Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur (C.G.)

Scheme and Syllabus

of

M. Sc. (Maths)

Program Code: MSCMATHR115

Semester system for affiliated college
(As per LOCF and credit system)

w.e.f. 2023-2024

(As approved by AC and EC meetings held on 16.08.2023 and 18.04.2023 respectively)

Scheme of M.Sc. Mathematics Program under Semester System

Program Code: MSCMATHR115

Semester	N.	Course Code	Subject Name	Credit			Total Credit	Marks			
								ESE	IA	Total	
				L	P	T				Max	Min
First	1	MATHT101	Advanced Abstract Algebra - I	3	0	1	4	80	20	100	36
	2	MATHT102	Real Analysis- I	3	0	1	4	80	20	100	36
	3	MATHT103	Topology- I	3	0	1	4	80	20	100	36
	4	MATHT104	Complex Analysis- I	3	0	1	4	80	20	100	36
	5	MATHT105	Advanced Discrete Mathematics- I	3	0	1	4	80	20	100	36
		Subtotal					20				
Second	1	MATHT201	Advanced Abstract Algebra- II	3	0	1	4	80	20	100	36
	2	MATHT202	Real Analysis - II	3	0	1	4	80	20	100	36
	3	MATHT203	Topology- II	3	0	1	4	80	20	100	36
	4	MATHT204	Complex Analysis-II	3	0	1	4	80	20	100	36
	5	MATHT205	Advanced Discrete Mathematics-II	3	0	1	4	80	20	100	36
		Subtotal					20				

Abbreviations used:

ESE: End Semester Exam
IA: Internal Assessment

NAME OF PROGRAM: M.Sc. Mathematics

Program Outcomes:-

Program outcomes describe what students are expected to know or be able to do by the time of Post-Graduation. On completion of M.Sc. Mathematics program students will be able to-

1. Understand fundamental axioms in Mathematics and capability of developing ideas based on them.
2. Develop proficiency in the analysis of complex physical problems and the use of mathematical or other appropriate technique to solve them.
3. Inculcate critical thinking to carry out scientific investigation objectively without being biased with preconceived notions.
4. Equip with skills to analyze problems, formulate a hypothesis, evaluate and validate results and draw reasonable conclusion thereof.
5. Gain advanced knowledge on topics in pure mathematics, empower to pursue higher degrees at reputed academic institutions.
6. Pursue research or careers in industry in mathematical sciences and allied fields.
7. Gain knowledge of a wide range of mathematical technique and application of mathematical methods/tools in other scientific and technological domains.
8. Gain advanced knowledge on topics in pure mathematics, empowering the students to pursue higher degrees at reputed academic institutions.
9. Gain strong foundation on Algebraic Topology and representation theory and good understanding o number theory which can be used in modern online cryptographic technologies.
10. Provide a systematic understanding of the concepts and theories of mathematics and their applications in the real world-to an advanced level, and enhance career prospects in a huge array of fields.
11. Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standard of ethical issues in mathematical sciences.
12. Select, interpret, and critically evaluate information from a range of sources that include books, scientific reports, journals, case studies and internet.
13. Recognize the needs to engage in lifelong learning through continuing education and research.

S.N.	Member Name	Signature
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Part A: Introduction				
Program: M.Sc. Mathematics		Semester: I	Year: 2023-24	w.e.f.:2023-2024
1.	Course Code	**MATHT101**		
2.	Course Title	ADVANCED ABSTRACT ALGEBRA -I		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain skills of solving problems using powerful concepts of group action. • Gainknowledge of Normal Series, Solvable groups, Nilpotent groups. • Gain ability to deal with module theory which is indispensable in wide ranges of mathematical disciplines. • Gain knowledge of Nilpotent and Nil ideals. • Gain knowledge of representation and rank of linear mapping.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Group**- Permutation group, Normal subgroup, Three Isomorphism Theorems, Correspondence Theorem, Maximum Normal subgroup, Automorphism and inner Automorphism, Centre of groups.	12
II.	**Normal Series**- Normal and Subnormal series, Composition Series, Jordan-Holder theorem, Solvable groups. Nilpotent groups.	12
III.	**Rings & Ideals**- Definitions, Maximal and prime ideals, Nilpotent and Nil Ideals,Zorn's Lemma (statements only) its application to obtain maximal Ideals.	12
IV.	**Modules**-Definition and examples of sub-modules, Quotient Modules, Direct sum, Modules generated by a set R, Homomorphism of Modules, Isomorphism Theorem, Exact sequence of modules, Short Exact Sequence.	12

