Ahmednagar Jilha Maratha Vidya Prasarak Samaj's New Arts, Commerce, and Science College, Ahmednagar (Autonomous) (Affiliated to Savitribai Phule Pune University, Pune)



National Education Policy (NEP) Choice Based Credit System (CBCS)

Programme Skeleton and Syllabus of Mathematics (Minor)

Implemented from

Academic Year 2023-24

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

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

Board of Studies in Mathematics

Sr. No.	Name	Designation
1.	Dr. S. B. Gaikwad	Chairman
2.	Dr. S. V. Ingale	Member
3.	Mr. S. A. Tarate	Member
4.	Mr. K. A. Kshirsagar	Member
5.	Ms. B. N. Todkari	Member
6.	Ms. D. G. Gade	Member
7.	Mr. A. S. Jadhav	Member
8.	Ms. P. D. Kasule	Member
9.	Ms. P. S. Ansari	Member
10.	Mr. R. V. Sharma	Member
11.	Mr. T. A. Bhakare	Member
12.	Mr. H. N. Shaikh	Member
13.	Dr. A. A. Kulkarni	Member
14.	Prof. (Dr). A. V. Mancharkar	Member
15.	Dr. N. S. Darkunde	Academic Council Nominee
16.	Dr. S. B. Bhalekar	Academic Council Nominee
17.	Dr. G. S. Kadu	Vice-Chancellor Nominee
18.	Mr. P. L. Pawar	Alumni
19.	Mr. Shirish Padalkar	Industry Expert

1. Prologue/ Introduction of the programme:

Welcome to the B.Sc. Mathematics Honours and Honours by Research program! This program is designed for students who have a passion for mathematics and wish to pursue an in-depth study of this fascinating field. Through this prologue, let's explore the essence and significance of this program. The B.Sc. Mathematics Honours program offers a comprehensive curriculum that combines core mathematical principles with advanced topics, enabling students to develop a strong foundation in mathematics. This program is specifically tailored for students who are seeking a rigorous academic experience and aspire to pursue higher studies or research in mathematics. The Honours by Research component provides students with an opportunity to delve deeper into a specific area of mathematics under the guidance of experienced faculty members. This research-oriented approach allows students to explore their interests, develop critical thinking skills, and make original contributions to the field of mathematics. It serves as a stepping stone for those considering a career in academia or research.

During the course of the program, students will be exposed to a wide range of mathematical topics, including calculus, algebra, geometry, number theory, mathematical analysis, probability theory, and more. They will acquire both theoretical knowledge and practical problem-solving skills, enabling them to tackle complex mathematical problems and develop analytical thinking abilities. The program emphasizes the development of mathematical reasoning, logical thinking, and the ability to communicate mathematical ideas effectively. Students will engage in rigorous mathematical proofs, problem-solving exercises, and mathematical modeling, fostering their ability to analyze and interpret real-world phenomena using mathematical principles. Through hands-on projects, seminars, and collaborative research opportunities, students will also develop essential skills such as data analysis, computer programming, and numerical methods, which are increasingly important in today's data-driven world. The B.Sc. Mathematics Honours and Honours by Research program aims to cultivate a deep appreciation for the elegance and beauty of mathematics while nurturing the intellectual curiosity and creativity of students. It provides a supportive learning environment where students can interact with faculty members, participate in academic discussions, and engage in a vibrant mathematical community. Upon successful completion of the program, students will be equipped with a solid foundation in mathematics, critical thinking skills, and research experience. Graduates will have a wide range of career options, including pursuing advanced degrees in mathematics or related disciplines, teaching mathematics at the secondary or tertiary level, working in research institutions, or applying their mathematical skills in industries such as finance, technology, data science, and more. We invite you to embark on this exciting journey of discovery and exploration in the field of mathematics. Through the B.Sc. Mathematics Honours and Honours by Research program, you will develop a profound understanding of mathematics, acquire invaluable skills, and contribute to the advancement of this timeless discipline. Get ready to unlock the wonders of mathematics and make your mark in the world of numbers!

2. Programme Outcomes (POs)

1. Graduates will have a solid foundation in fundamental mathematical concepts, theories, and techniques across various branches of mathematics, including calculus, algebra, geometry, analysis, and discrete mathematics.

2. Students will acquire advanced knowledge in specialized areas of mathematics through coursework, seminars, and research projects.

3. Graduates will develop strong analytical and critical thinking skills, enabling them to analyze complex mathematical problems, identify patterns, and develop logical and rigorous proofs. They will be adept at applying mathematical principles to solve real-world problems.

4. Students will develop exceptional problem-solving skills, both in theoretical and practical contexts. They will be able to formulate and solve mathematical problems using appropriate mathematical techniques and tools.

