GOVT. M. H. COLLEGE OF HOME SCIENCE & SCIENCE FOR WOMEN (AUTONOMOUS), JABALPUR (M.P.)

PG SYLLABUS
SESSION 2023-2024

M.Sc.
MATHEMATICS

Department of Mathematics & Computers

Govt. M. H. College of Home Science & Science for Women (Autonomous) Jabalpur (M.P.)

SYLLABUS OF M.A./M.Sc. MATHEMATICS SEMESTER SYSTEM SEMESTER - I

(Session 2023 - 24 and onwards)

Syllabus opted by the board of studies in Mathematics

S.No.	Paper	Name of the Papers	Theory (MM)	Min. Pass. Mark	C.C.E	Min.Pass. Mark	Practical M.M.	Min. Pass Mark	Total
1	I	Advanced Absract Algebra - I	35	12	15	5	-	-	50
2	II	Complex Analysis - I	35	12	15	5	-	-	50
3	III	Functional Analysis	35	12	15	5	-	-	50
4	Iv	Real Analysis	35	12	15	5	-	-	50
5	V	Topology	35	12	15	5	-	-	50
6	Project / Seminar and Attendance		40 + 10						50
Grand Total									**300**

1. Project / Seminar 40 marks is allocated. Out of 40 marks, 15 marks is allocated for project file, 15 mark is allocated for presentation of their project work and 10 marks is allocated for project Viva-Voce examination.
2. In attendance 10 marks is allocated as per ordinance No. 79 of R.D. University Jabalpur.
3. The students , whose attendance is less as per ordinance No. 79 of R.D. University Jabalpur, will not be allowed to appear in the examination at the close of semester and he/she would be declared having failed in that semester.

Signature of Members of Board of Studies

Dr. K. S. Bhatia

Dr. Manju Gupta

Dr. Mridula Dube

Dr. Geeta Shrivastava 25.07.23

Dr. Kusumlata Rajak

Dr. Mandira Kar

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Department of Mathematics

Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : First
M.Sc.	Mathematics	I	35	12	Advanced Abstract Algebra - I

Unit – I

Another Counting Principle, Conjugacy relation, Normalizer, Class Equation, Cauchy theorem, Sylow's theorems, Double coset, Second & Third part of Sylow's theorem, Application of Sylow's theorems in finite groups.

Unit – II

Series of Groups: Normal and Subnormal series, Composition series, Zassenhaus lemma, Schreir refinement theorem, Jordan Holder theorem.

Unit- III

Solvable Groups and its properties, Commutator subgroup, Nilpotent Groups and its. Properties

Unit – IV

Fields: Extension field, Finite extension, Algebraic element, Algebraic and transcendental extension, Roots of polynomials, Splitting field.

Unit – V

More about roots: Derivative of a polynomial, Simple extension, Primitive element, Separable and inseparable extension, Perfect field, Finite field.

Text Book:-

1. I.N.Herstein: Topics in Algebra, Wiley Eastern, New Delhi.1975 (For Units I, III, IV, and V)
2. Vivek Sahai & Vikas Bist, Algebra, Narosa Publishing House, 1999 (For unit II)

Reference Books:-

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra (2nd Ed.), Cambridge University Press, Indian Edition, 1997
2. I.S. Luther and I.B.S. Passi, Algebra, Vol. I - Groups, Narosa Publishing House, 1996.
3. Surjeet Singh and Quazi Zameeruddin, Modern Algebra, Vikas Publishing House Pvt. Ltd., 1990.
4. N. Jacobson, Basic Algebra, Vols. I & II, Hindustan Publishing Company, 1980.
5. Advanced Abstract Algebra, H.K. Pathak, Shiksha Sahitya Prakashan.
6. Advanced Abstract Algebra, Goyal & Gupta, Pragati Prakashan

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Academic Council
Approved

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Govt. M.H. College of Home Science
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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Second
M.Sc.	Mathematics	I	35	12	Complex Analysis - I

Unit – I

Complex integration. Cauchy-Goursat theorem, Cauchy's integral formula, Higher order derivatives.

Unit – II

Morera's theorem. Cauchy's inequality. Liouville's theorem. The fundamental theorem of algebra. Taylor's theorem.

Unit- III

The maximum modulus principle. Schwartz lemma. Laurent series. Isolated singularities. Meromorphic functions. The argument principle, Rouche's theorem. Inverse function theorem.

Unit – IV

Residues Cauchy's residue theorem, Evalution of integrals. Branches of many valued functions with special reference to arg z, log z, za.

Unit – V

Bilinear transformations. Their properties and classification. Definitions and examples of conformal mappings.

Text Book:- **1.** J.B.Convey: Functions of one complex variable, Springer-verlag , 1980

Reference Books:-
1. S.Ponnuswamy, Foundations of complex analysis, Narosa Publishing House,1997
2. L.V. Ahlfors, Complex analysis ,McGraw Hill,1979
3. Complex Analysis, H. K. Pathak
4. Function of Complex Variable, Goyal & Gupta.

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Third
M.Sc.	Mathematics	I	35	12	Functional Analysis

Unit – I

Convergence, Completeness and Baire's Theorem, Cantors intersection Theorem, Continuous mappings, Uniformly continuous mapping, Spaces of continuous functions.

Unit – II

Euclidean and Unitary spaces, Cauchy, Minkowski and Holders inequalities, Normed linear spaces, Examples and elementary properties, Equivalence of norms, Banach space and examples, Continuous linear transformations.

