M.Sc. APPLIED MATHEMATICS (THIRD SEMESTER)
21AM-301: MEASURE THEORY
(With effect from 2021-2022 Admitted Batch)
Course Code:21AM301

(A total of Ten questions to be set by selecting two questions from each unit with internal choice. Each question carries 16 marks.)

Course outcomes (COs): At the end of the course, the students will be able to :

CO1: Apply the knowledge of concepts of functions of several variables and measure theory in order to study theoretical development of different mathematical concepts and their applications.

CO2 :Understand the nature of abstract mathematics and explore the concepts in further details.

CO3:Recognize the need of concept of measure from a practical view point.

CO4: Understand measure theory and integration from theoretical point of view and apply its tools in different fields of applications.

CO5: Extend their knowledge of Lebesgue theory of integration by selecting and applying its tools for further research in this and other related areas.

Course Specific outcomes (CSOs):

CSO1: Learn about measuring an object through the concept of outer measure, measurable set, non-measurable set.

CSO2: Learn Lebesgue integral of a function**.**

CSO3: Learn about Banach space and properties.

Learning outcomes(LOs):

LO1: By the end of the course the student is familiar with the basic concepts and results of Lebesgue measure theory (outer measure, measurable sets and connections with topology, Borel sigma algebra) as well as of Lebesgue theory of integrals (measurable functions, convergence theorems).

LO2 : The student masters' basic concepts from measure theory, including sets of measure zero, measurable functions, the Lebesgue integral and Lebesgue spaces.

LO3: The student has an overview of the central results of the theory of Lebesgue integration, including convergence theorems and Fubini's theorem.

LO4: They will learn about the classical Banach space and Its properties.

LO5: Existence of functionals on Banach spaces.

Mapping of course outcomes with the program outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	
CO2	✓		✓	✓	
CO3	✓	✓	✓		
CO4	✓	✓		✓	
CO5	✓	✓	✓	✓	

Unit-I

Lebesgue Measure: Introduction to Outer measure, Measurable sets and Lebesgue measure, A nonmeasurable set, Measurable functions, Littlewood's three principles. (Chapter 3 of Text book)

Unit-II

The Lebesgue Integral: The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure. The integral of a nonnegative function. The general Lebesgue integral, Convergence in measure. (Chapter 4 of Text book).

Unit-III

Differentiation: Differentiation of Monotone functions, Functions of bounded variation. (Section 1, 2 of Chapter 5 of Text book)

Unit-IV

Integration: Indefinite integral of a function, Absolute continuity, convex functions. (Section 3, 4 of Chapter 5 of Text book)

Unit-V

The classical Banach Spaces: The L_p spaces, The Holder and Minkowski inequalities, Convergence and completeness, Bounded linear functionals on the L_p spaces. (Chapter 6 of Text book)

<u>Text Book</u>: Real Analysis, H.L. Royden – Macmillan publishing Comp.

M.Sc. APPLIED MATHEMATICS(THIRD SEMESTER)
21AM 302: PROGRAMMING IN PYTHON
(With effect from 2021-2022 Admitted Batch)
Course Code:21AM302

(A total of ten questions are to be set taking two questions from each unit with internal choice in each unit. Each question carries 16 marks.)

Course Outcome(COs):

CO1: This course introduces computer programming using the Python programming language which will help you to master the Programming with Python.
CO2: Introducing the Object Oriented programming concepts, creation of Data Structures.
CO3: Acquiring the basic knowledge of writing scripts using Python libraries and OOPs concepts.
CO4: Lastly you will get into design, code, test, and debug Python programming Language Scripts.
CO5: Increases the subject knowledge that helps in pursuing higher studies as well as getting employment.

Course Specific Outcome(CSOs):

CSO1: Study on the basic concepts ofobject oriented programming, data structures and various Python libraries.
CSO2: Introduction to Scripting Language.
CSO3: Exposure to various problems solving approaches of Applied Mathematics, computer science and information Technology.

Learning Outcome(LOs):

LO1: After studying the course, the students are expected to learn some basic concepts of object oriented programming, data structures and various Python libraries.
LO2: Learns to apply data structures concepts for programs and scripts writing using Python programming.
LO3: Gains knowledge and orientation for applying the knowledge for Python programming.
LO4: Helps in getting employment in various software companies as well as in higher educational institutions.

