



Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Name of the Program: B.Sc. in Mathematics

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA101	DC	Abstract Algebra I	60	20	20	-	-	4	-	-	4

Course Objective

To introduce the students to the Sylow theory, field extension and Galois theory.

Course Outcomes

After the successful completion of this course, students will be able to:

1. Understand and apply the basics of Sylow's theory.
2. Understand fundamental principles of field extensions.
3. Analyse and demonstrate examples of Galois theory and splitting fields.
4. Use the concepts of automorphisms and isomorphism over fields.
5. Apply algebra to solve problems in other areas of mathematics and other disciplines.
6. Produce rigorous proofs in the context of abstract algebra.

Course Content:

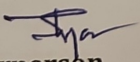
UNIT – I

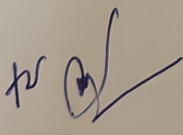
Sylow Theorem: p -group, Cauchy Theorem, Sylow Theorem, Sylow p -subgroups, Applications of Sylow Theory: Application to p -groups and Class equation (Text 1. Section 36, 37.1-37.6).

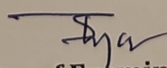
UNIT – II

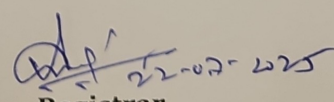
Extension Fields: Introduction to Extension Fields, Kronecker's Theorem, Algebraic and Transcendental Elements, Irreducible Polynomials, Simple Extensions. (Text 1: Section 29, 30.23)

Algebraic Extension: Finite Extensions, Algebraic Closed Fields and Closure. (Text 1: Section 31)


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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA101	DC	Abstract Algebra I	60	20	20	-	-	4	-	-	4

UNIT – III Automorphisms of Fields: Automorphisms and Fixed Fields. The Frobenius Automorphism. (Text 1: Section 48)

The isomorphism Extension Theorem: The Extension Theorem, Isomorphism Extension Theorem, The Index of Field Extension. (Text 1: Section 49)

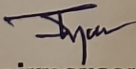
UNIT – IV Splitting Fields: Definition, Properties and Examples (Text 1: Section 50).

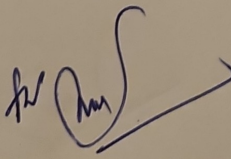
Separable Extension: Multiplicities of Zeros of a Polynomial, Separable Extension, Perfect Fields, The Primitive Element Theorem Totally Inseparable Extension. (Text 1: Section 51, 52)

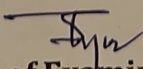
UNIT – V Galois Theory: Normal Extension, The Main Theorem of Galois Theory, Galois Group over Finite Fields. (Text 1: Section 53)

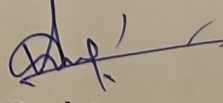
Texts:

1. John B. Fraleigh, A First Course in Abstract Algebra, Narosa Publication.
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, Cambridge University Press.
3. Herstein, I.N., Topics in Abstract Algebra, Wiley Eastern Limited. Hungerford, T.W., Algebra, Springer.
4. Jacobson, N., Basic Algebra, I & II, Hindusthan Publishing Corporation, India.
5. V. Sahi and V. Bisht, Algebra, Narosa Publication.


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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA102	DC	Real Analysis	60	20	20	-	-	4	-	-	4

Course Objective

To introduce the students to the Fundamentals of the Real Analysis.

Course Outcomes

After the successful completion of this course, students will be able to:

- 1. understand and apply the basics of the Riemann-Stieltjes Integral.*
- 2. understand and apply the concepts of convergence and uniform convergence.*
- 3. apply Power Series and Linear Transformations.*
- 4. Illustrate and demonstrate the functions of several variables in the context of their differentiability and Integrals.*

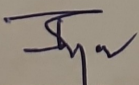
Course Content:

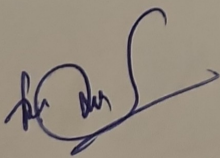
UNIT – I:

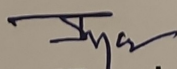
Definition and existence of Riemann-Stieltjes Integral and its properties, Integration and Differentiation, Fundamental Theorem of Calculus, Integration by Parts (Text 1: Chapter 6, Sec. 6.1-6.22).