5. The Honours by Research component of the program will equip students with the necessary skills to conduct independent mathematical research. Graduates will be proficient in formulating research questions, designing experiments or investigations, collecting and analyzing data, and presenting their findings in a coherent and rigorous manner.

6. Students will be capable of formulating mathematical models, interpreting their results, and making informed predictions or decisions based on the models.

7. Students will be able to explain mathematical concepts clearly, write technical reports and research papers, and engage in scholarly discussions.

8. Students will develop proficiency in using mathematical software, programming languages, and computational tools for data analysis, numerical simulations, and mathematical modeling.

9. Students will develop an understanding of the ethical responsibilities and professional standards associated with mathematical research and practice. They will exhibit integrity, intellectual honesty, and respect for intellectual property rights in their work.

	Type of Courses	III Yr	IV Yrs	IV Yrs
			(Honours)	Researc
				h
Major	Discipline-Specific Courses (DSC)	46	74	66
Marathi	Discipline Specific Elective (DSE)	08	16	16
	Skill Enhancement Courses (SEC)	06	06	06
	Vocational Skill Courses (VSC)	08	08	08
	On-Job Training (OJT)	04	08	04
	Field Project (FP)	04	04	04
	Community Engagement and Service (CEP)	02	02	02
	Research project	00	00	12
	Research Methodology	00	04	04
	Indian Knowledge System	02	02	02
	Total (I, II and III Year)	80	124	124
Minor	Minor	20	20	20
Other	Open Elective (OE)/ Multidisciplinary	12	12	12
Courses	Courses			
	Co-Curricular Courses	08	08	08
	Ability Enhancement Courses	08	08	08
	Value Education Courses	04	04	04
	Total	132	176	176

Credit Distribution: B.Sc. Mathematics including Minor and OE and other courses.

Programme Framework (Courses and Credits): B.Sc. Mathematics (Minor)

Sr.	Year	Semeste	Leve	Course	Course Code	Title	Credits
No.		r	1	Туре			
1.	Ι	Ι	4.5	MNR-	BS-	Algebra and	03
				1	MT101T+P	Calculus	
2.	Ι	II	4.5	MNR-	BS-MT201	Discrete	03
				2	T+P	Mathematics	
3.	II	III	5.0	MNR-	BS-MT301	Linear	03
				3	T+P	Algebra	
4.	II	IV	5.0	MNR-	BS-MT401	Numerical	03
				4	T+P	methods	
5.	III	V	5.5	MNR-	BS-MT501	Computationa	04
				5	T+P	1 Geometry	
6.	III	VI	5.5	MNR-	BS-MT601	Operations	04
				6	T+P	Research	
							20

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

Title of the Course: Algebra and Calculus										
Year: I		ester: I								
Course	Course Code	Credit Distribution		Credits	Allotted	Allotted Marks				
Туре		Theory	Practical		Hours					
							1	1		
						CIE	ESE	Total		
MNR-	BS-MT101	02	01	03	60	30	70	100		
1	T+P									

Learning Objectives:

- 1. To understand the basic concepts of sets, relations and functions.
- 2. Analyze functions using limits, derivatives, and integrals.
- 3. Evaluate mathematical expressions to compute quantities that deal with linear systems.
- 4. This course to learn, how Matrix Algebra is ubiquitous in Mathematics and therefore a strong foundation has to be laid in studying the abstract algebraic concepts intertwining geometric ideas.

Course Outcomes (Cos)

- 1. To learn basic concepts and properties of sets and relations.
- 2. To understand the notion of differentiation and integration.
- 3. To Find the determinant of a product of square matrices, transpose and of the inverse of an invertible matrix.
- 4. Students will demonstrate competence with the basic ideas of linear algebra including concepts of linear systems.

Details of Syllabus:

Unit I: Sets, Relation and Functions

- 1.1 Sets, subsets, Set operations and the laws of set theory and Venn diagrams, Examples of finite and infinite sets, Finite sets and counting principle, Empty set, properties of empty set, Standard set operations, Classes of sets, Power set of a set.
- 1.2 Difference and Symmetric difference of two sets. Set identities, Generalized union and intersections.
- 1.3 Relation: Product set, Composition of relations, Types of relations, Partitions, Equivalence Relations.
- 1.4 Definition of a function. Domain, co-domain and the range of a function. Review of injective, surjective and bijective functions, Composition of functions. Invertible functions and the inverse of a function.

Unit II: Differentiation and Integration

(10 Hours)

(12 Hours)

- 2.1 Definition of derivative of a real valued function at a point, notion of differentiability, geometric interpretation of a derivative of a real valued function at a point.
- 2.2 Statement of rules of differentiability, chain rule of finding derivative of composite of differentiable functions (without proof).
- 2.3 Integration as an inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts, Evaluation of simple integrals of the following types and problems based on them.
- 2.4 Basic properties of definite integrals and evaluation of definite integrals.