V.	**Modules and Vector Space-** Cyclic modules, Semi Simple Modules, Simple Modules, Schur's Lemma, Free Modules, Representation of Linear mapping, Rank of Linear mapping, Rank Nullity Theorem.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. P.B. Bhattacharya S.K.Jain and S. R. Nagpaul, Basic Abstract Algebra (2nd Ed.), Cambridge University Press Indian Edition, 1997.

Reference Books:

1. I.S. Luther & IBS Passi, Algebra Vol. I, II & III Narosa Pub. House, New Delhi.
2. I. N. Herstein, Topic in Algebra, Wiley Eastern, New Delhi.
3. S. Lang: Algebra, 3rd Edition Addison-Wesley, 1993.
4. N. Jacobson. Basic Algebra vols I & II, Hindustan Publishing Company, 1980.

E-Resources:

1. **https://onlinecourses.nptel.ac.in**
2. **https://epgp.inflibnet.ac.in**
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Part A: Introduction				
Program: M.Sc. Mathematics		Semester: I	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MATHT102**		
2.	Course Title	Real Analysis -I		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain the knowledge of Riemann-StieltjesIntetgral, Sequence and Series of Functions, Power Series, Function of Several Variables. • Gain the knowledge of Differentiability of Function in Several Variables and their relation to Partial Derivatives. • Develop competency to apply Implicit and Inverse Function Theorems and moving towards Calculus of Manifolds. • Gain Knowledge of Riemann-Stieltjes Integral of Real Valued Function on Intervals and its extension to Complex and Vector-Valued Functions on Interval.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Total Number Lectures : 60		
Unit	**Topics**	**Total Hours**
I.	**The Riemann-Stieltjes Integral** : Definition and existence of Riemann-Stieltjes integral, Properties of the Integral, Integration and Differentiation, The Fundamental Theorem of Calculus, Integration of Vector-Valued Function, Rectifiable Curves.	12
II.	**Sequence and Series of Functions:** Point wise and Uniform Convergence, Cauchy Criterion for Uniform Convergence, Weierstrass M-Test, Abel's and Dirichlet's Tests for Uniform Convergence, Uniform Convergence and Continuity, Uniform Convergence an Riemann-Stieltjes Integration, Uniform Convergence and Differentiation, Weierstrass Approximation Theorem.	12
III.	**Power Series:**Uniqueness Theorem for Power Series, Abel's Theorem, Taylor's Theorem, Tauber's Theorem.	12

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IV.	**Function of Several Variables:** Linear Transformation, Derivatives in an Open Subset of R^n, Chain Rule, Partial Derivatives, Contraction Principle, Derivatives of Higher Order, Inverse Function Theorem, Implicit Function Theorem.	12
V.	Extremum Problems with Constraints, Lagrange's Multiplier, Method, Differentiation of Integrals, Partitions of Unity, Differential Forms, Stoke's Theorem.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Principles of Mathematical Analysis by Walter Rudin, McGraw-Hill, Kogakusha, 1976, International Edition.
2. Real Analysis by H. L. Royden, Macmillan Pub. Co. Inc., Fourth Edition, New York 1962.

Reference Books:

1. Mathematical Analysis, T. M. Apostol, Narosa Publishing House, New Delhi, 1985.
2. Mathematical Analysis, Gabriel Klambauer, Marcel Dekkar, Inc. New York, 1975.
3. Real Analysis; an Introduction, Addison-Wesley Publishing Co., Inc., 1968.
4. Real and Abstract Analysis, E. Hewitt and K. Stromberg, Berlin, Springer, 1969.

