Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati

Autonomous

Course Structure for B.Sc. Mathematics (2022 Pattern)

F. Y. B. Sc. Mathematics

Semester	Course Code	Title of Course	No. of Credits	No. of Lectures
I	USMT111	Algebra	2	36
	USMT112	Calculus	2	36
	USMT113	Practical based on USMT111 and USMT112	2	48
II	USMT121	Geometry	2	36
	USMT122	Calculus and Differential Equations	2	36
	USMT123	Practical based on USMT121 and USMT122	2	48

S. Y. B. Sc. Mathematics

Semester	Course Code	Title of Course	No. of Credits	No. of Lectures
III	USMT231	Calculus of Several Variables	3	48
	USMT232	Laplace Transform & Fourier Series	3	48
	USMT233	Practical based on USMT231 and USMT232	2	48
IV	USMT241	Vector Calculus	3	48
	USMT242	Linear Algebra	3	48
	USMT243	Practical based on USMT241 and USMT242	2	48

T.Y.B.Sc Mathematics

Semester	Course Code	Title of Course	No. of Credits	No. of Lectures
V	USMT351	Metric Spaces	3	48
	USMT352	Real Analysis I	3	48
	USMT353	Group Theory	3	48
	USMT354	Ordinary Differential Equation	3	48
	USMT355	Number Theory	3	48
	USMT356(A)	Operation Research	3	48
	USMT356(B)	C Programming	3	48
	USMT357	Practical based on USMT351 and USMT352	2	48
	USMT358	Practical based on USMT353 and USMT354	2	48
	USMT359	Practical based on USMT355 and USMT356	2	48
VI	USMT361	Complex Analysis	3	48
	USMT362	Real Analysis II	3	48
	USMT363	Ring Theory	3	48
	USMT364	Partial Differential Equation	3	48
	USMT365	Lebesgue Integration	3	48
	USMT366(A)	Optimization Techniques	3	48
	USMT366(B)	Python Programming	3	48
	USMT367	Practical based on USMT361, USMT362, and USMT363	2	48
	USMT368	Practical based on USMT364, USMT365, and USMT366	2	48
	USMT369	Mathematics Project	2	48

Class: T.Y.B.Sc. (Semester – V)
Course Code: USMT 351
Course: 1 **Title of the Course:** Metric Spaces
Credit: 2 **No. of Lectures:** 36

Course Objectives

1. Develop a rigorous understanding of metric spaces as a foundation for advanced analysis.
2. Learn to define and manipulate distances in metric spaces.
3. Grasp the concepts of convergence and completeness in metric spaces.
4. Explore the topological properties of metric spaces, including open and closed sets, subspaces, and separation axioms.
5. Analyze continuity and its variations (uniform continuity, homeomorphism) in the context of metric spaces.
6. Investigate connectedness and its different forms (connected, locally connected, arcwise connected) in metric spaces.
7. Introduce the concept of compactness in metric spaces and its applications**.**

Course Outcomes

1. Students will be able to define a metric space and provide examples of common metric spaces.
2. Students will be able to prove statements about distances in metric spaces and use them to solve problems.
3. Students will be able to determine the convergence of sequences in a metric space and identify Cauchy sequences.
4. Students will be able to explain the concept of completeness and demonstrate its importance in metric spaces.
5. Students will be able to define open and closed sets in a metric space and prove basic theorems related to them.
6. Students will be able to analyze the continuity of functions between metric spaces and apply extension theorems.
7. Students will be able to identify connected and compact sets in metric spaces and prove their key properties

TOPICS	No. of Lectures
Unit 01: Basic Concepts	**8**
• Inequalities • Metric Spaces • Sequences in Metric Spaces • Cauchy Sequences • Completion of a Metric Space	
Unit 02: Topology of a Metric Space	**8**
• Open and Closed Sets	

- Relativisation and Subspaces
- Countability Axioms and Separability
- Baire's Category Theorem

Unit 03: Continuity **10**

- Continuous Mappings
- Extension Theorems
- Real and Complex-valued Continuous Functions
- Uniform Continuity
- Homeomorphism, Equivalent Metrics and Isometry

Unit 04: Connected Spaces **8**

- Connectedness
- Local Connectedness
- Arcwise Connectedness

Unit 05: Compact Spaces **10**

- Bounded sets and Compactness
- Other Characterisations of Compactness
- Continuous Functions on Compact Spaces
- Locally Compact Spaces
- Compact Sets in Special Metric Spaces