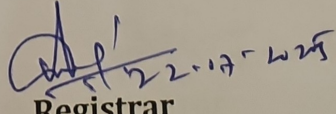
UNIT – II:

Integration of Vector-valued Functions, Rectifiable Curves, Sequence and Series of Functions: Weierstrass M Test, Abel's and Dirichlet's Test for Uniform Convergence, Uniform Convergence and Continuity. (Text 1: Chapter 6, Sec. 6.23-6.27, Chapter 7, Sec 7.1-7.15).


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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA102	DC	Real Analysis	60	20	20	-	-	4	-	-	4

UNIT – III:

Uniform Convergence and Riemann-Stieltjes Integration, Uniform Convergence and Differentiation, Equicontinuous Families of Functions, Stone-Weierstrass Theorem (Text 1: Chapter 7, Sec. 7.16-7.33).

UNIT – IV:

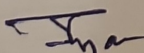
Some Special Functions: Power Series, The Exponential and Logarithmic Functions, The Trigonometric Functions, The Algebraic Completeness of the Complex Field, Functions of Several Variables: Linear Transformation. (Text 1: Chapter 8, Sec. 8.1-8.8, Chapter 9, Sec. 9.1-9.9).

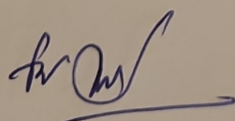
UNIT – V:

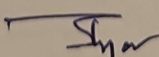
Functions of Several Variables: Differentiation, Chain Rule, Partial Derivatives, The Contraction Principle, The Inverse Function Theorem, The Implicit Function Theorem, Derivatives of Higher Order, Differentiation of Integrals. (Text 1: Chapter 9, Sec. 9.10-9.29, 9.39-9.43).

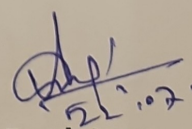
Texts:

1. W. Rudin, Principles of Mathematical Analysis, *Third Edition*, McGraw-Hill Book Co.
2. C.D. Aliprantis, O. Burkinshaw, *Principles of Real Analysis*, 3rd Edition, Harcourt Asia Pte Ltd., 1998.
3. H.L. Royden, *Real Analysis*, 3rd Edition, Macmillan, New York & London, 1988.
4. T.M. Apostol, *Mathematical Analysis*, Narosa.
5. Introduction to Real Analysis, 4th Edition by Robert G. Bartle and Donald R. Sherbert (<https://sciencemathematicseducation.files.wordpress.com/2014/01/0471433314realanalysis4.pdf>)


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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA103	DC	Complex Analysis I	60	20	20	-	-	4	-	-	4

Course Objective

To introduce the students to the Fundamentals of the Complex Analysis.

Course Outcomes

After the successful completion of this course, students will be able to:

- 1. understand and represent complex numbers algebraically and geometrically*
- 2. define and analyze limits and continuity for complex functions as well as consequences of continuity*
- 3. evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula*
- 4. illustrate functions by Taylor, power and Laurent series, identify singularities and poles*
- 5. apply power series methods for solving multiple physical and engineering problems*

Course Content:

Unit I:

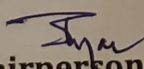
Complex Numbers: Complex Numbers, Geometrical representation, Complex Conjugate, Modulus and Argument, Properties of Modulus, Properties of Arguments, Inequalities of Modulus, Cauchy's Inequality, D'Moivre's Theorem, Limit and Continuity, Analytic Function, C-R equations, Conjugate and Harmo. Functions.

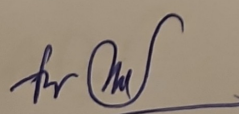
(Text 1: Chapters 1 and 2)

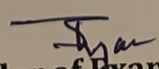
Unit II:

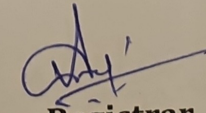
Complex Integration, Cauchy's Fundamental Theorem, Cauchy-Goursat Theorem, Cauchy Integral Formula Higher Order Derivatives, Extension of Cauchy Theorem to multiply connected regions.

