Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Two Year Degree Program in Mathematics

(Faculty of Science & Technology)

CBCS Syllabus

M.Sc. (Mathematics) Part-I Semester -II

For Department of Mathematics

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2023 Pattern)

(As Per NEP 2020)

To be implemented from Academic Year 2023-2024

Title of the Programme: M.Sc. (Mathematics)

Preamble

AES's Tuljaram Chaturchand College has made the decision to change the syllabus of across various faculties from June, 2023 by incorporating the guidelines and provisions outlined in the National Education Policy (NEP), 2020. The NEP envisions making education more holistic and effective and to lay emphasis on the integration of general (academic) education, vocational education and experiential learning. The NEP introduces holistic and multidisciplinary education that would help to develop intellectual, scientific, social, physical, emotional, ethical and moral capacities of the students. The NEP 2020 envisages flexible curricular structures and learning based outcome approach for the development of the students. By establishing a nationally accepted and internationally comparable credit structure and courses framework, the NEP 2020 aims to promote educational excellence, facilitate seamless academic mobility, and enhance the global competitiveness of Indian students. It fosters a system where educational achievements can be recognized and valued not only within the country but also in the international arena, expanding opportunities and opening doors for students to pursue their aspirations on a global scale.

In response to the rapid advancements in science and technology and the evolving approaches in various domains of Mathematics and related subjects, the Board of Studies in Mathematics at Tuljaram Chaturchand College, Baramati - Pune, has developed the curriculum for the first semester of M.Sc. Part-I Mathematics, which goes beyond traditional academic boundaries. The syllabus is aligned with the NEP 2020 guidelines to ensure that students receive an education that prepares them for the challenges and opportunities of the 21st century. This syllabus has been designed under the framework of the Choice Based Credit System (CBCS), taking into consideration the guidelines set forth by the National Education Policy (NEP) 2020, LOCF (UGC), NCrF, NHEQF, Prof. R.D. Kulkarni's Report, Government of Maharashtra's General Resolution dated 20th April and 16th May 2023, and the Circular issued by SPPU, Pune on 31st May 2023.

A Mathematics degree equips students with the knowledge and skills necessary for a diverse range of fulfilling career paths. Graduates in Mathematics find opportunities in various fields, including Financial Planner, Market Research Analyst, Data Scientist, teaching, Insurance underwriter, operations research analyst, software developer, and many other domains. After graduating with a degree in mathematics, students can embark on a multitude of rewarding and diverse career paths. The analytical and problem-solving skills honed during their studies equip them with a strong foundation for success in various fields. Many graduates choose to pursue careers in academia and research, where they can contribute to the advancement of mathematical knowledge through teaching, publishing papers, and conducting ground breaking research. Others may opt for careers in the financial sector, such as investment banking or actuarial science, utilizing their expertise in mathematical modelling and statistical analysis to make informed decisions and manage risks. Additionally, the field of data science offers abundant opportunities for mathematics graduates, as they possess the ability to extract meaningful insights from complex data sets and develop algorithms that drive innovation in industries like technology, healthcare, and marketing. Moreover, mathematics graduates can find fulfilling careers in engineering, cryptography, software development, and operations research, to name just a few areas where their mathematical skills are highly sought after. Overall, a degree in mathematics opens doors to a wide range of intellectually stimulating and financially rewarding professions, allowing graduates to make significant contributions to society and thrive in a rapidly evolving world.

Overall, revising the Mathematics syllabus in accordance with the NEP 2020 ensures that students receive an education that is relevant, comprehensive, and prepares them to navigate the dynamic and interconnected world of today. It equips them with the knowledge, skills, and competencies needed to contribute meaningfully to society and pursue their academic and professional goals in a rapidly changing global landscape.

Programme Specific Outcomes (PSOs)

PSO 1-Proficiency in Mathematical Concepts: Graduates will have a deep understanding of fundamental mathematical concepts and theories across various branches of mathematics, including calculus, algebra, geometry, probability, and statistics.

PSO 2-Problem-Solving Skills: Graduates will possess strong problem-solving skills and the ability to apply mathematical principles to real-world situations. They can analyze complex problems, develop logical reasoning, and devise creative strategies to find solutions.