E-Resources:

1. **https://onlinecourses.nptel.ac.in**
2. **https://epgp.inflibnet.ac.in**
3. **https://swayam.gov.in**

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Part A: Introduction				
Program: M.Sc. Mathematics		Semester: I	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MATHT103**		
2.	Course Title	Topology -I		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this coursc, the students will be able to:** • Gain knowledge of countable and uncountable sets, topological spaces, connectedness, compactness, first and second countable spaces, Projection maps, filters and their comparison. • Gainskills to define topological spaces, product topology, metric topology, quotient space. • Gaincompetency to discuss continuous functions, connected space, compact space, complete metric space, related theorem on Baire space. • Gaincompetency of topological spaces and having grasp on basic result. • Gainability to express T-1, T-2, T-3 and T-4 separation axioms and use them to prove various properties.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	Definition and examples of topological spaces, closed sets, Closure Dense subsets Neighborhoods, interiors, exteriors and boundary points. Accumulation point and derived set, Closure Operator and Neighborhoods systems.	12
II.	Kuratowski space, Alternate methods of defining a topology in terms of Kuratowski Closure axioms, relative topology, subspace, hereditary property, Define open and closed subset relative to subspace of topology.	12
III.	Base for topology, sub-base, base for the neighborhood system of a point, First and second countable spaces, separable space.	12
IV.	Continues functions and Homeomorphism, Continuity in Topological spaces,sequential continuity at a point,biocontinuos function, open and closed functions,Homeomorphic functions.	12
V.	Separation axioms. T_0, T_1,, T_2, T_3, $T_{31/2}$, T_4 spaces, their characterization and basic properties, Uryshohn's lemma and Tietz Extension Theorem.	12

Part C - **Learning Resource**
Text Books, Reference Books, E-Resources

Text Books:

1. G F Simmons: Introduction to Topology and Modern Analysts, McGraw –Hill.
2. M.J Mansfield: Introduction to Topology Van Nostrand, Princeton, New Jersey, t963.
3. Jame R. Munkres: Topology, A First Couse. Prentice Hall, incorporated, 1974.
4. J. Dugundji: Topology, Boston: Allyn and Bacon, 1966 [OP].
5. B Mendelson: introduction to Topology, Dover Publications, 1990.

Reference Books:

6. J. N. Sharma: Topology, Krishna Prakashan Mandir, Meerut.
7. K. D. Joshi: introduction to General Topology, New Age international (P) Ltd. New Delhi.

E-Resources:

1. **https://onlinecourses.nptel.ac.in**
2. **https://epgp.inflibnet.ac.in**
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Part A: Introduction				
Program: M.Sc. Mathematics		Semester: I	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MATHT104**		
2.	Course Title	Complex Analysis-I		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain knowledge of complex integration, argument principle, Rouches theorem, Residues theorem, bilinear transformation, conformal mappings,Weierstrass factorization theorem, Runge's theorem, power series, canonical products, range of analytic function, Schottky's theorem, univalent function. • Gain knowledge of expressing Residue theorem and calculation of complex and real integrals. • Gain ability of calculating complex integrals using Residue theorem. • Gain ability to express logarithmic derivative and Rouche's theorem. • Gain ability of viewing analytic functions as conformal mappings		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	Complex integration, Cauchy-Goursat Theorem, Cauchy's integral Formula, Higher order derivatives.	12
II.	Morera's theorem, Cauchy inequality and Liouville theorem, the fundamental theorem of Algebra, Taylor's theorem, Maximum modulus principle. Laurent's series isolated singularities.	12
III.	Meromorphic functions, Schwartz lemma, the Argument principle, Rouche's theorem, inverse function theorem.	12
IV.	Residues, Cauchy's residue theorem, Evaluation of integrals, Branches of many values functions with special references to argz, logz. and z^8.	12

V.	Bilinear transformations, their properties and classification, Definitions and examples of conformal mappings.	12

Part C - **Learning Resource**
Text Books, Reference Books, E-Resources

Text Books:

1. B. S. Tyagi: Functions of a Complex Variable, Kedar Nath, Ram Nath Prakashan, Meerut, 1981.
2. S. Ponnusamy: Foundation of complex Analysis. Narosa publishing house 1997.
3. L. Ahlfors: Complex Analysis, McGraw Hill Education.