Unit 05: Product Spaces **4**

- Finite and Infinite Products of Sets
- Finite Metric Products
- Infinite Metric Products
- Cantor Set .
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Textbook: Satish Shirali and Harkrishan L. Vasudeva, Metric Spaces, Springer

Reference Books:

1) O'Searcoid, Metric Spaces, Springer
2) James R. Munkres, Topology, Pearson
3) Richard R. Goldberg, Methods of Real Analysis, Oxford & IBH Publishing Co Pvt.Ltd

Class: T.Y.B.Sc. (Semester – V)
Course Code: USMT 352
Course: 2 **Title of the Course:** Real Analysis 1
Credit: 3 **No. of Lectures:** 48

Course Objectives:

1. Understand the fundamental concepts of sets and operations on sets.
2. Define and analyze various types of functions, including real-valued functions.
3. Explore the properties of real numbers and their significance in mathematical analysis.
4. Investigate the concepts of equivalence and countability in relation to sets.
5. Grasp the concept of least upper bound and its role in real analysis.
6. Analyze sequences of real numbers, including subsequence, convergence, and monotonicity.
7. Examine the properties of bounded sequences and their relevance in mathematical analysis.
8. Understand operations on sequences and their implications in the context of real analysis.
9. Investigate the notions of limit superior and limit inferior in the study of sequences.
10. Study the concept of Cauchy sequences and their significance in real analysis.

Course Outcomes:

By the end of the course, students will be able to:

1. Demonstrate proficiency in performing operations on sets and understanding their properties.
2. Apply knowledge of functions to solve problems involving real-valued functions.
3. Analyze real numbers and their properties in the context of mathematical analysis.
4. Determine the equivalence and countability of sets and their relevance in mathematical analysis.
5. Utilize the concept of least upper bound to analyze real numbers and sequences.
6. Evaluate the convergence and monotonicity of sequences and their implications.
7. Demonstrate proficiency in applying various tests for convergence and absolute convergence of series, including the class l^2.

Topics and Learning Points

Teaching Hours

Unit 1: Sets and functions **12**

1.1 Sets and operations on sets
1.2 Functions
1.3 Real valued functions
1.4 Equivalence and countability
1.5 Real numbers
1.6 Least upper bound

Unit 2: Sequence of real numbers **18**

2.1 Sequence and subsequence
2.2 Convergence of sequence
2.3 Bounded and monotone sequences
2.4 Operations on sequences
2.5 Limit superior and limit inferior
2.6 Cauchy sequences

Unit 3: Series of real numbers **18**

3.1 Convergence of series
3.2 Series with nonnegative terms
3.3 Alternating series
3.4 Conditional and absolute convergence
3.5 Tests for absolute convergence of series
3.6 The class l^2

Text Book:

Richard R. Goldberg, *Methods of Real Analysis*, Oxford & IBH Publishing Co. Pvt. Ltd., Indian Edition.
Unit 1 – Sections 1.1 to 1.7, **Unit 2** – Sections 2.1 to 2.10,
Unit 3 – Sections 3.1 to 3.4, 3.6, 3.7 & 3.10

Reference Books:

1. Ajit Kumar and S. Kumaresan, *A Basic Course in Real Analysis*, CRC Press, Second Indian Reprint 2015.
2. D. Somasundaram and B. Choudhary, *A first course in Mathematical Analysis*, Narosa Publishing House, 1997.
3. Robert G. Bartle and Donald Sherbert, *Introduction to Real Analysis*, John Wiley and Sons, 3rd Edition.
4. Shantinarayan and Mittal, *A course of Mathematical Analysis*, S. Chand and Co., Revised Edition (2002).
5. S. C. Malik and Savita Arora, *Mathematical Analysis*, New Age International Publications, 3rd Edition (2008).

Class : T.Y. B. Sc. (Semester- V)
Paper Code : USMT3504
Paper : IV **Title of Paper :** Group Theory
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

1. To Introduce students to the fundamental concept of abstract algebra and the notion of mathematical structures called groups.
2. To develop problem-solving skills through the exploration of group theory concepts and the solution of theoretical and practical problems.
3. To study various operations on groups, including multiplication, addition, and composition, and understanding how these operations interact with group properties.
4. To understand the notion of group isomorphisms, Caley's theorem and their role in establishing equivalences between different groups.
5. To explore the concepts of subgroups and cosets within groups, and understanding their significance in group theory.
6. To enhance students' ability to formulate rigorous mathematical arguments and proofs related to group theory concepts and theorems.
7. Demonstrating the applications of group theory in various areas of mathematics, such as number theory, geometry, cryptography, and particle physics.