Mapping of course outcomes with the program outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓		✓	
CO2			✓		
CO3	✓		✓		
CO4	✓	✓		✓	✓
CO5		✓		✓	✓

Unit 1. Introduction and fundamentals of Python

Introduction: What Is a Program?, Programming Languages, Installing Anaconda Python Distribution, Installing PyCharm IDE to Set Up a Python Development Environment Creating and Running Your First Python Project, Installing and Using Jupyter Notebook, Open Source Software

Parts of Python Programming Language, Identifiers, keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language

Unit 2.Control Flow and functions

Control Flow: if, if…else , if…elif…else, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Catching Exceptions Using try and except Statement

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments

Unit 3.Strings and lists

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods,The del Statement, Use of numpy and pandas: basics

Unit 4.Dictionaries, Tuples and Sets

Dictionaries: Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods,The del Statement

Tuples and Sets: Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Using zip() Function, Sets, Set Methods, Traversing of Sets, Frozenset

Unit 5.Files and OOP fundamentals

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, OS paths.

OOP fundamentals: classes and objects, constructors, encapsulation, inheritance and polymorphism

TextBook

1) Introduction to Python Programming*Gowrishankar S.* and *Veena A.* and published by CRC Press/Taylor and Francis, Boca Raton, USA.

Reference Books:

1) Fundamentals of Python First programs, K Lambert et al, Cengage

2) Python Programming: A modern approach, VamsiKurama, Pearson

M.Sc. APPLIED MATHEMATICS (THIRD SEMESTER)
21AM-302: TECHNIQUES OF APPLIED MATHEMATICS
(With effect from 2021-2022 Admitted Batch)
Course Code:21AM302

(A total of Ten questions to be set by selecting two questions from each unit with internal choice. Each question carries 16 marks.)

Course outcomes(COs):

CO1: Familiar with the theory and applications of difference calculus, first order homogeneous difference equations .

CO2: Familiar with theory of non homogeneous difference equations and applications.

CO3: Familiar with theory and applications of system of difference equations.

CO4: Familiar with discrete transformations and its applications.

CO5: Familiar with optimizations by the method of calculus of variations.

Course Specific Outcomes(CSOs):

CSO1: Theory and applications of homogeneous and non homogeneous difference equations

CSO2: System of difference equations and its applications to certain models.

CSO3: Utilizing the applications of Z-transforms in solving difference equations.

Learning Outcomes(LOs):

LO1: Able to formulate and solving the homogeneous difference equations

LO2: Able to apply the theory of non homogeneous difference equation.

LO3: Able to find the relation between higher order difference equations and system of equations

LO4: Able to apply the discrete transformations in solving difference equations.

LO5: Able to apply the tools in calculus of variations in optimizing certain physical problems.

Mapping of course outcomes with the program outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	
CO2	✓	✓		✓	
CO3	✓	✓	✓		
CO4	✓		✓	✓	
CO5	✓	✓	✓	✓	

Unit-1

Difference equations: Introduction, Linear first order difference equations, Important special cases, Basics of difference calculus, General theory of difference equations, first order difference equations explained through examples, steady-state and stability, linear homogeneous equations with constant coefficients. (Chapter 1-sections 1.1, 1.2 & Chapter 2 – sections 2.1 to 2.3 of Text book 1)

Unit-II

Non-homogeneous equations, method of undetermined coefficients, Limiting behavior of solutions, Non-linear equations transformable to linear equations system of linear difference equations, Applications. (Chapter 2 – sections 2.4 to 2.7 of Text book 1)

Unit-III

System of linear difference equations : Autonomous systems, Discrete analogue of the Putzer algorithm, Algorithm for A^n, The basic theory, The Jordan form, Linear periodic systems. (Chapter 3-sections 3.1 to 3.4 of Text book 1)

Unit-IV

Z-transform methods, definition with examples, properties of Z-tranforms, inverse Z-transforms, solution to difference equations by Z-transform method. (Chapter 6-Section 6.1, 6.2of Text book 1),

Unit-V

Calculus of variations : Euler's equations, functions of the form $\int_{x_0}^{x_1} F(x, y_1, y_2 \ldots y_n, y_1', y_2' \ldots y_n')dx$. Functional dependence on higher order derivatives, variational problems in parametric form and applications (Chapter VI of Text book 2).