Reference Books:

1. J.B. Convay: Functions of one complex variable, Springer-Verlag international student Edition, Narosa publishing House, 1980.
2. D Sarason: Complex Function theory, Hindustan Book Agency, Delhi 1994.
3. J N. Sharma.: Functions of a complex variable, Krishna Prakashan Mandir, Meerut.

E-Resources:

1. **https://onlinecourses.nptel.ac.in**
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Part A: Introduction				
Program: M.Sc. Mathematics		Semester: I	Year: 2023-24	w.e.f.:2023-2024
1.	Course Code	**MATHT105**		
2.	Course Title	Advanced DiscreteMathematics -I		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain knowledge of Mathematical logic, semi groups and monoids, lattices, Boolean Algebra, logical circuit, graph theory, trees, planar graphs, matrices of graphs, directed graphs, formal languages, grammars and finite state machine. • Gainability to define semi groups, monoids homomorphism and isomorphism. • Gainability to interpret lattices, Boolean Algebra, Karnaugh map, switching circuits. • Gainability to use graphs as unifying theme for various combinatorial problems. • Gainability to illustrate tautology, tautological implications, truth tables, normal forms, principal normal forms. • Gainability to write an argument using logical notation and determine if the arguments is or is not valid.		
6.	**Credit Value**	04		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Formal logic**- Statement and Notation, Connectives- Negation, Conjunction, Disjunction Truth Table, Conditional and Bi - conditional statement, well-formed formula' Tautology, Equivalent formula, Duality and functionally complete set of connectives, two state devices and statement logic, Normal form, Principle conjunctive and Principle Disjunctive Normal forms, The theory of interface for the statement calculus, Rules of interface Automatic Theorem proving, the predicate calculus, Quantifiers, Rules of interface, Free and Bound variables, interface theory of predicate calculus' valid formulas over finite universe, valid formulas involving quantifiers, formulas involving more than one quantifiers.	12
II.	**Algebraic Structure** - Algebraic system, Semi groups and Monoids (including those pertaining to concatenation operation), Homomorphism of semi group and Sub monoids Direct products, Basic Homomorphism theorem	12
III.	**Lattices** - Lattices as partially ordered sets and their properties Lattices as Algebraic systems. Sub lattices, direct products and homomorphism, Complete, Complemented and Distributive Lattice.	12

	Lattice.	
IV.	**Boolean Algebra-** Boolean Algebras as lattices, Various Boolean identities, The switching Algebra, example, Sub algebras, Direct products and Homomorphism, Join irreducible elements, Atoms and min-terms, Boolean forms and their Equivalence Min term Boolean forms, Sum of products, canonical forms, minimization of Boolean functions.	12
V.	Application of Boolean Algebra to Switching theory (Using AND, OR' NOT gates) switching circuits and logic circuits, Relay circuits, Design and implementation of digital networks. The Karnaugh map method	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. J P. Tremblay & R. Manohar: Discrete Mathematical structure with application to computer sciences. [McGraw Hill Book Co. 1997].
2. Seymour Lepschutz. Finite Mathematics (international edition 1993) [McGraw Hill Book Co New York].
3. N Deo: Graph Theory with applications to Engineering and Computer Sciences. Prentice Hall of India.
4. S Wiitala: Discrete Mathematics - A unified approach McGraw Hill Book Co New York.
5. C. L. Liu: Elements of Discrete mathematics McGraw Hill Book Col.

Reference Books:

6. M. K. Gupta. Discrete Mathematics, Krishna Prakashan Mandir(P) Ltd , Meerut.

E-Resources:

1. **https://onlinecourses.nptel.ac.in**
2. **https://epgp.inflibnet.ac.in**
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Part A: Introduction				
Program: M.Sc. Mathematics		Semester: I	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MATHT201**		
2.	Course Title	ADVANCED ABSTRACT ALGEBRA -II		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain knowledge of Field theory. • Gainknowledge of Galois Theory. • Gainknowledge to test if a polynomial is irreducible finite field (Galois field). • Gain knowledge of Smith Normal Form, principal ideal domain in details. • Know about finitely generated modules over PID.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	Topics	Total Hours
I.	**Field Theory** - Extension field, Algebraic and transcendental extensions, Separable andinseparable extensions, Normal extension, Splitting Field, Uniqueness of Splitting field.	12
II.	**Galois Theory**-Perfect fields, Finite fields, Primitive element, Algebraically closed fields, Automorphisms of extensions, Galois extensions, Fundamental theorem of Galois Theory.	12
III.	**Smith Normal Form**- Uniform Modules, Primary Modules, Smith Normal Form over a PID and rank.	12
IV.	Noetherian and Artinian modules and rings, Hilbert basis theorem, Wedderburn–Artintheorem.	12
V.	Fundamental Structure theorem for finitely generated modules over a PID and its application to finitely generated abelian groups, Rational canonical form.	12