PSO 3-Mathematical Modeling: Graduates will be proficient in mathematical modeling, which involves using mathematical techniques to describe and analyze real-world phenomena. They can formulate and solve mathematical models to address problems in diverse fields, including physics, economics, engineering, and social sciences.

PSO4-Computational and Analytical Skills: Graduates will be skilled in using computational tools and software, such as programming languages, statistical software, and mathematical modeling software. They can leverage these tools to perform numerical analysis, data visualization, and simulations.

PSO 5-Communication and Presentation: Graduates will possess effective communication skills, both written and oral, to convey complex mathematical ideas and results to both technical and non-technical audiences. They can present mathematical arguments, proofs, and findings in a clear and concise manner.

PSO 6-Research and Inquiry: Graduates will have the ability to engage in mathematical research and inquiry. They can critically evaluate existing mathematical theories, develop new mathematical models, and contribute to the advancement of mathematical knowledge through independent research or collaborative projects.

PSO 7-Interdisciplinary Collaboration: Graduates will be adept at collaborating with professionals from other disciplines, such as scientists, engineers, economists, and

computer scientists. They can effectively communicate and work in multidisciplinary teams to solve complex problems that require mathematical expertise.

PSO 8-Lifelong Learning: Graduates will have developed a strong foundation for lifelong learning in mathematics. They will have the skills to stay abreast of new developments in the field, adapt to emerging technologies and methodologies, and continue their professional growth through self-directed study or advanced academic pursuits.

PSO 9-Advanced Mathematical Techniques: Graduates will have a command of advanced mathematical techniques, such as differential equations, mathematical analysis, linear algebra, number theory, and optimization. They can apply these advanced mathematical tools to solve complex problems and contribute to specialized areas of research.

PSO 10-Mathematical Software Development: Graduates will possess programming skills and the ability to develop mathematical software or algorithms. They can design, implement, and optimize software applications that facilitate mathematical calculations, simulations, data analysis, and modeling.

PSO 11-Mathematical Education and Teaching: Graduates interested in pursuing a career in education will have the necessary skills to teach mathematics at various levels. They can design and deliver effective lessons, develop curriculum materials, and assess student progress in mathematics. They can also inspire and motivate students to develop an appreciation for the subject.

PSO 12-Mathematical Finance and Risk Analysis: Graduates with an interest in finance and economics will have specialized knowledge in mathematical finance and risk analysis. They can apply mathematical models, stochastic calculus, and statistical methods to analyze financial markets, manage investment portfolios, assess risk, and make informed financial decisions.

Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Board of Studies (BOS) in Mathematics

From 2022-23 to 2024-25

Sr. No.	Name	Designation
1.	Mr. Sadashiv R. Puranik,	Chairman
2.	Ms. Varsha H. Shinde	Member
3.	Dr. Prakash B. Fulari	Member
4.	Ms. Shaila S. Jadhav	Member
5.	Ms. Nikita R. Shinde	Member
6.	Ms. Sonali V. Kate	Member
7.	Dr. Anil S. Khairnar	Vice-Chancellor Nominee
8.	Dr. Nitin S. Darkunde	Expert from other University
9.	Dr. Kishor D. Kucche	Expert from other University
10.	Mr. Amit Patil	Industry Expert
11	Dr. Haribhau R. Bhapkar	Meritorious Alumni
12.	Ms. Pranali Jadhav	Student Representative
13.	Mr. Ankita Anpat	Student Representative

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
(Autonomous)

Credit Distribution Structure for (M.Sc. Mathematics) Part-I (2023 Pattern)

Year	Level	Sem.	Major		Research Methodology (RM)	OJT/ FP	RP	Cum. Cr.
			Mandatory	Electives				
I	6.0	Sem-I	MAT-501-MJM: Measure Theory and Integration(**Credit 04**) MAT-502-MJM: Advanced Calculus (**Credit 04**) MAT-503-MJM: Practical in Ordinary Differential Equations(**Credit 02**) MAT-504-MJM: Programming in C (**Credit 02**)	MAT-511-MJE (A): Numerical Analysis (**Credit04**) **OR** MAT-511-MJE (B): Group Theory(**Credit 04**)	MAT-521-RM: Research Methodology in Mathematics (**Credit 04**)	--	--	**20**
		Sem- II	MAT-551-MJM: Complex Analysis (**Credit 04**) MAT-552-MJM:Topology (**Credit 04**) MAT-553-MJM: Practical in Partial Differential Equations (**Credit 02**) MAT-554-MJM: Programming in C++ (**Credit 02**)	MAT-561-MJE(A): Number Theory(**Credit04**) **OR** MAT-561-MJE(B): Rings and Modules(**Credit04**)	--	MAT-581-OJT/FP **Credit 04**	--	**20**
Cum. Cr.			**24**	**8**	**4**	**4**	**--**	**40**