Unit- III

Functionals and their extensions, related Lemma, Hahn-Banach Theorem for normed linear spaces, Conjugates of normed linear spaces, The natural embedding of normed linear space in its second conjugate space, Reflexive Banach spaces, open mapping theorem, Closed graph theorem.

Unit – IV

Conjugate of an operator, Uniform boundedness principle and its applications, Inner product spaces and their elementary properties, Parallelogram law, triangle inequality and Pythogorus theorem. Schwartz inequality and polarization identity, Hilbert Space and examples. orthogonal complements in Hilbert spaces.

Unit – V

Orthonormal sets, Bessel's inequality, Gram Schmidt orthonormalization process, Conjugate Space of Hilbert Space, Riesz representation theorem. Adjoint of an operator, Properties.

Text Book:- **1.** G.F. Simmons, Topology and Modem Analysis, McGraw Hill International Edition, 1963

Reference Books:- **1.** E. Kreyszig, Introductory Functional Analysis with Applications, John Wiley & Sons, New York, 1978.

2. R.E. Edwards, Functional Analysis, Dover Publ., New York, 1995.P.K. Jain, O.P. Ahuja and Khalil Ahmed, Functional Analysis, New Age International (P) Ltd. Publ.

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Fourth
M.Sc.	Mathematics	I	35	12	Real Analysis

Unit – I

Definition and existence of Riemann - Stieltjes integral and its Properties, Integration and Differentiation. The fundamental theorem of Calculus.

Unit – II

Integration of vector-valued functions, Rectifiable curves, Rearrangements of terms of a series. Riemann's theorem.

Unit- III

Sequence and series of functions. Pointwise 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 and Riemann-Stieltjes integration, Uniform convergence and differentiation. Weierstrass approximation theorem, Power series, uniqueness theorem for power series, Abel's and Tauber's theorems.

Unit – IV

Functions of several variables, Linear transformations, Derivatives in an open subset of R^n, Chain rule, Partial derivatives, Interchange of the order of differentiation, Derivatives of higher orders, Taylor's theorem, Inverse function theorem.

Unit – V

Implicit function theorem, Jacobians extremum problems with constraints, Lagrange's multiplier method. Differentiation of integrals, Partitions of unity, Differential forms, Stoke's theorem.

Text Book:- **1.** Walter Rudin, Principles of Mathematical Analysis, McGraw Hill. 1978

Reference Books:-
1. T.M.Apostal, Mathematical Analysis Narosa.
2. H.L. Royden, Real Analysis, Macmillan (Indian Edition)
3. Real Analysis, H.K. Pathak, Shiksha Sahitya Prakashan.

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Govt. M.H. College of Home Science
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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Fifth
M.Sc.	Mathematics	I	35	12	Topology

Unit – I

Definition and examples of topological spaces, Basis for a topology, Standard topology, lower limit topology, The order topology, The product topology on X xY. Projections, The Subspace topology, Closed sets and limit points, Closure and interior of a set, Hausdorff spaces.

Unit – II

Continuous functions, Equivalence with ε-δ condition, Examples of continuous functions, the alternative conditions of Continuity, Homeomorphisms, topological property, topological Imbedding, Examples of Homeomorphisms, Rules for Constructing continuous functions, The Pasting lemma, Maps into products, The product topology, Box topology, Projection mapping, comparison of the product topology and the box topology.

Unit- III

The Metric topology, Metrizable space, Standard bounded metric, The spaces Rn and Rw, Euclidean metric, square metric, Metrizability of Rn and Rw, Uniform metric, The sequence lemma, Uniform limit theorem.

Unit – IV

Connected space, Separation, Definition and examples, Cartesian product of connected spaces, Connected sets in the real line, Linear continuum, Intermediate value theorem, Path connectedness, Definition and examples.

Unit – V

Compact spaces, Finite product of compact spaces, The Tube Lemma, Finite intersection property, compact sets in the real line, Maximum and minimum value theorem, Limit point compactness, The Lebesgue number : Lemma, Second countable and first countable spaces, Separation Axioms (T1, T2, T3 spaces).

Text Book:- **1.** James R. Munkres, Topology: A First Course, Prentice Hall or India, 1988.

Reference Books:-

1. G.F. Simmons, Topology and Modern Analysis, McGraw Hill International Edition, New York,1963.
2. J. Dugundji, Topology, Prentice Hall of India, 1975.
3. K.D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.

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& Science for Women, Jabalpur

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SYLLABUS OF M.A./M.Sc. MATHEMATICS SEMESTER SYSTEM SEMESTER - II

(Session 2023 - 24 and onwards)

Syllabus opted by the board of studies in Mathematics

S.No.	Paper	Name of the Papers	Theory (MM)	Min. Pass. Mark	C.C.E	Min.Pass. Mark	Practical M.M.	Min. Pass Mark	Total
1	I	Advanced Absract Algebra - II	35	12	15	5	-	-	50
2	II	Advanced Discrete Mathematics	35	12	15	5	-	-	50
3	III	Complex Analysis - II	35	12	15	5	-	-	50
4	Iv	Lebesgue Measure and Integration	35	12	15	5	-	-	50
5	V	Fuzzy Sets and their Applications	35	12	15	5	-	-	50
6	Optional	Ordinary and Partial Differential Equations							
6	Two Seminars and Attendance		40 + 10						50
Grand Total									**300**

1. Project / Seminar 40 marks is allocated. Out of 40 marks, 15 marks is allocated for project file, 15 mark is allocated for presentation of their project work and 10 marks is allocated for project Viva-Voce examination.
2. In attendance 10 marks is allocated as per ordinance No. 79 of R.D. University Jabalpur.
3. The students , whose attendance is less as per ordinance No. 79 of R.D. University Jabalpur, will not be allowed to appear in the examination at the close of semester and he/she would be declared having failed in that semester.