Part C - **Learning Resource**
Text Books, Reference Books, E-Resources

Text Books:

1. P.B. Bhattacharya, S.K. Jain and S. R. Nagpaul, Basic Abstract Algebra (2nd Ed.), Cambridge University Press Indian Edition, 1997.

Reference Books:

1. I.S. Luther & IBS Passi, Algebra Vol. I, II & III Narosa Pub. House, New Delhi.
2. I.N. Herstein, Topic in Algebra, Wiley Eastern, New Delhi.
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E-Resources:

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Part A: Introduction				
Program: M.Sc. Mathematics		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MATHT202**		
2.	Course Title	Real Analysis -II		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain the knowledge of Measurable Sets, Measurable Functions, Lebesgue Integrals, Differentiation and Integration, Lebesgue L^p Spaces. • Gain skills of establishing Measurability or Non-Measurability of Sets and Functions. • Gain skills of deciding under which conditions the Fundamental Theorem of Calculus is Applicable inthe context of Lebesgue Integration. • Develop competency of viewing Differentiation and Integration as Inverse Operations in the more general context of Lebesgue Theory.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Total Number Lectures : 60		
Unit	**Topics**	**Total Hours**
I.	**Measurable Sets**:Lebesgue Outer Measure, Lebesgue Measure, Properties of Measurable Sets, Borel Sets and their Measurability, Characterization of Measurable Sets, Non-Measurable Sets.	12
II.	**Measurable Functions:**Definition and Properties, Simple, Step and Characteristic Functions, Continuous Functions, Sets of Measure Zero, Sequence of Functions Egoroff's Theorem, Lusin Theorem, Frechet Theorem, Convergence in Measure and Riesz Theorem.	12
III.	**Lebesgue Integral:**Lebesgue Integral of Bounded Function, Comparison of Riemann Integral and Lebesgue Integral, Bounded Convergence Theorem, Integral of Non-negative Measurable Functions, Fatou's Lemma, Monotone Convergence Theorem, General Lebesgue Integral, Lebesgue Dominated Convergence Theorem.	12

IV.	**Differentiation and Integration:** Dini Derivatives, Differentiation of Monotone Functions, Lebesgue Differentiation Theorem, Function of Bounded Variation, Differentiation of Integral, Lebesgue Sets, Absolutely Continuous Functions, Integral of Derivatives.	12
V.	**Lebesgue L^p Spaces:** The Classes L^p, Holder and Minkowski Inequalities, L^p Banach Spaces, Convergence in Mean, Properties of L^p Spaces.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. Lebesgue Measure and Integration, P. K. Jain and V. P. Gupta, New Age International (P) Limited Publication, New Delhi, 1986, (Reprint 2000).
2. Real Analysis, H. L. Royden, Macmillan Pub. Co. Inc., Fourth Edition, New York 1962.

Reference Books:

1. Measure Theory and Integration, G. d Barra Wiley Eastern Limited 1981.
2. Measure and Integral: An Introduction to Real Analysis, Rechard L. Wheeden, Marcel Dekkar Inc. 1977
3. Measure Theory. P R. Halmos, Van Nostrand, Princeton, 1950.
4. Introduction to Probability and Measure, K. R. Parthasarthy, Macmillan Company of India Ltd. Delhi 1977.
5. An Introduction to Measure and Integration, Inder K. Rana, Narosa Publishing House, Delhi 1997.
6. Analysis I & II, Serge Long, Addison-Wesley Publishing Company, Inc. 1969.