*** 1 credit = 15 Hr.**

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati (Autonomous)

Course Structure for (M.Sc. Mathematics) Part-I (2023 Pattern)

Sem	Course Type	Course Code	Course Title	Theory/ Practical	No. of Credits
I	Major (Mandatory)	MAT-501-MJM	Measure Theory and Integration	Theory	04
	Major (Mandatory)	MAT-502-MJM	Advanced Calculus	Theory	04
	Major (Mandatory)	MAT-503-MJM	Practical in Ordinary Differential Equations	Practical	02
	Major (Mandatory)	MAT-504-MJM	Programming in C	Practical	02
	Major (Elective)	MAT-511-MJE (A)	Numerical Analysis	Theory	04
		MAT-511-MJE (B)	Group Theory	Theory	
	Research Methodology (RM)	MAT-521-RM	Research Methodology	Theory	04
	Total Credits Semester I				**20**
II	Major (Mandatory)	MAT-551-MJM	Complex Analysis	Theory	04
	Major (Mandatory)	MAT-552-MJM	Topology	Theory	04
	Major (Mandatory)	MAT-553-MJM	Practical in Partial Differential Equations	Practical	02
	Major (Mandatory)	MAT-554-MJM	Programming in C++	Practical	02
	Major (Elective)	MAT-561-MJE(A)	Number Theory	Theory	04
		MAT-561-MJE(B)	Rings and Modules	Theory	
	On Job Training (OJT)/Field Project (FP)	MAT-581-OJT/FP	On Job Training Filed Project	Training/ Project	04
	Total Credits Semester-II				**20**
Cumulative Credits Semester I and II					**40**

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the Programme : M.Sc (Mathematics)

Program Code : PSMAT

Class : M.Sc.I

Semester : II

Course Type : Major (Mandatory)

Course Name : Complex Analysis

Course Code : MAT-551-MJM

No. of Lectures : 60

No. of Credits : 4

Course Objectives:

1. To understand and learn to use Argument principle.
2. To study techniques of complex variables and functions together with their derivative, Contour integration and transformation.
3. To study complex power series and classification of singularities.
4. To study calculus of residue and its applications in the evaluation of integrals.
5. To understand range of analytic functions.
6. To understand the modulus of a complex valued functions and results regarding that,
7. To understand Gamma and Zeta functions, their properties and relationships.

Course Outcomes:

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

CO1: Represent complex numbers algebraically and geometrically.
CO2: Analyze limit, continuity and differentiation of functions of complex variables.
CO3: Understand Cauchy-Riemann equations, analytic functions and various properties of analytic functions.
CO4: Understand Cauchy theorem and Cauchy integral formula and apply these to evaluate complex contour integrals.
CO5: Classify singularities and poles and evaluate complex integration using the residue theorem.
CO6: Understand conformal mapping.
CO7: Find the Taylor's series of a function and determine its circle of convergence.

Topics and Learning Points

Teaching Hours

UNIT1: The Complex number system **04**
1.1 The field of Complex numbers
1.2 The Complex plane
1.3 Polar representation and roots of complex numbers
1.4 Lines and half planes in the Complex plane

UNIT2: Elementary properties and examples of Analytic functions **16**
2.1 Power Series
2.2 Analytic Functions
2.3 Analytic functions as mapping, Mobius transformation

UNIT3: Complex Integration **16**
3.1 Power series representation of analytic functions
3.2 Zeros of analytic function
3.3 The index of a closed curve
3.4 Cauchy's Theorem and Integral formula
3.5 The homotopic version of Cauchy's Theorem and simple connectivity
3.6 Counting zeroes; the Open Mapping Theorem
3.7 Goursat's Theorem