Unit III: Determinant and Matrices

- 3.1 Matrix addition and Scalar multiplication.
- 3.2 Matrix multiplication, Transpose of a matrix.
- 3.3 Square matrices, Powers of matrices.
- 3.4 Invertible matrices, Special types of square matrices.
- 3.5 Determinants and its properties.

Unit IV: System of Linear equations

- 4.1 Linear equations.
- 4.2 Linear system in two and three unknowns.
- 4.3 Gauss Elimination Method.
- 4.4 Special cases: unique solution, no solution and infinitely many solutions.

Suggested Readings:

1. Ivo Düntsch Günther, Gediga- Sets, Relations, Functions, Methods Publishers (UK), First edition, 2000.

Calculus Gilbert Strang Wellesley Cambridge Press Second Edition, 2012.

- 2. SCHAUM'S outlines Linear Algebra Seymour Lipschutz Fourth Edition, 2015.
- 3. H. Anton and C. Rorres, Elementary Linear Algebra with Applications, Seventh Ed Wiley, (1994).
- 4. Carla C. Morris, Robert M. Stark- Fundamentals of Calculus, Second edition, Wiley publications, 2015.

(11 Hours)

(12 Hours)

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

Title of the Course: Discrete Mathematics									
Year: I Semester: II									
Course Type	Course Code	Credit Distribution							
		Theory Practi		Credits	Allotted Hours	Allotted Marks			
			Practical			CIE	ESE	Total	
MNR-2	BS-MT201 T+P	02	01	03	60	30	70	100	

Learning Objectives:

- 1. To provide overview of theory of discrete objects, starting with relations and partially ordered sets.
- 2. Study about recurrence relations, generating function and operations on them.
- 3. Give an understanding of graphs and trees, which are widely used in software.
- 4. Provide basic knowledge about models of automata theory and the corresponding formal languages.

Course Outcomes (Cos)

- 1. Understand sets, relations, functions and discrete structures.
- 2. Ability to apply mathematical logic to solve problems.
- 3. Learn the basic concepts of Boolean algebra, lattice, logical gates and relations of Boolean function.
- 4. Use the properties of trees to find a minimal spanning tree for a given weighted graph and understand Eulerian and Hamiltonian graphs.

Detailed Syllabus:

Unit I: Sets

- 1.1 Set Theory Sets and Classes.
- 1.2 Relations and functions.
- 1.3 Binary relations, properties of binary relation in a set, equivalence relations.
- 1.4 Pigeon hole principle, Recursive definitions.

Unit II: Mathematical Logic

- 2.1 Statement and notations, proposition and logic operations.
- 2.2 Connectives(conjunction, disjunction, negation).
- 2.3 Statement formulas and truth tables, propositions generated by set.
- 2.4 Equivalence of formulas and implication laws of logic, mathematical systems.
- 2.5 Principal of mathematical induction, variables, quantifiers.

(15 Hours)

(15 Hours)

Unit III: Boolean algebra

- 3.1 Posets, lattice and basic properties of Boolean algebraic.
- 3.2 Principle of duality, distributive and complemented lattices.
- 3.3 Uniqueness of finite Boolean algebra, Boolean functions and Boolean expressions.
- 3.4 Normal forms of Boolean expression and simplifications of Boolean expressions.
- 3.5 Basic circuits and theorems, logical gates and relations of Boolean function.

Unit IV: Graph theory

- 4.1 Basic terminology of graph theory, paths, circuits.
- 4.2 Graph connectivity, Eulerian paths, multigraphs, weighted graphs.
- 4.3 Trees, spanning trees, binary trees, rooted trees, planar graphs, Eulers theorem.
- 4.4 The Konigsberg bridge problem and Eulerian graphs, Hamiltonian graphs.

Suggested Readings/Material:

- 1. Ram, B. Discrete Mathematics, Pearson Education, 2012.
- 2. Rosen, K. H. Discrete Mathematics and Its Applications. 7th edition, Tata McGraw Hill, 2011.
- 3. Khanna, V. K. Lattices and Boolean Algebras. PHI Publication, 2004.
- 4. Lipschutz, S., Lipson, M.L. and Patil, V.H. Discrete Mathematics. Schaum's Outline Series, Tata McGraw-Hill Education, 2006.
- 5. Liu, C. L. Elements of Discrete Mathematics. Tata McGraw Hill, 2000.
- 6. Trembley, J. P. and Manohar, R. A First Course in Discrete Structure with applications to Computer Science. Tata McGraw Hill, 1999.

(15 Hours)

(15 Hours)