B) Learning Outcome:

By the end of the course, students will be able to:

CO1 Understand the abstract algebra ,particularly in relation to and be able to articulate the key concepts and properties associated with groups.
CO2 Explain the significance of the notions of cosets, normal subgroups and factor groups.
CO3 Analyse consequences of Lagrange's theorem.
CO4 Recognize group structures in various mathematical contexts and understand how different mathematical objects can be analyzed using group theory.
CO5 Describe about structure preserving maps between groups and their consequences.
CO6 **C**onstruct clear and rigorous mathematical proofs related to group theory concepts and theorems, demonstrating logical reasoning and mathematical maturity.
CO7 **A**pply group theory concepts and techniques to solve problems in mathematics and related fields, such as cryptography, particle physics, and chemistry.

TOPICS/CONTENTS: **Teaching Hours**

Unit 01: Introduction to Groups [8]

1. 1 Symmetries of square
1. 2 The Dihedral groups
1. 3 Definition and examples of groups
1. 4 Elementary properties of groups

Unit 02: Finite Groups and Subgroups [*8*]

2. 1Order of group, order of elements.
2. 2Subgroup Tests and examples.
2. 3Center of a group
2. 4Centralizer of element.
2. 5Cosets: definition and properties
2. 6 Lagrange's theorem and corollary

Unit 03: Cyclic Groups [10]

3. 1 Properties of cyclic groups and examples
3. 2 Order of finite cyclic groups
3. 3 Generators of finite cyclic groups
3. 4 Generators of Zn
3. 5 Fundamental theorem of Cyclic Groups

Unit 04: Permutation Groups [*8*]

4. 1 Definition and examples
4. 2 Permutation on S_n, detail discussion of S_3
4. 3 Cycle notation
4. 4 Properties and theorems on permutation.
4. 5 Even odd permutation

Unit 05: Normal Subgroup [*4*]

5. 1 Definition
5. 2 If G is abelian then every subgroup of G is normal subgroup
5. 3 Theorems on Normal subgroup.

Unit 06: Homomorphism and Isomorphism's [*10*]

6. 1 Homomorphism and fundamental theorem of homomorphism
6. 2 Group isomorphism's
6. 3 Cayley's Theorem
6. 4 Properties of isomorphism
6. 5 Automorphisms

Textbook:

1. Contemporary Abstract Algebra, Joseph Gallian. (Ch. 1 to 6 and ch .9 to 10)

Unit 01: Chapter1&Chapter2
Unit 02:Chapter3
Unit 03:Chapter4
Unit 04:Chapter5
Unit 05:Chapter9
Unit 06:Cahpter6 &Chapter10

Reference Books:

1. I.N. Herstein, Topics in Algebra, Wiley.(Normal subgroup chapter)
2. .P. B. Bhattacharya, S. K. Jain and S. R. Nagpal, Basic abstract Algebra, Second Ed.
3. J. B. Fraleigh, A. First Course in Abstract Algebra, Third Edition, Narosa publication.
4. M. Artin, Algebra, Prentice Hall of India, New Delhi.

Class : T.Y. B. Sc. (Semester- V)
Paper Code :USMT3505
Paper : V **Title of Paper:** Ordinary Differential Equations
Credit : 3 **No. of lectures:** 48

A) Learning Objectives:

1. To introduce students ordinary differential equations, their definitions, classifications, and basic properties.
2. To teach students techniques to solve various types of ordinary differential equations, including first-order, second-order, linear, and nonlinear equations.
3. To explain the existence and uniqueness theorems for solutions of initial value problems, and their implications in understanding the behavior of solutions to ODEs.
4. To familiarizing students with analytical methods such as separation of variables, integrating factors, variation of parameters, and power series solutions for solving ODEs.
5. To develop students' critical thinking skills by presenting them with challenging problems involving ordinary differential equations.
6. To apply ordinary differential equations in various scientific and engineering fields, such as physics, chemistry, biology, economics, and engineering, including modeling physical systems, population dynamics, chemical reactions, and electrical circuits.
7. To prepare students for further study in advanced topics related to ordinary differential equations, such as partial differential equations, dynamical systems, control theory, and mathematical modeling.