(Text 1: Chapter 3: Sections 3.1-3.4,3.6)


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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA103	DC	Complex Analysis I	60	20	20	-	-	4	-	-	4

Unit III:

Morera's Theorem, Cauchy's Inequality, Liouville's Theorem, The Fundamental Theorem of Algebra, Taylor's Theorem, Problems based on Taylor's Theorem.

(Text 1: Chapter 3: Sections 3.7-3.8, 3.10 Only Taylor's Theorem, Theorem 5-8 and Theorem 13)

Unit IV:

The Maximum Modulus Principle, Schwartz Lemma, Laurent Series, Problems based on the Laurent Series, and the Uniqueness of Laurent Expansion.

(Text 1: Chapter 3: Sections 3.9-3.10 (Laurent Theorem), Theorem 9-11, 14-15)

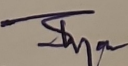
Unit V:

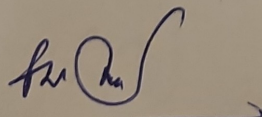
Bilinear Transformation, Fixed Points, Critical Points, Cross-ratio, Normal Form of a Bilinear Transformation and Problems, Mapping by Elementary Transformations (Translation, Rotation, Magnification, Rotation and Magnification, Inversion), Conformal Mappings, Necessary and Sufficient Condition for Conformal Mapping.


(Text 1: Chapter 6)

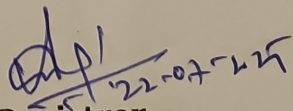
Text Books:-

1. B. Singh, V. Karanjgaokar, R.S. Chandel, *Complex Analysis*, Golden Valley Publ., Agra.
2. J.B. Conway, *Functions of one complex variable*, Second Edition, Narosa Publishing
3. L.V. Ahlfors, *Complex Analysis*, McGraw-Hill, 1979.
4. W. Rudin, *Real and Complex Analysis*, McGraw-Hill Book Co., 1966.
5. S. Ponnusamy, *Foundations of Complex Analysis*, Narosa Publishing House, 1997.


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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA104	DC	Topology I	60	20	20	-	-	4	-	-	4

Course Objective

To introduce the students to the Fundamentals of the Topology.

Course Outcomes

After the successful completion of this course, students will be able to:

- 1. use sets and functions, images and preimages, and you can distinguish between finite, countable, and uncountable sets*
- 2. understand and construct the topological spaces*
- 3. establish continuity in equivalent forms*
- 4. apply and analyse countability axioms to real-world problems*

Course Content:

Unit I:

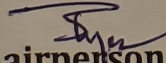
Finite and Infinite Sets, Countable and Uncountable Sets, Schroeder-Bernstein Theorem, Axiom of Choice, Well-ordered Set. Cardinal Numbers and its Arithmetic, Zorn's Lemma (Text 1. Sections 6,7,9,10,11).

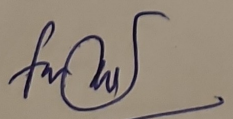
Unit II:

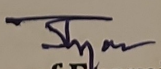
Definition and Examples of Topological Space, Bases and Subbases, Order Topology, Product Topology, Subspace and Relative Topology. (Text 1. Section 12 to 16)

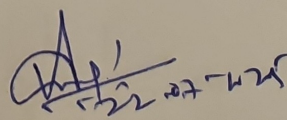
Unit III:

Closed Sets and Limit Points, Closure of a Set, Dense Subsets, Interior Exterior and Boundary of Sets, Neighborhoods and Neighborhood Systems. Continuous Functions and Homeomorphism, Examples. (Text 1. Section 17.1 to 17.7, 18)


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			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
MSMA104	DC	Topology I	60	20	20	-	-	4	-	-	4

Unit IV:

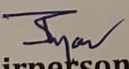
Connected Spaces, Connected Subspaces of the Real Line, Path Connectedness, Components and Local Connectedness (Text 1. Section 23 to 25).