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Department of Mathematics

Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : First
M.Sc.	Mathematics	II	35	12	Advanced Abstract Algebra - II

Unit – I

The elements of Galois theory: Automorphism of a field, Group of automorphisms of a field, Fixed field, Normal extension, Galois group of a polynomial, Fundamental theorem of Galois theory, Solution of polynomial equations by radicals, Insolvability of the general equation of degree 5 by radicals.

Unit – II

Introduction to Modules, Examples, Submodules and Direct sum of submodules, R-homomorphisms and Quotient modules, Finitely generated modules, Cyclic module.

Unit- III

Simple modules, Semi-simple modules, Schur's lemma, Free modules, Rank of a module.

Unit – IV

Noetherian and Artinian modules, Ascending and Descending chain condition (ace & dcc), Noetherian and Artinian rings, Examples, Hilbert basis theorem.

Unit – V

Fundamental Structure theorem of finitely generated modules over a Principal Ideal Domain and its applications to finitely generated abelian groups.

Text Book:

1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975. (For Unit-I).
2. P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra(2nd Ed.)
3. Cambridge University Press, Indian Edition, 1997. (For Units II, III, IV and V).

Reference Books:

1. Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999.
2. N. Jacobson, Basic Algebra, Vols. I & II, Hindustan Publishing Company, 1980.
3. S. Lang, Algebra, 3rd Edition, Addison-Wesley, 1993.
4. I.S. Luther and I.B.S. Passi, Algebra, Vol. III - Modules, Narosa Publishing House, 1996.
5. Surjeet Singh and Quazi Zameeruddin, Modern Algebra, Vikas Publishing House Pvt. Ltd., 1990
6. Ramji Lal, Algebra, Vols. I & II, Shail Publication, 2002.

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Dr. Nidhi Choubey
Head of the Department

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Professor & Head
Department of Mathematics
Govt. M.H. College of Home Science
& S...

Govt. M. H. College of Home Science & Science for Women (Autonomous) Jabalpur (M.P)

Department of Mathematics

Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Second
M.Sc.	Mathematics	II	35	12	Advanced Discrete Mathematics

Unit – I

Algebraic Structures : Introduction, Algebraic Systems : Examples and General Properties : Definition and examples, Some Simple Algebraic Systems and General properties, Homomorphism and isomorphism, congruence relation, Semigroups and Monoids : Definitions and Examples, Homomorphism of Semigroups and Monoids

Unit – II

Lattices: Lattices as Partially Ordered Sets : Definition and Examples, Principle of duality, Some Properties of Lattices, Lattices as Algebraic Systems, Sublattices, Direct product, and Homomorphism.

Unit- III

Some special Lattices, e.g. Complete, Complemented and Distributive Lattices, Boolean Algebra: Definition and Examples, Subalgebra, Direct product and Homomorphism, join irreducible, atoms and antiatoms.

Unit – IV

Graph Theory: Definition of a graph, applications, Incidence and degree, Isolated and pendant vertices, Null graph, Path and Circuits: Isomorphism, Subgraphs, Walks, Paths and circuits, Connected graphs, disconnected graphs, and components, Euler graph.

Unit – V

Trees: Trees and its properties, minimally connected graph, Pendant vertices in a tree, distance and centers in a tree, rooted and binary tree. Levels in binary tree, height of a tree, Spanning trees, rank and nullity.

Text Book:

1. J. P. Tremblay & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co.,1997(for Units I, II, and III).
2. N. Deo, Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India (for Units IV and V).

Reference Books:

1. C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Book Co.
2. S. Wiitala, Discrete Mathematics- A Unified Approach, McGraw-Hill Book Co.
3. Seymour Lepschutz, Finite Mathematics, Schaum Series, MGH.
4. J. L. Gersting, Mathematical Structures for Computer Science (3rd ed.) Computer SciencePress, New York.

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Third
M.Sc.	Mathematics	II	35	12	Complex Analysis - II

Unit – I

Weierstrass factorization theorem. Gamma function and its properties, Riemann Zeta function. Riemann's functional equation.

Unit – II

Rung's theorem, Mittage-Leffler's theorem, Schwartz Reflection principle, Analytic Continuation, Analytic Continuation along a path.

Unit- III

Monodromy theorem and its consequences, Harmonic function, Harmonic functions on a disk, Harnack's inequality and theorem.

Unit – IV

Dirichlet's problem, Green's function, Jenson's formula, Poisson-Jenson Formula.

Unit – V

Order of an entire function, Hadamard's three circle theorem, Hadamard's factorization theorem, Bloch's theorem, The Little Picard theorem.

Text Book:

1. J.B.Convey:Functions of one complex variable,Springer-Verlag International student-Edition, Narosa publishing house, 1980.

Reference Books:-

1. L.V. Ahlfors, Complex Analysis, McGraw Hill, 1979.
2. E.C. Titchmarsh, The theory of functions, Oxford University, Press, London.
3. S. Ponnusomy, Fundamental of complex Analysis, Narosa Publishing House, 1997
4. Function of Complex Variable, Goyal & Gupta.

