2. To acquire Object-Oriented Skills in Python.
3. To develop the skill to solve Operational Research problems in Python.
4. To learn the concepts of visualization of data and database connectivity.

Course Outcomes (Cos):
1. Students will learn basic concepts of dictionary data type in Python.
2. Demonstrate the use of Python in Mathematics such as operations research and computational Geometry etc.
3. Study graphics and design and implement a program to solve a real-world problem.
4. The students will implement the concepts of data with Python and interpret from data visualization.

Detailed Syllabus:

Unit I : Dictionary and Sorting, Minimum and Maximum (08 Hrs)
1.1 Introduction to Dictionary, Avoiding Key Error Exceptions, Iterating Over a Dictionary.
1.2 Dictionary with default values, merging dictionaries, Accessing keys and values, accessing values of a dictionary, creating a dictionary.
1.3 Creating an ordered dictionary, unpacking dictionaries using the ** operator.
1.4 Sorting, Minimum and Maximum: Special case: dictionaries, Using the key argument, Default Argument to max, min.
1.5 Getting a sorted sequence, Getting the minimum or maximum of several values.

Unit II : 2D and 3D Graphs (08 Hrs)
2.1 Installation of NumPy, and Matplotlib packages.
2.2 Graphs plotting of functions, Different formats of graphs.
2.3 Markers and line styles, Control colors, Specifying styles in multi-line plots,
2.4 Control line styles, Control marker styles.

2.5 Three-dimensional Points and Lines
2.6 Three-dimensional Contour Plots, Wireframes, and Surface Plots.

Unit III : Data Visualization with Python (06 Hrs)

3.1 NumPy, Pandas, basics of File handling
3.2 Data Visualization in Seaborn
3.3 Graph plotting and visualization Matplotlib

Unit IV : Computational Geometry and Operational Research in Python (08 Hrs)

4.1 Points: distance between two points, Lists of Points, Integer point lists, Ordered
4.2 Point sets, Extreme Points of a PointList.
4.3 Displaying Points and other geometrical objects, the geometry of line segments, displaying lines, rays, and line segments.
4.4 Polygon: Representing polygons in Python, Triangles, Signed area of a triangle, relationships of points to lines is Collinear, is Left, is Left On, is Right, is Right

Practical/Lab work to be performed in the Computer Lab.

List of the Practicals to be done using Python IDLE or Jupyter editor.

Practical 1: Basics of Dictionary data type and operations on it.
Practical 2: Iterating over Dictionaries by indexing.
Practical 3: Merging Dictionaries with different commands
Practical 4: Creating an Ordered Dictionary, Getting keys and values in the Dictionary.
Practical 5: Basics of NumPy and problems on NumPy package.
Practical 6: Basics of MatplotLib and problems on MatplotLib package.
Practical 7: Graphs of functions using MatplotLib, Markers, line styles and colors.
Practical 8: Plotting three-dimensional Contour Plots, Wireframes and Surface Plots.
Practical 9: Basic commands in Pandas to import CSV files and file handling.
Practical 10: Accessing rows and columns of data files
Practical 11: Plotting scatter plot, Line Plot, Histogram, and Heatmap in Seaborn, Plotting scatter plot and line Plot in MatplotLib.
Practical 12: Distance between two points, Lists of Points, Lines, rays, and line segments. representing polygons in Python, Triangles, the Area of a triangle, is Collinear.

Suggested Readings:

1. Kenneth A. Lambert, Fundamentals of Python: From First Programs to Data Structure, Martin Osborne, 2010, Course Technology, Cengage Learning.
2. Python: Notes for Professionals, Goalkicker.com, Free Programming books.
3. Jim Arlow, Interactive Computational Geometry in Python.
4. Operations Research: https://pypi.org/project/PuLP/
5. Guzdial, M. J., Introduction to Computing and Programming in Python, Pearson India.
6. Perkovic, L., Introduction to Computing Using Python, 2/e, John Wiley, 2015.
7. Robert Johansson, Introduction to Scientific Computing in Python.