C) Learning Outcome:

By the end of the course, students will be able to:

CO1 Understand basic concept of differential equations.
CO2 Solve first order differential equations.
CO3 Grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.
CO4 Solve differential equations using variation of parameter method, undetermined coefficient and by numerical methods.
CO5 Solve constant-coefficient linear second-order differential equations.
CO6 Demonstrate ability to think critically by determining and using appropriate techniques for solving a variety of differential equations.
CO7 Demonstrate the ability to integrate knowledge and ideas of differential equations in a coherent and meaningful manner for solving real world problems.

TOPICS/CONTENTS: **Teaching Hours**

Unit 01: Differential Equations [*12*]

1.1 Introduction
1.2 Nature of solution
1.3 Separable Equations
1.4 First order linear equations
1.5 Exact Equations
1.6 Orthogonal Trajectories and Families of Curves
1.7 Homogeneous Equations
1.8 Integrating Factor

Unit 02: Second Order Differential Equations [*14*]

2.1 Method of undetermined coefficients.
2.2 Method of variation of parameters.
2.3 Method of reduction of order.
2.4The use of a known solution to find another.

Unit 03: Power series solutions [*12*]

3. 1 Introduction and review of power series.
3. 2 Linear equations and power series.
3. 3 Convergence of power series.
3. 4 Ordinary points and regular singular points.

Unit 04: **System of First-Order Equations** [*10*]

4. 1 Introductory remarks
4. 2 Linear systems
4. 3 Homogeneous linear systems with constant Coefficients
4. 4 Distinct roots, repeated roots, Complex roots

Textbook:

1. Differential Equations by George F. Simmons, Steven G. Krantz, Tata McGrawHill.

Unit 01: Chapter 1; Section 1.1 to 1.9
Unit 02: Chapter2; Section 2.1 to 2.4
Unit 03: Chapter 3; Section 3.1 to 3.3
Unit 04: Chapter 8: Secton 8.1 to 8.2

Reference Books:

2. Ordinary and Partial Differential Equation, by M.D.Raisinghania, S.Chand and Company LTD, 2009.
3. Daniel Murray, Introductory Course in Differential Equations, Orient Longman.
4. Elementary Differential Equations, Rainville and Bedient, Macmillan Publication.

Class: T.Y.B.Sc. (Semester – V)
Course Code: USMT 355
Course: 5 **Title of the Course:** Operations Research
Credit: 2 **No. of Lectures:** 36

Course Objectives:

1. To familiarize students with the basic concepts, terminologies, and constraints involved in linear programming problems, enabling them to articulate problem formulations effectively.
2. Develop students' proficiency in graphically representing and solving linear programming problems using the graphical method, including identifying feasible regions, optimal solutions, and sensitivity analysis.
3. Enable students to apply the simplex method algorithmically to solve complex linear programming problems, emphasizing the understanding of pivot operations and iterations.
4. Equip students with the skills to handle linear programming problems with constraints that require artificial variables using the Big-M method, focusing on conversion and manipulation techniques.
5. Introduce students to graphical sensitivity analysis methods to assess the impact of changes in objective function coefficients, resource availability, and constraint boundaries on optimal solutions.
6. To enable students to understand and apply the concept of duality in Linear Programming (LP) problems, exploring its significance, properties, and practical implications.
7. To familiarize students with the core concepts, algorithms, and mathematical techniques used in transportation modeling, enabling them to comprehend the underlying principles of optimization in transportation systems.
8. To equip students with the ability to identify, formulate, and solve transportation problems using appropriate mathematical models and optimization techniques. This includes practical applications in logistics, supply chain management, and urban transportation planning.
9. To familiarize students with the fundamental principles and concepts underlying assignment models in Operations Research, including the Hungarian method, transportation problems, and linear programming techniques used in solving assignment problems.

Course Outcomes:

1. Students will demonstrate the ability to formulate real-world problems into mathematical linear programming models, identifying decision variables, constraints, and the objective function accurately.
2. Students will be able to graphically solve and interpret linear programming problems, accurately identifying feasible regions, optimal solutions, and performing sensitivity analysis on graphical representations.