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Session 2023-2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Fourth
M.Sc.	Mathematics	II	35	12	Lebesgue Measure & Integration

Unit – I

Lebesgue Outer Measure. Measurable sets. Regularity of Measure, Borel and Lebesgue Measurability, Non - Measurable sets.

Unit – II

Integration of Non-negative functions, The General integral, Integration of Series, Riemann and Lebesgue Integrals.

Unit- III

The four derivatives. Functions of Bounded Variation, Lebesgue Differentiation Theorem, Differentiation and Integration.

Unit – IV

The L^p-spaces, Convex Function, Jensen's Inequality, Holder's and Minkowski's Inequalities, Completeness of L^p.

Unit – V

Dual of space when $1< P < \infty$, Convergence in Measure, Uniform Convergence and almost Uniform convergence.

Text Book: 1. G.de Barra : Measure Theory and Integration, Wiley Eastern (Indian Edition)

Reference Books:- 1. Walter Rudin: Principles of Mathematical Analysis, McGraw-Hill, International Student Edition.

2. H. L.Royden: Real Analysis, Macmillan, Indian Edition.

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Fifth
M.Sc.	Mathematics	II	35	12	Fuzzy Sets and their Application

Unit – I

Idea of fuzzy set and membership function, Definition of a fuzzy set, Membership function, representation of membership function, General definition and properties of fuzzy set's, Support, height, equality of two fuzzy sets, containment, examples.

Unit – II

Union and Intersection of two fuzzy sets, Complement of a fuzzy set, normal fuzzy set, α – cut set of a fuzzy set, strong α – cut, convex fuzzy set, a necessary and sufficient condition for convexity of a fuzzy set (Theorem I), Decomposition of fuzzy sets, Degree of subsethood, Level set of a fuzzy set, Cardinality, fuzzy Cardinality, examples.

Unit- III

Other important operations on fuzzy sets, Product of two fuzzy sets, Product of a fuzzy set with a crisp number, Power of a fuzzy set, Difference of two fuzzy sets, Disjunctive sum of two fuzzy sets, examples.

Unit – IV

General Properties of operations on fuzzy sets, Commutativity, associativity, distributivity, Idempotent law, identities for operations, Transitivity, involution, Demorgans laws, Proofs and examples, Some important theorems on fuzzy sets, set inclusion of fuzzy sets and corresponding α – cuts and strong α – cuts (Theorem I).

Unit – V

Comparison of α – Cut and strong α – Cut, Order relation of scalars is inversely preserved by set inclusion of corresponding α – Cuts and strong α – Cuts, α – Cut of union and intersection of two fuzzy sets, α – cut of complement of a fuzzy set (Theorem 2), Examples, α – Cuts and strong α – Cuts of union and intersection of arbitrary collection of fuzzy sets.

Text Book:

1. Fuzzy sets and their Application by Pundir and Pundir, Pragati Prakashan (PP 30-76)

Reference Books:-

1. Fuzzy sets and fuzzy logic by G.J. Klir and B. Yuan, Prentice Hall of Indai, New Delhi, 1995.
2. Fuzzy sets Theory and its Application by H. J. Zimmermann, Allied Publishers Ltd, Delhi, 1991.

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Govt. M.H. College of Home Science
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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Fifth Optional
M.Sc.	Mathematics	II	35	12	Ordinary and Partial Differential Equations

Unit – I

Exact differential equations and adjoints, The adjoint operator, Lagrange's identity, Strum-Liouville differential equation, Eigen values, The normal form, Change of independent variable, Lagrange's method of variation of parameters.

Unit – II

Partial differential equations, Construction of partial differential equations of first order, Lagrange's linear equation, Charpit's general method of solutions, Green's functions, Domain and range of the operators, One dimensional Green's functions, Construction of Green's functions.

Unit- III

Power series solutions and special functions, A review of power series, Series solution of first order linear equations, Second order linear equations, Ordinary points, Regular singular points, Gauss's hypergeometric series.

Unit – IV

Laplace Transforms, Integral transforms, A few remarks on the theory, Conditions for the existence of Laplace transforms, Applications to differential equations.

Unit – V

Derivatives and integrals of Laplace transforms, Convolutions and Abel's Mechanical problem, More about convolutions, The unit step and impulse functions.

Text Book:

1. G.F.Simmons, Differential Equations with applications and Historical Notes, McGraw Hill International Editions, 1991 (for Units IV & V).
2. B.P.Parashar; Diffrerential and Integral Equations , CBS publishers and Distributors Ltd. 1992 (for Units I, II, & III).

Reference Books:-

1. H. T. H. Piaggio, An Elementary Treatise on differential Equations and Their Applications, Indian Reprint, 1966.
2. E.A. Coddington, An Introduction, The Solution of Ordinary Differential Equations, Indian reprint.
3. B.L. Ince and I. N. Sneddon, The Solution of Ordinary Differential Equations, Longman. 1987.
4. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill International Editions, 1957.