UNIT4: Singularities **16**
4.1 Classification of singularities
4.2 Residues
4.3 The Argument Principle

UNIT5: The Maximum Modulus Theorem **08**
5.1 The Maximum Principle
5.2 Schwarz's Lemma
5.3 The gamma function
5.4 The Riemann zeta function

Text Book:

John B. Conway: Functions of one complex variable (Narosa Publishing house)

UNIT1: Sections 1.2 to 1.5
UNIT2: Sections 3.1 to 3.3
UNIT3: Sections 4.2 to 4.8
UNIT4: Sections 5.1 to 5.3
UNIT 5: Sections 6.1 to 6.2 and 7.7 to 7.8.

Reference Books:

1. S. Ponnusamy, Foundation of Complex Analysis, Narosa Publications, Second Edition.
2. E. Stein and Shakarchi, Complex Analysis, Overseas Press (India) Ltd.
3. Lars V. Ahlfors, Complex Analysis, McGrawHill.
4. Ruel V. Churchill, James Ward Brown, Complex Variables and Applications, McGraw Hill.
5. Anant R. Shastri, Basic Complex Analysis of One Variable, Macmillan publishers India, 2010.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the Programme : M.Sc (Mathematics)
Program Code : PSMAT
Class : M.Sc.I
Semester : II
Course Type : Major (Mandatory)
Course Name : Topology
Course Code : MAT-552-MJM
No. of Lectures : 60
No. of Credits : 4

Course Objectives:

1. To develop the student's ability to handle abstract ideas of Mathematics and Mathematical proofs.
2. To introduce the fundamental ideas of Topological Spaces.
3. To provide knowledge of the point set topology and understand the significance of topology and metric spaces
4. To acquaint students with homeomorphism and some topological properties like connectedness, compactness, etc.
5. To introduce the properties of continuous mappings and basic theorems on topological spaces.
6. To get familiar with concepts such as basis, open sets, closed sets, interior, closure and boundary etc.
7. Create new topological spaces by using subspace, product and quotient topologies etc.

Course Outcomes:

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

CO1: Construct maps between topological spaces.
CO2: Understand difference between Metric Spaces and Topological Spaces.
CO3: Classify certain topological spaces based on topological properties like Connectedness and compactness.
CO4: Understand the separation axioms, metrizable spaces, first and second countability axioms among various spaces.
CO5: Demonstrate an understanding of the concepts of metric spaces and topological spaces, and their role in mathematics.
CO6: Prove basic results about completeness, compactness, connectedness and convergence within these structures.
CO7: Prepare for studying advanced research level courses on Topology.

Topics and Learning Points

	Teaching Hours
UNIT1: Topological Spaces	**15**
1.1 Finite sets	
1.2 Countable and Uncountable Sets	
1.3 Well Ordered Sets	
1.4 Topological Spaces	
1.5 Basis for a Topology	
1.6 Order Topology	
1.7 Product Topology on X× Y	
1.8 Subspace Topology	
UNIT2: Continuous Functions	**10**
2.4 Closed Sets and Limit Points	
2.5 Continuous Functions	
2.6 The Product Topology, Metric Topology	
2.7 Quotient Topology	
UNIT3: Connected and Compact Spaces	**20**
3.1 Connected spaces	
3.2 Connected Subspaces of Real Line	
3.3 Components and Local Connectedness	
3.4 Compact spaces	
3.5 Compact Subspaces of the Real Line	
3.6 Limit point compactness	
3.7 Local Compactness	
UNIT4: Countability and Separation Axioms	**15**
4.1 The Countability Axioms	
4.2 The Separation axioms and Normal Spaces	
4.3 Urysohn Lemma	
4.4 The Urysohn Metrization Theorem (Without proof)	
4.5 Tietze Extension Theorem (Without proof)	
4.6 Tychonoff's Theorem (Without proof)	

Text Book:

James R. Munkres, Topology Second Edition (Prentice Hall), 2000.

Unit 1- Chapter 1: 6, 7, 10, Chapter 2: 12 to 16.
Unit 2- Chapter 2: 17 to 22.
Unit 3- Chapter 3: 23 to 29.
Unit 4- Chapter 4: 30 to 35, Chapter 5: 37.