E-Resources:

1. **https://onlinecourses.nptel.ac.in**
2. **https://epgp.inflibnet.ac.in**
3. **https://swayam.gov.in**

S.N.	Member Name	Signature
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02	**Dr. Smt. Kiran Lata Awasthi** Asstt. Prof. & P.G. Head, C.M. Dubey P.G. College, Bilaspur	
03	**Dr.Aradhana Sharma,** Asstt. Prof. & U.G. Head, Govt. Bilasa Girls P.G. College, Bilaspur	
04	**Shri Yatendra Kumar Upadhyay** Asstt. Prof. & U.G. Head , Govt. Niranjan Keshrwani College, Kota	
05	**Shri Dildar Singh Tandan,** Asstt. Prof. Govt. Agrasen College, Bilha	
06	**Smt. Suchitra Tiwari,** Asstt. Prof., Govt. J.P.Verma Arts & Comm. College, Bilaspur	

Part A: Introduction				
Program: M.Sc. Mathematics		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MATHT203**		
2.	Course Title	Topology -II		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain ability to express regularity and normality separation axioms and use them to prove various properties. • Gainskills to construct the product topology on product spaces. • Prove basic results about completeness, connectedness and convergence within these structures. • Learn about NETS and Convergence, Filter and Ultra filter.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Connectedness-** Connected spaces, Components of space, Locally connected spaces, totally disconnected spaces.	12
II.	**Compactness-** Basic properties of compactness, compact sub space, Finite intersection Property, Bolzano Weirstrass properties, Sequentially and Countably compact sets, Local compactness in metric space, Equivalence of compactness, countable compactness and sequential compactness in metric space, Lindeloff space and theorem.	12
III.	**Product topology** -Product topology-Tychonoff product topology in terms of standard sub-base and its characterization, Projection maps, Connectedness and product space, compactness and product space Tychonoff's theorem.	12
IV.	**Netsand Convergence** –Directed sets,Residual subset,cofinite subset,Net,Convergence of a Net,Cluster point of a net,Subnet,Hausdorffness and Nets.	12
V.	**Filters and ultra-filters-** filters, free and fixed filters, Discrete and indiscrete filter, cofinite filter, Neighborhood filter, filter base, ultra filter, convergent filter, Zorn's lemma, Characterization of ultra-filter.	12

Part C - **Learning Resource**
Text Books, Reference Books, E-Resources

Text Books:

1. G F Simmons: Introduction to Topology and Modern Analysts, McGraw –Hill.
2. M.J Mansfield: Introduction to Topology Van Nostrand, Princeton, New Jersey, t963.
3. Jame R. Munkres: Topology, A First Couse. Prentice Hall, incorporated, 1974.
4. J. Dugundji: Topology, Boston: Allyn and Bacon, 1966 [OP].
5. B Mendelson: introduction to Topology, Dover Publications, 1990.

Reference Books:

6. J. N. Sharma: Topology, Krishna Prakashan Mandir, Meerut.
7. K. D. Joshi: introduction to General Topology, New Age international (P) Ltd. New Delhi.

E-Resources:

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Part A: Introduction				
Program:M. Sc. Mathematics		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MATHT204**		
2.	Course Title	Complex Analysis-II		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain ability to represent functions as Taylor, power and Laurants series, classify singularities and poles, find residue and evaluate complex integrals using the residue theorem. • Gainability to apply problem solving using complex analysis techniques applied to diverse situation in physics, Engineering and other Mathematical contexts. • Express entire function in the form of canonical products. Also, they knowing about theory related to convergence of infinite product and expression of some well-known functions in the form of Infinite products.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	Entire Functions- Weierstress factorization theorem, Gamma function and its properties, Riemann Zeta function, Riemann's functional equation, Runge's theorem, MittagLeffler's theorem.	12
II.	Analytic continuation, uniqueness of direct analytic continuation, Uniqueness of analytic continuation along curve, Power series method of analytic continuation, Schwartz's Reflection Principle.	12
III.	Monodromy theorem and it consequences. Canonical product, Jensen's formula, Poisson- Jenson Formula, Hadamard's three circles theorem.	12
IV.	Order of an entire function, Exponent of convergence, Borel's theorem, Hadamard's factorization theorem.	12

V.	The range of and analytic function, Bloch's theorem, The little Picard theorem. Schottky's theorem, Montel Caratheodory and the Great Picard theorem. Univarient functions, Bieberbach's conjecture (statement only) and the "1/4 - theorem".	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. B. S. Tyagi: Functions of a Complex Variable, Kedar Nath, Ram Nath Prakashan, Meerut ,1981.
2. S. Ponnusamy: Foundation of complex Analysis. Narosa publishing house 1997.
3. L. Ahlfors: Complex Analysis, McGraw Hill Education.