Signature of Members of Board of Studies

Dr. K. S. Bhatia — Dr. Manju Gupta — Dr. Mridula Dube

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Dr. Vijay Khare — Dr. Manoj Shukla — Dr. Archana Pasari 25/07/2023

Dr. Sudipta Sanyal — Dr. Anil Rajput — Dr. Vinit Jain

Academic Council Approved

Dr. Nidhi Choubey
Head of the Department

Dr. Nidhi Choubey
Professor & Head
Department of Mathematics
Govt. M.H. College of Home Science & Science for Women, Jabalpur

Govt. M. H. College of Home Science & Science for Women (Autonomous) Jabalpur (M.P.)

SYLLABUS OF M.A./M.Sc. MATHEMATICS SEMESTER SYSTEM SEMESTER - III

(Session 2023 - 24 and onwards)

Syllabus opted by the board of studies in Mathematics

S.No.	Paper	Name of the Papers	Theory (MM)	Min. Pass. Mark	C.C.E	Min.Pass. Mark	Practical M.M.	Min. Pass Mark	Total
1	I	Linear Programming	35	12	15	5	-	-	50
2	II	Mathematical Statistics	35	12	15	5	-	-	50
3	III	Advanced Special Functions - I	35	12	15	5	-	-	50
4	IV	Applied Functional Analysis	35	12	15	5	-	-	50
5	V	Integral Transform - I	35	12	15	5	-	-	50
6		Two Seminars and Attendance	40 + 10						50
			Grand Total						**300**

1. Project / Seminar 40 marks is allocated. Out of 40 marks, 15 marks is allocated for project file, 15 mark is allocated for presentation of their project work and 10 marks is allocated for project Viva-Voce examination.
2. In attendance 10 marks is allocated as per ordinance No. 79 of R.D. University Jabalpur.
3. The students , whose attendance is less as per ordinance No. 79 of R.D. University Jabalpur, will not be allowed to appear in the examination at the close of semester and he/she would be declared having failed in that semester.

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Dr. Vinit Jain

Dr. Nidhi Choubey
Head of the Department

Academic Council
Approved

Dr. Nidhi Choubey
Professor & Head
Department of Mathematics
Govt. M.H. College of Home Science
& Science for Women, Jabalpur

Govt. M.H. College of Home Science & Science for Women (Autonomous) Jabalpur (M.P.)

Department of Mathematics

Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : First
M. Sc.	Mathematics	III	35	12	Linear Programming

Unit – I

General Linear Programming Problem, Formulation of the Linear Programming Problem, Solution by Graphical method, Simplex method.

Unit – II

Solution of a Linear Programming Problem by Big-M method, Two phase method, concept of duality, Fundamental theorem of duality, Dual simplex method.

Unit – III

Assignment problem, Solution of assignment problem, Unbalanced Assignment Problem, Crew Assignment problem, Traveling Salesman problem.

Unit – IV

Transportation problem, Initial basic feasible solution, Vogel's Approximation method, Optimality test by MODI method, Stepping Stone method, Degeneracy in Transportation Problem.

Unit – V

Sequencing problem, processing n jobs on two machines, n jobs on three machines, n jobs on m machines, processing two jobs through m machines.

Text Book:

1. Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.
2. S. D. Sharma, Operations Research.

Reference Books:

1. F. S. Hiller and G.J. Lieberman, Industrial Engineering Series, 1995(This book comes with a CD containing software.
2. H. Hadley, Linear and Dynamic programming, Addison-Wesley Reading Mass.
3. H.A. Taha,Operations Research- An introduction, Macmillan Publishing Co.Inc. New
4. Prem Kumar Gupta and D. S. Hira, Operations Research, an Introduction, S. Chand Ltd. New Delhi.
5. N. S. Kambo, mathematical Programming Techniques, Affiliated East- West Pvt. Ltd.

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Department of Mathematics
Govt. M.H. College of Home Science
& Science for Women, Jabalpur

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Second
M.Sc.	Mathematics	III	35	12	Mathematical Statistics

Unit – I

Introduction: Attribute & variables, Frequency distribution and its representation. Measures of central tendency: Mean, Median & Mode, Geometric and Harmonic mean: Comparisons and usefulness of these measures. Measures of dispersion: Range, Mean deviation, standard deviation, their comparisons, measures based on mutual differences of observation, quartile deviation, curve of concentration. Moments: raw and central moments, Measures of Skewness & Kurtosis, sheppard's correction for moments.

Unit – II

Probability theory and its application, Baye's theorem. Population & sample.

Unit – III

Univariate Theoretical distributions: Binomial, Poisson, Normal distributions and its properties, Fitting of Binomial, Poisson and Normal distributions.

Unit – IV

Bivariate distributions: Scatter diagram, Correlation coefficient and its limits, Correlation ratio and correlation index. Regression coefficients and lines, some related applications. Multivariate distributions: Multivariate data, Multiple and Partial correlation and coefficients. Rank correlation, Intra- class correlation.

Unit – V

Testing of hypotheses, Tests based on t, F, $\chi 2$, and Z distributions. Joint distribution of attributes: - Data on two or more attributes, independence and association, Measures of association for 2 x 2case. Test for goodness of fit and homogeneity tests.

Text Book: **1.** Mathematical Statistics:- M. Ray

Reference Books: **1.** Fundamental of Mathematical Statistic:- H.C. Gupta, V. K. Kapoor

2. Fundamental of Statistic:- D.N Elhance, Veena Elhance, B. M. Aggarwal

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Third
M.Sc.	Mathematics	III	35	12	Advanced Special Function-I

Unit – I

Gamma and Beta Functions : The Euler or Mascheroni Constant γ, Gamma Function, A series for Γ' (z) / Γ (z), Difference equation Γ(z+1) = zΓ(z).