Text books:

1. An introduction to difference equations by Saber Elaydi, Springer Publisher, Third Edition.
2. L. Elsgolts: Differential equations and calculus of variations, Mir Publishers, Moscow.

M.Sc. APPLIED MATHEMATICS (THIRD SEMESTER)
21AM 304(A): BOUNDARY VALUE PROBLEMS-I
(With effect from 2021-2022 Admitted Batch)
Course Code:21AM304(A)

(A total of Ten questions to be set by selecting two questions from each unit with internal choice. Each question carries 16 marks.)

Course Outcomes(COS) :

CO1: The quantitative properties theory on Differential equations taught in detailed. Existence and Uniqueness of solution for Initial value problem and certain results on solutions dependence on initial conditions and parameters to be learn.

CO2: The system of first order homogeneous and non homogeneous equations and their solution space are discussed.

CO3: The adjoint vector and scalar equations and their relations are to be established. A procedure to determine Fundamental matrix to be developed for various types of eigenvalues.

CO4: The homogeneous and non homogeneous two point boundary value problems and their solutions in terms of Green's matrix/function to be learned.

CO5: As an application Controllability and observability of the system to be taught in detailed.

Course Specific Outcomes(CSOs):

CSO1: The relation between higher order differential equations and system of equations and results on them are discussed.

CSO2: The Boundary value problems and their solutions for system of equations and higher order scalar differential equations , scalar and vector adjoint boundary value problems are discussed.

CSO3: Linear control systems, Controllability and observability of the systems and its applications to real world problems are discussed.

Learning Outcomes(LOs):

LO1:Familiar with the quantitative properties of differential equations like what are the conditions are required for the existence and uniqueness of solutions of initial value problems and their properties.

LO2:Various results on adjoint vector , scalar equations and determining the fundamental matrix of the system of equations are to be familiar.

LO3: Understanding the Results on Homogeneous Boundary value problems associated with vector and higher order differential equations and their index of compatibility.

LO4:Able to express the solutions of non homogeneous boundary value problems associated with vector and scalar equations in terms of Green's matrix and Green's function and familiar with properties of above functions.

LO5: Familiar with the concepts of Controllability and observability and their applications.

Mapping of course outcomes with the program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	✓		✓	✓	
CO2	✓		✓	✓	
CO3	✓		✓	✓	
CO4	✓		✓	✓	
CO5	✓		✓	✓	

UNIT - I

Elementary Topology on Metric spaces: Mappings on metric spaces, Existence and uniqueness theorem via the principle of contraction. Continuation of solutions, Dependence of solutions on initial conditions and on parameters.

(Chapter 2 of text book I)

UNIT - II

General theory for linear first order system of equations, solution space, The non-homogeneous equation. The nth order linear homogeneous equation, The nth order non-homogeneous equation, The adjoint vector equation, The adjoint nth order equation, The relationship between scalar and vector adjoints. **(Chapter 3 of text book I)**

UNIT - III

Linear equation with constant coefficients, Real distinct eigenvalues, The general solution. Direct solutions, Real solutions associated with complex eigenvalues. The two point boundary value problem: The two point homogeneous boundary value problem, the adjoint boundary value problem.

UNIT - IV

The non-homogeneous boundary value problem and Green's matrix. The nth order boundary value problem, The nth order adjoint boundary value problem, the nth order non-homogeneous boundary value problems and Green's function. Self-adjoint boundary value problem

(Chapter 4, Section: 4.1, 4.2, 4.3, and Chapter 6 of text book l)

UNIT - V

Linear Control System: Controllability, Observability, Controllability and Polynomials, linear feed back, state observers, Relization of constant systems.

(Chapter 4 of text book 2)

Text books:

1. Theory of Ordinary differential equations, Randal H.Cole Appleton-Century-Crafts, New York (1968)

2. Introduction to Mathematical Control Theory, S.Barnett, R.G.Camaron, Clarendon Press, 1985.

Reference book: Theory of Ordinary differential equations by E.A. Coddington and Normal Levinson, Tata Mcgraw Hill Inc., New York (1980)

M.Sc. APPLIED MATHEMATICS(THIRD SEMESTER)

21AM305(B)OPTIMIZATION TECHNIQUES-I

(With effect from 2021-2022 Admitted Batch)

Course Code:21AM305(B)

(A total of ten questions are to be set taking two questions from each unit with internal choice in each unit. Each question carries 16 marks.)