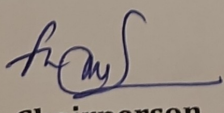
Unit V:

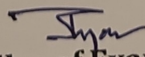
The Countability axiom, First and Second Countable Space, Lindelöf Theorem, Separable Space, Second Countability and Separability Hausdorff space. (Text 1. Section 17.8 to 17.10, 30)

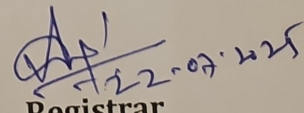
Text Books:

1. James R. Munkres, Topology, A First Course, Prentice Hall of India Pvt. Ltd. New Delhi.
2. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill.
3. K.D. Joshi, Introduction to General Topology, Kelley, Eastern
4. K.P. Gupta, Topology, Pragati Prakashan.


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Name of the Program: Undergraduate Programs

SUBJECT CODE	Category	SUBJECT NAME	Teaching & Evaluation Scheme								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSCMT701	Major	Research Methodology	60	20	20	-	-	4	0	0	4

Course Objective

To introduce the students to Research Methodology Techniques.

Course Outcomes

After the successful completion of this course, students will be able to:

1. Understand notions and ideas of basic set theory
2. Understand and apply the Research Methodology Techniques.
2. Able to know scientific writing.
3. Able to apply the techniques of scientific writing and mathematical presentation.

Course Content:

UNIT-I

The axiom of extension, The axiom of specification, Unordered pairs, Unions and intersections, Complements and powers, Ordered pairs, Relations, Functions, Families, Inverses and composites, Numbers, and the Peano axioms.

UNIT-II

How to Learn Mathematics: Why learn mathematics? Studying mathematics, homework assignments, problem-solving, tests, and inspirations.

How to Write Mathematics: What is the goal of mathematical writing? General principles of mathematical writing, writing mathematical sentences, avoiding errors, writing mathematical solutions and proofs, writing longer mathematical works, the revision process.

UNIT-III

How to Research Mathematics: What is mathematical research? Finding a research topic, general advice, taking basic steps, fixing common problems, using computer resources, and practicing good mathematical judgment. How to Present Mathematics, why give a presentation of mathematics? Preparing your talk, Dos, and DON'Ts, using technology, answering questions, and publishing your research.

UNIT-IV

Getting Started with LATEX, what is TEX? What is LATEX, how to create LATEX files, how to create and typeset a simple LATEX document, how to add basic information to your document, and how to do elementary mathematical typesetting? What is Beamer? How to think in terms of frames? How to set up a Beamer document? How to enhance a Beamer presentation? How to learn more?

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Name of the Program: Undergraduate Programs

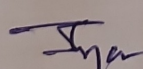
SUBJECT CODE	Category	SUBJECT NAME	Teaching & Evaluation Scheme								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM	MST	Q/A	END SEM	Q/A				
BSCMT701	Major	Research Methodology	60	20	20	-	-	4	0	0	4

UNIT-V

Publication Ethics: Definition, introduction, and importance of publication ethics; Best practices /standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; Publication misconduct: Definition, concept, problems that led to unethical behaviour and vice versa, types; Violation of publication ethics, authorship, and contributorship; Identification of publication misconduct, complaints and appeals; Predatory publishers and journals.

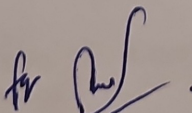
Reference Books:

1. Naive set theory: Paul R. Halmos, Courier Dover Publications, 2017.
2. A student's guide to the study, practice, and tools of modern mathematics: Donald Bindner and Martin Erickson. CRC Press, ISBN: 978-1-4398-4606-3
3. University Grants Commission (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulations 2018 (The Gazette of India: Extraordinary, Part-iii-Sec.4)
4. Kitsakorn Locharoenrat, Research Methodologies for Beginners, Pan Stanford Publishing Pte. Ltd., Singapore, 2017.
5. Anthony, M., Graziano, A.M. and Raulin, M.L., Research Methods: A Process of Inquiry, Allyn and Bacon, 2009.
6. Committee on Publication Ethics- COPE (<https://publicationethics.org/>)


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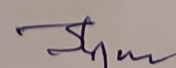
Board of Studies

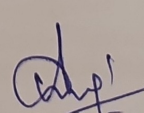
Shri Vaishnav Vidyapeeth
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Chairperson

Faculty of Studies

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