Unit – II

Beta function, value of Γ(z) Γ(1-z), Factorial Function, Legendre's duplication formula, Gauss multiplication theorem.

Unit – III

Hyper geometric and Generalized Hyper geometric functions: Function 2F1 (a,b;c;z) A simple integral form evaluation of 2F1 (a, b; c ; z), Values of F (a,b;c;1) and F (-n,b;c;1) etc.

Unit – IV

Contiguous function relations, Some Special Generalized Hyper geometric functions, Kummer's theorem, Ramanujan's theorem, Hyper geometric differential equation and its solutions, F (a,b;c;z) as function of its parameters.

Unit – V

Elementary series manipulations, Simple transformation, Relations between functions of z and 1–z

Text Book: 1. Special Function- Earl D. Rainville

Reference Books:- 1. Special Function- Sharan, Sharma, Trivedi
2. Special Function- J.N. Sharma
3. Special Function- M.D. Rai, Singhania

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Fourth
M.Sc.	Mathematics	III	35	12	Applied Functional Analysis

Unit – I

Hilbert spaces obtained from Hilbert spaces, Cartesian and Tensor product of Hilbert spaces, convex sets and projections, Projection on a cone and a linear subspace.

Unit – II

Weak convergence, Weak compactness properties, Baire's Category Theorem, sequence of continuous linear functional, Banach Saks, Theorem, Weak semi continuity, Continuity of Projection on a closed convex set.

Unit – III

Convex sets and convex programming elementary notions, internal, bounding and external points, Support functional of a Convex set, simple example, Minkowski functional support plane through a boundary point, support mapping, support mapping, Separation theorem.

Unit – IV

Functions transformations and operators, Linear operators and their adjoints, bounded and unbounded operators projection operator and differential operator.

Unit – V

Spectral theory of operators, resolvent of operator, resolvent set and spectrum, Spectral radius, Compact operators, its characterizing property.

Text Book: 1. V. Balakrishnan : Applied Functional Analysis, Springer Verlag, New York.

Reference Books: 1. Ervin Kreyszig : introductiory Functional Analysis with Applications, Join Wiley and Sons.

2. B.V. Limaye : Functional Analysis II Edition, New Age International ublishers.

Signature of Members of Board of Studies

Dr. K. S. Bhatia

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Fifth
M.Sc.	Mathematics	III	35	12	Integral Transform - I

Unit – I

Application of Laplace Transforms in Differential Equations

Unit – II

Laplace's equations,

Unit – III

Laplace's wave equations,

Unit – IV

Application of Laplace Transforms in Integral Equations

Unit – V

Heat conduction equation.

Text Book:
1. Goyal , Gupta : Integral Transforms
2. Sneddon: Integral Transforms

Reference Books:
1. P.R, Halmos : Measure theory, Van Nostrand
2. I.K. Rana : Introduction to measure and integration, Narosa Publishing House, New Delhi.

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Govt. M.H. College of Home Science
& Science for Women, Jabalpur

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SYLLABUS OF M.A./M.Sc. MATHEMATICS SEMESTER SYSTEM SEMESTER - IV

(Session 2023- 24 and onwards)

Syllabus opted by the board of studies in Mathematics

S.No.	Paper	Name of the Papers	Theory (MM)	Min. Pass. Mark	C.C.E	Min.Pass. Mark	Practical M.M.	Min. Pass Mark	Total
1	I	Operations Research	35	12	15	5	-	-	50
2	II	Spline Theory	35	12	15	5	-	-	50
3	III	Programming in C (Therory and Practical)	35	12	15	5	-	-	50
4	IV	Advanced Special Functions -II	35	12	15	5	-	-	50
5	V	Integral Tranform - II	35	12	15	5	-	-	50
6	VI	Algebraic Topology	35	12	15	5	-	-	50
7	VII	Theory of Linear Operators	35	12	15	5	-	-	50
8	Internship (60 Hours)		50 External + 50 Internal						100
Grand Total									**350**

1. Project / Seminar 40 marks is allocated. Out of 40 marks, 15 marks is allocated for project file, 15 mark is allocated for presentation of their project work and 10 marks is allocated for project Viva-Voce examination.
2. In attendance 10 marks is allocated as per ordinance No. 79 of R.D. University Jabalpur.
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Dr. Vinit Jain

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Academic Council
Approved

Dr. Nidhi Choubey
Professor & Head
Department of Mathematics
Govt. M.H. College of Home Science
& Science for Women, Jabalpur

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max. Marks	Min. Marks	Paper Title : First
M.Sc.	Mathematics	IV	35	12	Operations Research

Unit – I

Operations Research and its scope. Origin and Development of Operations Research, Characteristics of Operations Research, Model in Operations Research, Phase of Operations Research, Uses and Limitations of Operations Research, Linear Programming Problems,

Unit – II

Inventory theory : Inventory models on economic lot size system with uniform and non uniform demand, Economic leet size with finite rate of replenishment, A simple order level system with constant rate of demand with shortage, Generalized economic lot size model, Multi items deterministic models, Probabilistic model, Instantaneous demand no setup cost model, Uniform demand, no setup cost model

Unit – III

Replacement problem: Replacement problem when money value does not change/changes with Time, Group replacement policy, Mortality theorem.