Reference Books:

4. J.B. Convay: Functions of one complex variable, Springer-Verlag international student Edition, Narosa publishing House, 1980.
5. D Sarason: Complex Function theory, Hindustan Book Agency, Delhi 1994.
6. J N. Sharma.: Functions of a complex variable, Krishna Prakashan Mandir, Meerut.

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Part A: Introduction				
Program: M.Sc. Mathematics		Semester: II	Year: 2023-24	w.e.f.:**2023-2024**
1.	Course Code	**MATHT205**		
2.	Course Title	Advanced Discrete Mathematics -II		
3.	Course Type	**Theory**		
4.	Pre-requisite (ifany)	No		
5.	Course Learning. Outcomes (CLO)	**At the end of this course, the students will be able to:** • Gain ability to demonstrate traversal methods for trees and graphs. • Assimilate various graph theoretic concepts and familiarize with their applications. • Gain knowledge of languages and grammars, finite state machine and their transition, machine minimization and describe homomorphism automata and equivalence of its powers to that of deterministic finite automata. • Understand countable methods and Probability and Probability Inequalities.		
6.	**Credit Value**	**04**		
7.	**Total Marks**	**Internal Marks: 20** **External Marks: 80**	**Min Passing Marks:36**	

Part B: Content of the Course		
Unit	**Topics**	**Total Hours**
I.	**Grammar and Language-** Phase structure grammar, Rewriting Rules, Derivation, sentential forms, context-sensitive context, Free and Regular grammars and language, Notion of syntax, Analysis, Polish Notation, Conversion of infix experience to Polish Notation, The Rename Polish Notation.	12
II.	**Introductory Computability Theory-** Finite state machines and their Transition, Table diagrams, Equivalence of Finite state machines, reduced machines, Homomorphism Finite automata, and equivalence of its power to that of Deterministic finite automata, Moore and Mealy Machines, Turing machines and partial recursive functions.	12
III.	**Graph Theory-** Definition of (undirected) graph, paths, Circuits Cycles & Sub graphs, induced Sub graphs, Degree of a vertex, Connectivity, Planar Graphs and their properties, Euler's Formula for connected planner Graphs Complete and complete Bipartite graphs, Kuratowski's Theorem(statement only), and it's use.	12
IV.	**Tree and Cut Set-** Tree, Spanning trees. Cut sets. Fundamental cut sets and cycles, minimal spanning trees. Matrix representation of graphs, Euler's theorem on the Existence of Eulerian Paths, and circuit, Directed Graphs, in degree and out degree of a vertex, weighted undirected Graphs.	12

V.	**Permutations, Combinations and Discrete Probability-** Introduction, The Rules of Sum and Product, Permutations, Combinations, Generating of Permutations and Combinations, Discrete Probability, Conditional Probability, Baye's theorem, inverse probability, Probability inequalities (Tchebyshef, Markov, Jensen), Binomial Distribution.	12

Part C - **Learning Resource**

Text Books, Reference Books, E-Resources

Text Books:

1. J P. Tremblay & R. Manohar: Discrete Mathematical structure with application to computer sciences. [McGraw Hill Book Co. 1997].
2. Seymour Lepschutz. Finite Mathematics (international edition 1993) [McGraw Hill Book Co New York].
3. N Dco: Graph Theory with applications to Engineering and Computer Sciences. Prentice Hall of India.
4. S Wiitala: Discrete Mathematics - A unified approach McGraw Hill Book Co New York.
5. C. L. Liu: Elements of Discrete mathematics McGraw Hill Book Col.

Reference Books:

6. M. K. Gupta. Discrete Mathematics, Krishna Prakashan Mandir(P) Ltd , Meerut.
7. Odile Pons, Inequalities in analysis and probability, world scientific.

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