References:

1. J. L. Kelley, General Topology, Springer.
2. Sidney A. Morris, Topology without Tears.
3. S. Willard, General Topology, Addison-Wesley Publishing Company
4. L.A. Steen and J.A. Seebach Jr., Counterexamples in Topology.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the programme : M.Sc (Mathematics)

Programme Code : PSMAT

Class : M.Sc.I

Semester II

Course Type : Major (Mandatory)

Course Name : Practical in Partial Differential Equations

Course Code : MAT-553-MJM

No. of Lectures : 60

No. of Credits : 2

Course Objectives:

1. To develop an understanding of numerical methods for partial differential equations.
2. To familiarize the students with first and higher order partial differential equations and their classification.
3. Students will learn the separation of variables method to solve linear parabolic, elliptic and hyperbolic partial differential equations.
4. Applications of partial differential equations in other subject and real world problems.
5. To apply problem solving using concepts & techniques from partial differential equations & Fourier analysis applied to diverse situations in physics, engineering, financial mathematics & in other mathematical context.
6. To introduce various applications of PDEs in many fields of science.
7. Determine the order and classification of PDEs.

Course Outcomes:

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

CO1: Student will be able to understand the formation and solution pf PDE of first and second order.

CO2: Student will solve first order linear and non Linear PDE by using Charpit and Jacobi method.

CO3: Student will be able to understand the basic properties of standard PDE's

CO4: Student will be able to use PDE's to find solutions of wave equation and laplace equation.

CO5: Student will be able to understand how to solve the given standard partial differential equations.

CO6: Students will be able to determine the type of a second order PDE.

CO7: Students should be able to distinguish between linear, nonlinear PDEs.

Topics and Learning Points	Teaching Hours
Unit 1 Pfaffian Differential Equations	**15**
1.1 Genesis of first order P.D.E.	
1.2 Classification of integrals	
1.3 Linear equations of the first order	
1.4 Pfaffian differential equations	
Unit 2 Charpit's and Jacobi's methods	**15**
2.1 Compatible systems of first order P.D.E.	
2.2 Charpit's Method	
2.3 Jacobi's Method	
Unit 3 Classification of Second Order P.D.E.	**15**
3.1 Genesis of second order P.D.E	
3.2 Classification of second order P.D.E.	
3.3 One Dimensional Wave Equation	
Unit 4 : Applications of Second Order P.D.E.	**15**
4.1 Laplace's equation	
4.2 Heat Conduction Problem	

Text Book:

T. Amarnath, An Elementary Course in Partial Differential Equations, 2nd edition, Narosa Publishing House.

UNIT 1: Sections 1.2 to 1.5
UNIT 2: Sections 1.6 to 1.8
UNIT 3: Sections 2.1 to 2.2 and 2.3.1, 2.3.2, 2.3.3
UNIT 4: Sections 2.4 (2.4.1, 2.4.3, 2.4.4, 2.4.5) and 2.5(2.5.1, 2.5.2).

References:

1. K. Sankara Rao, Introduction to partial differential equation, third edition.
2. I.N. Sneddon, Elements of partial differential equations, Mc-Graw Hill Book Company.
3. W. E. Williams, Partial Differential equations, Clarendon press-oxford.
4. E. T. Copson, Partial differential equations, Cambridge university press.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the programme : M.Sc. (Mathematics)
Program Code : PSMAT
Class : M.Sc. -I
Semester : II
Course Type : Major (Mandatory)
Course Name : Practical programming in C++
Course Code : MAT-554-MJM
No. of Lectures : 60
No. of Credits : 2

Course Objectives:

1. To understand basic programming in C++.
2. To study mathematics using programming and the basic syntax of c++.
3. Understand the OOP principles, objects, inheritance and polymorphism.
4. Understand the proficiency in using pointers and references to work.
5. To develop and understand the representation of numbers in c++.
6. Solve a specific problem or perform a task efficiently using C++.
7. Break the program into smaller, functions for easier maintenance and understanding.

Course Outcomes:

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

CO1: Describe and use constructors and destructors
CO2: Use fundamentals of C programming to implement algorithms in mathematics.
CO3: Develop a C ++ program.
CO4: Exploring C++ programming.
CO5: Managing input and output operations.
CO6: Understand the basics of file handling mechanisms.
CO7: Solve repetitive work using C++ programming.