Unit – IV

Network analysis, constraints in Network, Construction of network, critical Path Method (CPM)PERT, PERT Calculation, Resource Leveling by Network Techniques and advantages of network (PERT/CPM)

Unit – V

Game theory- Two persons, Zero-sum Games, Maximin - Minimax principle, games without saddle points-Mixed strategies, Graphical solution of 2xm and mx2 games, Solution by Linear Programming.

Text Book:

1. Kanti Swarup, P.K. Gupta and Manmohan : Operations Research, Sultan Chand & sons, New Delhi.
2. S.D. Sharma : Operation Research.

Reference Books:

1. F.S. Hiller and G. J. Lieberman : Industrial Engineering Series, 1995 (This book comes with a CD Containing software)
2. H.A. Taha,Operations Research- An introduction, Macmillan Publishing Co.Inc. New
3. Prem Kumar Gupta and D. S. Hira, Operations Research, an Introduction, S. Chand Ltd. New Delhi.

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Approved

Dr. Nidhi Choubey
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Govt. M.H. College of Home Science
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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Second
M.Sc.	Mathematics	IV	35	12	Spline Theory

Unit – I

Polynomial Interpolation: Lagrange form, Divided difference and Newton form, K-th divided difference, Osculatory interpolation, Limitation of polynomial approximation, Runge example.

Unit – II

Piecewise linear approximation: Broken line interpolation is nearly optimal, Least-squares approximation by broken lines, Good meshes, square root example.

Unit – III

Piecewise cubic interpolation: Cubic Hermite interpolation, Cubic Bessel interpolation, Akima interpolation, Cubic spline interpolation, Boundary conditions, Best approximation properties of complete cubic spline and its error, Truncated power function, Pythagoras theorem, smoothest interpolation property, Best approximation property.

Unit – IV

Parabolic spline interpolation: Difference of two parabolic splines, interpolation of data values given at mid points of mesh intervals, Existence and uniqueness of parabolic splines, Piecewise polynomial representation for Pk, ξ.

Unit – V

The space Pk, ξ, v and truncated power basis: The smoothing of a histogram by parabolic splines, power basis, truncated power function, representation of a function of Pk, ξ, v, The representation of pp truncated function by B-splines, The support of B-splines, Partition of unity by B-splines, Spline function as a combination of B-splines.

Text Book: **1.** C. De Boor, A Practical Guide to Splines, Springer-Verlag, New York, 1978.

Reference:- 1. L.L. Shumaker, Spline Functions Basic Theory, John Wiley & Sons, New York, 1981
Books: **2.** P.J. Davis, Interpolation and Approximation, Dover Publications, INC, New York,

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Dr. Nidhi Choubey
Head of the Department

Academic Council
Approved

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Professor & Head
Department of Mathematics
Govt. M.H. College of Home Science
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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Third
M.Sc.	Mathematics	IV	35	12	Programming in C (Theory and Practical)

Unit – I

Introduction to C language- Overview of C Language: History of C Language, Feature of C Language, Structure of C program, A Simple C Program, Compiling a C Program, Character Set in C, Keywords, Constants, Variables in C Type declaration, Types of Output Function and Input Function, Basic Data types.

Unit – II

Operators: Arithmetic operators, Unary operators, Relational and logical Operators, Increment and Decrement Operator, Condititional Operator, Bit- wise Operator, Assignment Operators, Precedence & Associativity Expressions, type casting.

Unit – III

Control Statements: Conditional Expressions if statement, if-else statement, switch and case statement, loop-statement: for loop, while loop, do while loop, break, continue and goto statement. Writing programs using conditional expression.

Unit – IV

Scope of Variable: local and global variable, storage classes of C variable. Arrays (single dimension & multidimensional array).

Functions: Introduction to Function, Library Function (Mathematical Function & String Function), User **Defined Function :** Declaration and Prototype, Function Definition, Concept of function parameters and how they are passed, Recursion. Function, Writing Program using recursive and non recursive functions.

Unit – V

Pointers: declaration, pointer Arithmetic, Structures, arrays of structures. Concept of Union. Differences between Structure and Union.

Text Book:
1. Programming in C - E. Balaguruswamy.
2. Programming in C - Yashwant Kanetkar.

Reference Books :
1. Samuel P.Harkison and Gly L Steel Jr. C; A Reference manual ,2an Edition Prentice hall 1984.
2. Brain W Kernigham & Dennis M Ritchie the C Programmed Languare 2nd Edition (ANSI Features) ,Prentice Hall 1989.

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Fourth
M.Sc.	Mathematics	IV	35	12	Advanced Special Function II

Unit – I

Legendre polynomials : Definition of Pn (z), Generating functions, recurrence relations, Beltrami's result Christoffels, summation formula, Murphy formula, Rodrigues formula, Bateman's generating relations and other generating relations.

Unit – II

Legendre differential equation and its solutions, Laplace first and second integral for Pn(z), Orthogonal properties of Legendre polynomials, Expansion involving Legendre polynomials, Fourier-Legendre Expansion.

Unit – III

Bessel function : Definition of Jn (z), Generating function, Bessel's differential equation, recurrence relations, Bassel's integral with index half and an odd integer, Orthogonality of Bessel's functions.

Unit – IV

Hermite polynomial: Definition of Hermite polynomials Hn(z), Pure recurrence relations, Differential recurrence elations, Rodrigue's formula, Other generating functions, Othogonality, Expansion of polynomials, more generating unctions.