Course Outcome(COs):

CO1: This course introduces some concepts of Operations Research some important optimization techniques which will help the students to master the skills in optimization.

CO2: Provides an in-depth knowledge of problem solving through various optimization techniques.

CO3: Tests and develops the students' knowledge of basic understanding of the problems through practical illustrations and examples and learn the basic concepts of Linear Programming, solution of LP problems.

CO4: Improves the logical thinking ability of the students and helps gain access to various employment opportunities.

CO5: Infuses practical knowledge that helps in pursuing higher studies as well as getting employment.

Course Specific Outcome(CSOs):

CSO1:Study on some optimization techniques like Linear Programming their solutions by simple methods.

CSO2:Gain knowledge of finding maximum or minimum for many real problems arising in Transportation, Assignment problems.

CSO3:Exposure to various problem solving approaches of dynamic programing and non-linear programming techniques.

Learning Outcome:

LO1: After studying this course, the students are expected to learn some techniques problem solving like simplex method, revised simplex method, transportation problem solving, assignment problem, etc.

LO2: Gains understanding of the practical problems and motivation for improvement.

LO3: Gains knowledge in various optimization techniques, dynamic programming, etc.

LO4: Gain ability to problem formulations, analysis and solution techniques.

LO5: Gain knowledge in computational skills and numerical problem solving.

Mapping of course outcomes with the program outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓			
CO2			✓		
CO3			✓		
CO4	✓			✓	✓
CO5		✓		✓	✓

Unit-I

Linear Programming anits Applications: Formulation of L.P. problems, slack and surplus variables, convex sets, simplex method, artificial variables techniques, big M-method, degeneracy, revised simplex method. (Chapter I (expect 1,3),Chapter II, Chapter III, Chapter IV of unit 2 and Appendix – A of Unit-6 of text book 1)

Unit-II

Duality in linear programming, the dual simplex method, Integer linear programming, Gomory's cutting plane method, branch and bound method (Chapter V, Chapter VI and Chapter VIII of unit –2 of text book 1)

Unit-III

Assignment models, Hungarian method, the traveling salesman problem, transportation models, methods for initial basic feasible solutions, MODI method, degeneracy in transportation problems. (Chapter IX, Chapter X, of unit 2 of text book1)

Unit-IV

Dynamic programming, concepts of dynamic programming, Bellman's principle of optimality, simple models(7.1 to 7.9 of Chapter VII of unit 5 of text book 1)

Unit-V

Non-linear programming-One dimensional minimization methods: Fibonacci method, Golden section method, unconstrained optimization techniques: Hooke and Jeeves' method -descent methods-gradient of a function, steepest descent(Cauchy) method, conjugate gradient (Fletcher-Reeves) method, Newton method, Marquardt method, Quasi-Newton method
(Chapter 5 - 5.7, 5.8 Chapter 6- 6.6, 6.10 to 6.15 of text book 2)

Text book: 1.S.D. Sharma, Operations Research, KedarnathRamnath& Company.

2. Optimization Theory and Applications by S. S. Rao, Wiley Eastern Limited,second edition.

Reference book: Linear Programming by G. Hadley, Oxford, IBH publishing Co.

M.Sc. APPLIED MATHEMATICS (THIRD SEMESTER)
21AM 306(C): RELATIVITY AND COSMOLOGY-I
(With effect from 2021-2022 Admitted Batch)
Course Code:21AM306(C)

(A total of ten questions are to be set taking two questions from each unit with internal choice in each unit. Each question carries 16 marks.)

Course Outcomes(COs): At the end of the course, the students will be able to

CO1: Describe the concept of Tensor and their properties.

CO2: Describe the concepts flat space and space of constant curvature.

CO3: Explain the meaning and significance of the postulate of Special Relativity.

CO4: Explain true nature of Lorentz transformation and their consequences.

CO5: Explain relativistic transformation equations for mass, work and kinetic energy.

Course Specific Outcomes(CSOs):

CSO1: Develops ability to solve mathematical problems involving vectors and tensors.