Topics and Learning Points

Teaching Hours

Theory: Programming in C++ **12**

1. Beginning with C++ and OOP programming.
2. Functions in C++ and Classes and objects.
3. Constructors and Destructors.
4. Operator overloading and type conversions
5. Inheritance: Extending classes
6. Pointers, virtual Functions and Polymorphism

Practical's: **48**

1. Average of numbers and some basic operations on numbers
2. Identify the numbers i.e. prime number,odd number, even number.
3. Quadratic equation solver.
4. To use of class and Inline function.
5. Matrix calculator
6. Nesting of member function and arrays within a Class
7. Statistical Analysis Tool.
8. Fraction simplifier.
9. Complex number calculator
10. To use of constructors and destructors
11. Overloading Unary and Binary operator
12. Mathematical operations on string and Inheritance.

Text Book:

E Balagurusamy, Object Oriented Programming with C++

Reference Books:

1. Byron Gottfried, Schaum's series programming with C++.
2. Yashwant Kanetkar, Let us C++.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the programme : M.Sc (Mathematics)

Programme Code : PSMAT

Class : M.Sc.I

Semester : II

Course Type : Major (Elective)

Course Name : Number Theory

Course Code : MAT-561-MJE (A)

No. of Lectures : 60

No. of Credits : 4

Course Objectives:

1. To impart the knowledge of encryption and decryption techniques and their applications in managing the security of data.
2. To express the concept and results of number theory effectively.
3. To learn various arithmetic functions, Sigma function, Algebraic Numbers, and congruence relation.
4. To identify and characterize prime numbers, and recognize their significance.
5. To Learn about divisibility rules, and prime factorization.
6. To give elementary ideas from number theory this will have applications in various fields.
7. To introduce the concepts of Quadratic reciprocity.

Course Outcomes:

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

CO1: Find the quotients and remainders from integer division.
CO2: Understand the definitions of congruence, residue classes and least residues.
CO3: Identify arithmetic functions and Dirichlet multiplications.
CO4: To establish existing identities using Mobius inversion formula.
CO5: Determine multiplicative inverses modulo n, and use to solve linear congruence.
CO6: Apply the Wilsons theorem and calculate primitive roots.
CO7: Understand the concepts of legendry symbol and identify the Quadratic or non-Quadratic residues modulo p.

Topics and Learning Points	Teaching Hours
Unit 1: Divisibility	**10**
1.1 Divisibility in integers	
1.2 Division algorithm	
1.3 G.C.D, L.C.M	
1.4 Fundamental theorem of arithmetic	
1.5 The number of primes	
1.6 Mersene numbers and Fermat numbers	
Unit 2: Congruences	**13**
2.1 Properties of congruence relation	
2.2 Residue classes their properties Fermat's and Euler's theorems	
2.3 Wilson's Theorem	
2.4 Linear congruence of degree one	
2.5 Chinese remainder theorem	
Unit 3: Arithmetic functions	**10**
3.1 Euler function	
3.2 Greatest integer function	
3.3 Divisor function $\delta(n)$	
3.4 Mobius function $\mu(n)$	
3.5 Properties and their inter relation.	
Unit 4: Quadratic Reciprocity	**15**
4.1 Quadratic residue.	
4.2 Legendre's symbol its properties	
4.3 Quadratic Reciprocity law	
4.4 Jacobi symbol its properties	
4.5 Sums of Two Squares	
Unit 5: Some Diophantine Equations	**04**
5.1 The equation ax + by = c	
5.2 Simultaneous linear equations	
Unit 6: Algebraic Numbers	**08**
6.1 Algebraic Numbers.	
6.2 Algebraic number fields.	
6.3 Algebraic integers.	
6.4 Quadratic fields.	
6.5 Units in Quadratic fields.	
6.6 Primes in Quadratic fields.	

Text Book:

Ivan Niven, H. S. Zuckerman, An introduction to number theory, Wiley Eastern Limited.