Unit – V

Laguerre Polynomials : The Laguerre Polynomials Ln(z), Generating functions, Pure recurrence relations, Differential ecurrence relation, Rodrigues formula, Orthogonality, Expansion of polynomials, Special properties, Other generating functions.

Text Book: **1**. Special Function- Earl D. Rainville

Reference Books: **1.**Special Function- Sharan, sharma,Trivedi
2 Special Function- J.N. Sharma
3. Special Function- M.D. Rai, Singhania

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Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Fifth
M.Sc.	Mathematics	IV	35	12	Integral Transform - II

Unit – I

Application of Laplace Transform to boundary value problems.

Unit – II

Electric circuits problems, related to application of Electric Circuits. Application to dynamics, Application to heat conduction equation, Application to wave equations, Application to Beams.

Unit – III

The complex fourier transform , Inversion formula , Fourier cosine & sine transform

Unit – IV

Properties of fourier transforms , Convolution & parseval's identity

Unit – V

Fourier transform of the derivatives , Finite fourier sine & cosine transform , Inversion operational & combind properties ,Fourier transform.

Text Book:

1. H.L. Royden : Real Analysis, Macmillan publishing co.Inc. Newyork, 4th Edition,1993.
2. Goyal , Gupta & Sneddon : Integral Transforms
3. Sneddon : Integral Transforms

Reference Books:

1. P.R, Halmos : Measure theory, Van Nostrand
2. I.K. Rana : Introduction to measure and integration, Narosa Publishing House, New Delhi.

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Department of Mathematics

Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Sixth
M.Sc.	Mathematics	IV	35	12	Algebraic Topology

Unit – I

The Fundamental Group: Introduction, Homotopy, Definition and Examples, Contractible space, Homotopy Equivalence and Homotopy Type, Comb space, Retract, Deformation retract, and Strong deformation retract.

Unit – II

Fundamental Group and its properties: Path and path homotopy, Path homotopy is an equivalence relation, Homotopy class, The set $\pi 1(X,x0)$ is a group, Properties of fundamental groups, Homomorphism induced by a continuous map, Properties of induced homomorphism.

Unit – III

Simply connected space, Sn is simply connected for $n \geq 2$, Results for computing fundamental groups of Disk Dn and the product space $X \times Y$, Path Lifting and Homotopy Lifting Property, Theorem 2.6.3 (Statement only), Fundamental group of Circle, Punctured plane, Torus, and Cylinder

Unit – IV

Covering Projections: Definition and Examples, Properties of Covering Projections, Lift of a map, Uniqueness of lifts, Path Lifting and Homotopy Lifting Property (Statement only).

Unit – V

Applications of Homotopy Lifting Theorem: The Monodromy Theorem, Proposition 5.3.2(Statement only), Lifting Theorem, Covering homomorphism, Group of Deck Transformations, Necessary and sufficient conditions for homomorphism and isomorphism of covering spaces.

Text Book: 1. Satya Deo, Algebraic Topology - A Primer, Hindustan Book Agency, TRIM Series # 27, New Delhi, 2003.

Reference Books: 1. Fred H. Croom, Basic Concepts of Algebraic Topology, Springer Verlag, 1978.

2. James R. Munkres, Topology, 2nd Edition, PHI, 2002.

Signature of Members of Board of Studies

Dr. K. S. Bhatia

Dr. Manju Gupta

Dr. Mridula Dube

Dr. Geeta Shrivastava 25.07.23

Dr. Kusumlata Rajak

Dr. Mandira Kar

Dr. Vijay Khare

Dr. Manoj Shukla

Dr. Archana Pasari 25/07/2023

Dr. Sudipta Sanyal 25/7

Dr. Anil Rajput

Dr. Vinit Jain

Academic Council Approved

Dr. Nidhi Choubey
Head of the Department

Dr. Nidhi Choubey
Professor & Head
Department of Mathematics
Govt. M.H. College of Home Science
& Science for Women, Jabalpur

Govt. M.H. College of Home Science & Science for Women (Autonomous) Jabalpur (M.P.)

Department of Mathematics

Session 2023 - 2024 & Onwards

Class	Subject	Semester	Max.Marks	Min.Marks	Paper Title : Seventh
M.Sc	Mathematics	IV	35	12	Theory of Linear operators

Unit – I

Spectral theory in normed linear spaces, resovent set and Spectral properties of bounded linear resolvent and spectrum. Spectum. Mapping thecrem for polynomials.

Unit – II

Spectral properties of n bounded linear operator on a complex banach space. Elementary theory of General properties if compact linear operators.

Unit – III

Spectral properties of Compact linear operators on normed spaces. Behaviours of Compact. linear to solvability of operators equation

Unit – IV

Fredholm type therems. Fredhom alternative theorem. Fredholm alternative for integral bounded self - adjoint operators on a complex roots of a positive operator. Projection operators.

Unit – V

Positive operators Monotone sequence theorem for bounded self - adjoint operators on a complex roots of a positive operator. projection operators.

Text Book:

1. E. Kreyszing Introductory functional analysis with applications , Ghon wiley & New York ,1978

Reference Books:

1. P.R.Halmos Introduction to Hilbert space and the theory of spectral edition Chelsea publishing co.N.Y.1957.
2. N.Dundford and J.T.Schwartz, linear operator - 3part , Intersceince /Wiley, New York 1958-71
3. G.Bachman and L.Narci, Functional analysis, Academic press New York, 1966

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