CSO2: Competently use vector and tensor algebra as a tool in the field of applied sciences and related fields.

CSO3: Provide advanced knowledge on topics in mathematical physics, empowering the students to pursue higher degrees at reputed academic/research institutions.

Learning Outcomes(LOs): Upon successful completion of this course, it is intended that a student will be able to

LO1: Know the fundamental mathematics of vector and tensor that are important for higher learning.

LO2: Understand the effect of co-ordinate transformations. Also, students shall learn the advanced concepts of tensor calculus, which will be useful in theory of relativity.

LO3: Demonstrate knowledge and broad understanding of Special Relativity.

LO4: Understand the meaning of relativity (as a coordinate symmetry) and the key role played by Einstein's new conception of space and time in its formulation.

LO5: Learn to use 4D tensors (such as 4- position, 4-derivative, 4-momentum, and electromagnetic field tensor and energy-momentum-stress tensor, etc.) to construct relativistic equations.

Mapping of course outcomes with the program outcomes					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	√	√	√	-	-
CO2	√	√	√	-	-
CO3	√	-	√	√	-
CO4	√	-	√	√	-
CO5	√	-	√	√	-

Unit-I

Tensor Analysis: N-dimensional space, covariant and contravariant vectors, contraction, second & higher order tensors, quotient law, fundamental tensor, associate tensor, angle between the vectors, principal directions, Christoffel symbols, covariant and intrinsic derivatives, geodesics (Chapters 1 to 4 of Text book.1).

Unit-II

Riemann Christoffel Tensor, covariant curvature tensor and its properties, Ricci Tensor, Curvature invariant, Einstein space, Bianchi's identity, Riemannian Curvature, Einstein space, flat space, space of constant curvature, Schur's Theorem (Chapter V of Text book.1).

Unit-III

Space-time continuum, the three plus one dimensions of space-time, the geometry corresponding to space-time, the signature of the line element and the three kinds of interval, Lorentz rotation of axes, transformation to proper coordinates (Chapter II, Articles 13-18 of Text book 2).

Unit-IV

The mass of a moving particle, the transformation equations for mass, work and kinetic energy, the relations between mass, energy and momentum, Four-dimensional expressions of the mechanics of a particle (Chapter III, Articles 23-28 of Text book 2).

Unit-V

The Maxwell-Lorentz Field Equations, The transformation equations for E, H and Q. The force on a moving charge, The energy and momentum of electromagnetic field, electromagnetic stresses, Four dimensional expressions for electron theory (Chapter IV, Articles 39-43 & 46 of Text book 2).

Text Books:

1. Barry Spain, Tensor Calculus-Radha Publishing House, Calcutta.
2. R.C. Tolman, Relativity, Thermodynamics and Cosmology, Clarendon Press, Oxford.

Books for further reference:

1. Introduction to Special Relativity by Robert Resnick, Johnwiley & Sons, New York.
2. Theory of Relativity by S.R. Roy and Raj bali Jaipur Publishing House, Jaipur.
3. J.K. Goyal and K.P. Gupta, Theory of Relativity, Krishna Prakasan Media(P) Ltd., Meerut.

M.Sc. APPLIED MATHEMATICS (THIRD SEMESTER)
21AM 307(D): Numerical solution of Partial Differential Equations-I
(With effect from 2021-2022 Admitted Batch)
Course Code:21AM307(D)

(A total of Ten questions to be set by selecting two questions from each unit with internal choice. Each question carries 16 marks.)

Course outcomes (COs):

On completion of this course, the students will have the ability to

CO1: learn to make a connection between the mathematical equations or properties and the corresponding physical meanings.
CO2: learn the connection between the exact relationship between derivatives and finite difference operators (Delta operators)
CO3: learn the principles for designing numerical schemes, both explicit and implicit, based on finite difference methods for PDEs.
CO4: analyze the numerical methods (schemes) for consistency, stability and convergence of a numerical scheme.
CO5: know, for each type of PDEs (hyperbolic, parabolic and elliptic), what kind of numerical methods are best suited and the reasons behind these choices.

Course Specific outcomes (CSOs):

CSO1: Learn about Elliptic PDEs and finding its solution numerically.
CSO2: Learn about Parabolic PDEs and finding its solution numerically.
CSO3 : Learn about Hyperbolic PDEs and finding its solution numerically.