3. Students will apply the simplex method proficiently to solve multi-variable linear programming problems, showcasing competence in formulating initial tables, conducting iterations, and identifying optimal solutions.
4. Students will exhibit proficiency in applying the Big-M method to solve problems with artificial variables, manipulating constraints effectively, and transitioning between phases while solving LP problems.
5. Students will be able to explain the concept of duality in Linear Programming, outlining its mathematical basis and relevance in optimization problems.
6. Students will be able to develop and implement transportation models to optimize logistical operations, effectively analyze transportation networks, and propose strategic solutions for minimizing transportation costs, maximizing efficiency, and addressing complex real-world transportation challenges.
7. Students will be proficient in formulating assignment problems in different contexts (such as workforce allocation, resource assignment, task optimization) as mathematical models. They will demonstrate the capability to apply appropriate algorithms and techniques, like the Hungarian algorithm or linear programming, to solve these assignment problems efficiently and effectively.

Topics and Learning Points

Teaching Hours

Unit 1: Modeling with Linear Programming **8**

1.1 Two variable LP Model
1.2 Graphical LP solution
1.3 Selected LP Applications
1.4 Graphical Sensitivity analysis

Unit 2: The Simplex Method **14**

2.1 LP Model in equation form
2.2 Transition from graphical to algebraic solutions
2.3 The simplex method
2.4 Artificial starting solutions.

Unit 3: Duality **6**

3.1 Definition of the dual problem
3.2 Primal dual relationship

Unit 4: Transportation Model **12**

4.1 Definition of the Transportation model
4.2 The Transportation algorithm

Unit 5: Assignment Model **6**

5.1 The Hungarian method
5.2 Simplex explanation of the Hungarian method.

Text Book:

Hamdy A. Taha, *Operation Research*, Prentice Hall of India Pvt. Ltd, 8th Edition 2009. Ch.2: 2.1,2.2,2.3(2.3.4, 2.3.5, 2.3.6). Ch.3: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 (3.6.1). Ch.4: 4.1, 4.2. Ch.5: 5.1,5.3 (5.3.1, 5.3.2, 5.3.3), 5.4(5.4.1, 5.4.2).

Reference Books:

1. Frederick S. Hillier, Gerald J. Lieberman, *Introduction to Operation Research* (8th Edition) Tata McGraw Hill.
2. J. K. Sharma, *Operations Research: Theory and Applications*, (2nd Edition, 2006), Macmilan India Ltd.
3. Hira and Gupta, *Operation Research*.

Class: T.Y.B.Sc. (Semester – V)

Course Code: USMT 356

Course: 6 **Title of the Course: Number Theory**

Credit: 3 **No. of Lectures:** 48

Course Objectives

1. Develop a solid understanding of divisibility properties of integers, including the Division Algorithm and the Fundamental Theorem of Arithmetic.
2. Introduce the concept of congruences and explore their properties, including residue classes and theorems like Fermat's, Euler's, and Wilson's.
3. Investigate the greatest integer function and related arithmetic functions like Euler's function, divisor function, sum of divisors function, and number of prime divisors function.
4. Introduce the concept of multiplicative functions and explore the Mobius function and its inversion formula.
5. Develop an understanding of quadratic residues, Legendre's symbol, and the Law of Quadratic Reciprocity.
6. Introduce Jacobi symbol as an extension of Legendre's symbol.
7. Expose students to Diophantine equations, focusing on linear equations ($ax + by = c$) and explore Pythagorean triplets as an example.

Course Outcomes

1. Students will be able to apply divisibility properties and the Division Algorithm to solve problems involving integers.
2. Students will be able to perform operations on congruence classes and utilize theorems like Fermat's, Euler's, and Wilson's to solve problems.
3. Students will be able to calculate the greatest integer function and related arithmetic functions for various integers.
4. Students will be able to identify and utilize multiplicative functions, particularly the Mobius function and its inversion formula.
5. Students will be able to determine quadratic residues and apply Legendre's symbol to solve problems related to quadratic reciprocity.
6. Students will be able to understand the concept of Jacobi symbol and its connection to Legendre's symbol.
7. Students will be able to solve linear Diophantine equations and identify Pythagorean triplets using number theory concepts.