Unit 1: Sections 1.1 to 1.3
Unit 2: Sections 2.1 to Section 2.4
Unit 3: Section 3.1, 3.3, 3.6.
Unit 4: Section 4.1 to Section 4.4
Unit 5: Section 5.1 and Section 5.2
Unit 6: Section 9.1 to Section 9.7

Reference Books:

1. T.M. Apostol, An Introduction to Analytical Number Theory, Springer International Student's Edition.
2. David M Burton, Elementary Number Theory, Universal Book Stall, New Delhi.
3. S. G. Telang, Number Theory, Tata Mc-graw Hill.
4. W. Rudin, Functional Analysis, Tata McGraw Hill.
5. G. H. Hardy, E.M.Wright, Introduction to Number Theory, Oxford university press.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the programme : M.Sc. (Mathematics)

Program Code : PSMAT

Class : M.Sc. -I

Semester : II

Course Type : Major (Elective)

Course Name : Rings and Modulus

Course Code : MAT-561-MJE(B)

No. of Lectures : 60

No. of Credits : 4

Course Objectives:

1. To understand the structure of a ring and its basic properties.
2. To understand the properties such as associativity, distributivity, and the existence of an additive identity and additive inverse.
3. To study importance of rings as a fundamental object in algebra.
4. To understand the concepts of modules as a generalization of vector spaces.
5. To know the interrelationship between Euclidean domains, principal ideal domains, and unique factorization domains.
6. To explain integral domains and fields as special types of rings.
7. To investigate polynomial rings and their properties.

Course Outcomes:

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

CO1: define a ring and recognize its fundamental properties, distinguishing it from other algebraic structure.
CO2: Understand the concept of ring homomorphisms, which are function preserves the ring structure.
CO3: Use knowledge of ideals in distinct subject problems.
CO4: To factor elements in a ring, including how to perform operations and factor polynomials within such rings.
CO5: Use the concept of ideals and how they relate to subrings, along with a deep knowledge of the quotient ring.
CO6: Understand the meaning of least common multiple of two polynomials.
CO7: Know how to add and multiply polynomials over arbitrary fields, and be able to use this to define polynomial rings.

Topics and Learning Points

Teaching Hours

UNIT 1: Rings **12**

1.1 Rings of continuous functions.
1.2 Matrix Ring.
1.3 Polynomial Rings.
1.4 Power series Rings.
1.5 Laurent Rings.
1.6 Boolean Ring.
1.7 Direct Products.
1.8 Several Variables.
1.9 Opposite Rings.
1.10 Characteristic of a Ring.

UNIT 2: Ideals **12**

2.1 Maximal Ideals.
2.2 Generators.
2.3 Basic Properties of Ideals.
2.4 Algebra of Ideals.
2.5 Quotient Rings.
2.6 Ideals in Quotient Rings.
2.7 Local Rings.

UNIT3: Homomorphism of Rings **12**

3.1 Fundamental Theorems.
3.2 Endomorphism Rings.
3.3 Field of fractions.
3.4 Prime field.

UNIT4: Factorization in Domains **14**

4.1 Division in Domains.
4.2 Euclidean Domains.
4.3 Principal Ideal Domains.
4.4 Factorization Domains.
4.5 Unique Factorization Domains.
4.6 Eisenstein's Criterion.

UNIT5: Modules **14**

5.1 Direct Sum.
5.2 Free Modules.
5.3 Vector Spaces.
5.4 Quotient Module.
5.5 Homomorphism
5.6 Simple Modules.
5.7 Modules over PID's.

Text Book:

C. Musili, Rings and Modules, Narosa Publishing House.

Unit 1: Section1.1.1 to 1.12
Unit 2: Section 2.1 to 2.8

Unit 3: Section3.1 to 3.5
Unit 4: Section4.1 to 4.6
Unit 5: Section5.1 to 5.8

Reference Books:

1. Bhattacharya, Nagpaul and Jain, Basic Abstract Algebra, Cambridge University Press.
2. Luther and Passi, Algebra II, Narosa Publishing House.
3. David S. Dummit, Richard M. Foote, Abstract Algebra.

CBCS Syllabus as per NEP 2020 for M.Sc. I (2023 Pattern)

Name of the Programme : M.Sc. (Mathematics)
Program Code : PSMAT
Class : M.Sc.I
Semester : II
Course Type : OJT/FP
Course Name : On Job Training
Course Code : MAT-581-OJT/FP
No. of Lectures : 60
No. of Credits : 4

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