Learning Outcomes (LOs):

LO1: This course is designed to prepare students to solve mathematical models represented by initial or boundary value problems involving partial differential equations that cannot be solved directly using standard mathematical techniques.
LO2: Students are introduced to the discretization methodologies, with particular emphasis on the finite difference method, that allows the construction of accurate and stable numerical schemes.
LO3 :In depth discussion of theoretical aspects such as stability analysis and convergence will be used to enhance the students' understanding of the numerical methods.
LO4: They will be able to construct stable numerical methods for solving problems in science, engineering, option pricing.
LO5: They will be able to identify different methods for different type of PDEs.

Mapping of course outcomes with the program outcomes:

	PO1	PO2	PO3	PO4	PO5
CO1	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓
CO3	✓	✓	✓	✓	✓
CO4	✓	✓	✓	✓	✓
CO5	✓	✓	✓	✓	✓

Unit-I

Numerical solutions of ODEs: General feature of Initial-Value ODEs. Basic Discretization methods: Taylor series method, Euler methods- Explicit and Implicit approaches. Consistency, stability, and convergence. (Chapter 7 of Textbook 1)

Unit-II

Numerical solutions of elliptic PDEs: General feature of elliptic PDEs. Finite difference approximation of Laplace equation. Consistency, and convergence. Iterative methods of solutions. Finite difference approximation of Poisson equation. (Chapter 9 of Textbook 1; Chapter 4 of Textbook 2)

Unit-III

Numerical solutions of parabolic PDEs: General feature of parabolic PDEs, Classification of 2^{nd} order PDEs in two independent variables via Characteristics. Parabolic equations in 1-D: Explicit and implicit finite difference schemes, Truncation error and consistency, Stability analysis (matrix method, maximum principle, Fourier analysis). (Chapter 11 of Textbook 1; Chapter 2 of TextBook 2)

Unit-IV

Parabolic Problems in 2-Dimension, Maximum principle and convergence, Lax equivalence theorem, general boundary conditions, multilevel difference schemes, explicit and implicit methods, ADI methods. (Chapter 11 of Textbook 1; Chapter 2 of TextBook 2)

Unit-V

Numerical solutions of hyperbolic PDEs: General feature of hyperbolic PDEs. Method of characteristics. FTCS, upwind, Lax, BTCS, Lax-Wendroff methods. Consistency, stability, and convergence. (Chapter 12 of Textbook 1; Chapter 3 of Textbook 2)

Text Books:

1. J. D. Hoffman, Numerical methods for Engineers and Scientists, McGraw Hill, 1993.
2. M.K. Jain, S.R.K. Iyengar, Computational Methods for Partial Differential Equations, New Age International, 2005.

Reference Books:

1. G. D. Smith, Numerical Solutions to Partial Differential Equations: Finite Difference Methods, Oxford University Press, 3rd Edn., 1986.
2. K. W. Morton and D. F. Mayers, Numerical Solution of Partial Differential Equations, Cambridge University Press, 2nd Edn., 2005
3. C. Strikwerda, Finite Difference Schemes and Partial Differential Equations, SIAM, 2004.
4. R. L. Burden and J. D. Fairs, Numerical Analysis, Brooks/Cole, 2001

LAB - PYTHONPROGRAMMING
Code:AMPR301

Course Outcome:

CO1: This course introduces computer programming using the Python programming language which will help you to master the Programming with Python.

Learning Outcome:

LO1: Learns to apply different concepts of data structures and apply them for preparing modules/scripts using Python programming.

LIST OF PROGRAMS

1. Write a program to compute HCF/GCD of two given numbers.
2. Write a program to check whether a number is prime or not .
3. Write a program to find the largest of n numbers using functions.
4. Write a program to convert binary to decimal number.
5. Write a program to generate and print the Fibonacci sequence.
6. Write Python program to count the total number of vowels, consonants and blanks in a given string.
7. Write a program to print the given number in reverse order and test for palindrome.
8. Write a python program to find the factorial of a given number using recursive function.
9. Write Python program to sorting of numbers in ascending or descending order.
10. Program for generating reports for student name with marks using lists.
11. Python program to solve quadratic equation.
12. Program to find the transpose of a matrix.
13. Program to find the product of two matrices.
14. Write a Python program to create a dictionary.