Unit 01: Divisibility **8**

- Divisibility in integers, Division Algorithm
- GCD, LCM,
- Fundamental theorem of Arithmetic

- Infinitude of primes

Unit 02: Congruences **12**

- Properties of Congruences
- Residue classes, complete and reduced residue system, their properties
- Fermat's theorem. Euler's theorem, Wilson's theorem
- Linear Congruences of degree 1
- Chinese remainder theorem

Unit 03: Greatest integer function **10**

- Arithmetic functions Euler's function
- the number of divisors d(n)
- $\sigma(n)$, $\omega(n)$ and $\Omega(n)$
- Multiplicative functions, Mobius function, Mobius inversion formula.

Unit 04: Quadratic Reciprocity **10**

- Quadratic residues
- Legendre's symbol and its properties
- Law of quadratic reciprocity
- Jacobi symbol

Unit 05: Diophantine Equations **8**

- Diophantine Equations ax + by = c
- Pythagorean triplets

Text Book:

I. Niven, H. Zuckerman and H.L. Montgomery, An Introduction to Theory of Numbers, 5th Edition, John Wiley and Sons.
(§1.1- §1.3, §2.1- §2.3, §3.1- §3.3, §4.1 -§4.3, §5.1 and §5.3.)

Reference Book:

David M. Burton, Elementary Number Theory (Second Ed.)

CBCS Syllabus as per 2022 Pattern for T.Y.B.Sc. Mathematics

Class: T.Y.B.Sc. (Semester – V)
Course Code: USMT 357
Course: 7 **Title of the Course:** Practical based on USMT351 & USMT352
Credit: 2 **No. of Lectures:** 48

Course Objectives:

1. Understand the fundamental concepts of metric spaces, including distance, open and closed sets, and convergence.
2. Explore the topology of metric spaces, including the concepts of open and closed balls, neighborhoods, and limit points.
3. Investigate the properties of continuous functions between metric spaces and their implications.
4. Analyze the notions of connectedness and path-connectedness in metric spaces and their applications.
5. Examine the concept of compactness in metric spaces and its relationship with continuity and convergence.
6. Study the construction and properties of product spaces and their relevance in various contexts.
7. Develop proficiency in formal mathematical reasoning and proof techniques applicable to metric spaces.
8. Gain familiarity with sets, functions, and basic operations in the context of real analysis.
9. Explore the properties of real numbers, including their construction and classification.
10. Investigate sequences and series of real numbers, including convergence criteria and their applications.

Course Outcomes:

1. Demonstrate proficiency in defining and manipulating basic concepts in metric spaces, such as open sets, closed sets, and metric functions.
2. Apply topological notions to analyze the structure and properties of metric spaces, including compactness and connectedness.
3. Evaluate the continuity of functions between metric spaces and understand its implications for various mathematical contexts.
4. Identify and classify different types of sequences of real numbers, including Cauchy sequences, and analyze their convergence behavior.
5. Analyze the convergence of series of real numbers using various tests and criteria, including absolute convergence.
6. Construct and analyze product spaces, understanding their properties and relationships with component spaces.
7. Demonstrate proficiency in constructing rigorous mathematical proofs to justify statements and conclusions related to metric spaces and real analysis.

List of Practical:

Teaching Hours

Practical based on Metric Spaces (USMT351): **24**

1. Practical 1: Basic Concepts in Metric Spaces
2. Practical 2: Topology of a Metric Space
3. Practical 3: Continuity
4. Practical 4: Connected Spaces
5. Practical 5: Compact Spaces
6. Practical 6: Product Spaces

Practical based on Real Analysis 1 (USMT352): **24**

1. Practical 1: Sets and Functions
2. Practical 2: Real numbers and Countability
3. Practical 3: Sequences of real numbers
4. Practical 4: Operations on sequences and Cauchy sequences
5. Practical 5: Series of real numbers
6. Practical 6: Tests for absolute convergence and the class l^2

Class : T.Y. B. Sc. (Semester- III)

Paper Code :US MT3508

Paper : VIII **Title of Paper:** Practical Based on USMT3503 & USMT3504

Credit : 2 **No. of lectures:** 48

Course Objectives:

1. To solve real-world problems using both ODE and Group Theory methodologies, emphasizing practical applications over theoretical abstraction
2. Ensure students are proficient in implementing numerical methods for ODEs, understanding the algorithms' strengths, limitations, and appropriateness for different scenarios.
3. To introduce students to computational techniques for group analysis, including subgroup identification, coset enumeration, and exploring group .
4. To Illustrate how ODEs and Group Theory can be applied across various disciplines such as physics, chemistry, biology, economics, and engineering through practical examples and case studies.
5. To provide opportunities for students to tackle challenging problems that require the integration of ODE and Group Theory concepts, fostering critical thinking and creativity.
6. To guide students in formulating mathematical models of physical, biological, or economic systems using ODEs and understanding how group theory can enhance these models.
7. To equip students with practical skills and theoretical understanding that can serve as a solid foundation for pursuing research or advanced study in mathematical modeling, computational mathematics, or related fields.

Course Outcomes:

By the end of the course, students will be able to:

CO1 Demonstrate when a binary algebraic structure is a group.
CO2 Determine possible subgroup of a group.
CO3 Understand the isomorphism between two groups.
CO4 Understand the symmetry of regular n-gon.
CO5 Understand the genesis of ordinary differential equations.
CO6 Learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
CO7 Understand the formation of modelling problems in ordinary differential equations and apply some standard methods to obtain its solutions.

TOPICS/ CONTENT:

Title of experiments:

Group Theory:

1. Elementary properties of groups
2. Finite Groups and Subgroups
3. Cyclic Groups

4. Permutation Groups
5. Normal Subgroup
6. Homomorphism and Isomorphism's

Ordinary Differential Equations:

7. • Linear Differential Equations with constant coefficients
8. • Non-Homogeneous Differential Equations
9. • Power series solutions
10. • System of First-Order Equations

Class: T.Y.B.Sc. (Semester – V)
Course Code: USMT 359
Course: 9 **Title of the Course:** Practical based on USMT355 & USMT356
Credit: 2 **No. of Lectures:** 48

Course Objectives:

1. Understand the fundamental concepts of Operations Research (OR) and its applications in decision-making processes.
2. Develop proficiency in formulating Linear Programming Problems (LPP) and solving them using graphical methods.
3. Master the graphical and simplex methods for solving LPPs efficiently.
4. Explore and analyze special cases that arise in the solution of LPPs, enhancing problem-solving skills.
5. Comprehend the concepts of duality and graphical sensitivity in LPPs, enabling a deeper understanding of optimization techniques.
6. Gain proficiency in solving transportation models and understanding their relevance in real-world logistics and distribution problems.
7. Acquire the necessary skills to solve assignment models and analyze transportation problems effectively.
8. Develop a strong foundation in Number Theory, focusing on divisibility properties and their applications.
9. Explore advanced concepts such as congruences, quadratic reciprocity, and Diophantine equations in Number Theory.
10. Apply Number Theory principles to solve real-world problems and develop analytical thinking skills.

Course Outcomes:

1. Students will be able to formulate and solve Linear Programming Problems using graphical and simplex methods, demonstrating proficiency in optimization techniques.
2. Students will analyze and interpret special cases in the solution of Linear Programming Problems, showcasing critical thinking and problem-solving abilities.
3. Upon completion of the course, students will demonstrate a clear understanding of duality and graphical sensitivity in Linear Programming Problems, enabling them to analyze optimization models effectively.
4. Students will be proficient in solving transportation models and assignment models, applying OR techniques to solve real-world logistics and distribution challenges.
5. Through the study of Number Theory, students will develop a deep understanding of divisibility properties and their applications in mathematical problem-solving.
6. Students will be able to apply congruence principles to solve mathematical problems and analyze their relevance in cryptography and computer science.
7. By exploring advanced topics such as quadratic reciprocity and Diophantine equations, students will enhance their problem-solving skills and develop a deeper appreciation for the theoretical aspects of Number Theory.

List of Practical:

Teaching Hours

Practical based on Operations Research (USMT355): 24

1. Practical 1: Formulation of LPP and Graphical method
2. Practical 2: Graphical and Simplex methods for LPP
3. Practical 3: Special cases in solution of LPP
4. Practical 4: Duality and Graphical Sensitivity in LPP
5. Practical 5: Transportation Model
6. Practical 6: Assignment Model and Transportation Model

Practical based on Number Theory (USMT356): 24

1. Practical 1: Divisibility
2. Practical 2: Congruences 1
3. Practical 3: Congruences 2
4. Practical 4: Greatest Integer Function
5. Practical 5: Quadratic Reciprocity
6. Practical 6: Diophantine Equations