MADHYANCHAL
PROFESSIONAL UNIVERSITY

Draft Rules &
Syllabus for the

Master of Science in Mathematics

(M.Sc. Maths.) Course

MADHYANCHAL PROFESSIONAL UNIVERSITY

DEPARTMENT OF MATHEMATICS

Scheme for M.Sc., CBCS Course

Semester I

S.No.	Subject Code	Subject Name & Title	Maximum Marks Allotted								Hours per week.			Total Credits	Remarks
			Theory				Practical								
			End Sem	Mid Sem. MST	Quiz, Assignment	Total Marks	Lab Work	Assignment /Quiz/Term paper	End Sem	Total Marks	L	T	P		One credit refers to one hour teaching in theory, Tutorial
1	MSc 101	Algebra – I	60	20	20	100	-	-	-	-	3	1	-	4	
2	MSc 102	Linear Algebra – I	60	20	20	100	-	-	-	-	3	1	-	4	
3	MSc 103	Real Analysis – I	60	20	20	100	-	-	-	-	3	1	-	4	
4	MSc 104	Topology	60	20	20	100	-	-	-	-	3	1	-	4	
5	MSc 105	Numerical Analysis – I	60	20	20	100	-	-	-	-	3	1	-	4	
	Total		300	100	100	500	-	-	-	-	15	5	-	20	500

Semester II

S.No.	Subject Code	Subject Name & Title	Maximum Marks Allotted								Hours per week.			Total Credits	Remarks
			Theory				Practical								
			End Sem	Mid Sem. MST	Quiz, Assignment	Total Marks	Lab Work	Assignment /Quiz/Term paper	End Sem	Total Marks	L	T	P		
1	MSc 201	Algebra – II	60	20	20	100	-	-	-	-	3	1	-	4	One credit refers to one hour teaching in theory, Tutorial
2	MSc 202	Linear Algebra – II	60	20	20	100	-	-	-	-	3	1	-	4	
3	MSc 203	Real Analysis – II	60	20	20	100	-	-	-	-	3	1	-	4	
4	MSc 204	Complex Analysis – I	60	20	20	100	-	-	-	-	3	1	-	4	
5	MSc 205	Numerical Analysis – II	60	20	20	100	-	-	-	-	3	1	-	4	
	Total		300	100	100	500	-	-	-	-	15	5	-	20	500

Chapter II Syllabus

MT 101 - Algebra I

Unit I

Groups: The definition of a group, Subgroups, Cyclic groups and generators, Isomorphisms, Homomorphisms, Equivalence relations and partitions, Cosets, Restriction of a homomorphism to a subgroup, Products of groups, Modular arithmetic, Quotient groups

Unit II

Symmetry: Symmetry of plane figures, The group of motions of the plane, Finite groups of motions. Abstract symmetry: Group operations, The operations on cosets, The counting formula, Permutation representations.

Unit III

More on Group Theory: The operations of a group on itself, Operations on subsets, The Sylow theorems, The groups of order 12, Computation in the symmetric group, Orbits, Cycles and the alternating groups, Factor groups and normal subgroups, Simple groups.

Unit IV

Rings and Fields**:** Definitions and basic properties, Homomorphisms and isomorphisms, Divisors of zero and cancellation, Integral domains, The characteristic of a ring, The field of quotients of an integral domain, Rings of polynomials, The evaluation of homomorphisms, Factor rings and ideals, Fundamental homomorphism theorems, Prime and maximal ideals.

References:

[1] Michael Artin - Algebra, Prentice Hall of India.

[2] J. B. Fraleigh - A First Course in Abstract Algebra, Addison Wesley, 5th Edition.

[3] I. N. Herstein - Topics in Algebra.

[4] Joseph A. Gallian - Contemporary Abstract Algebra, Narosa Publishing House, 4th Edition.

[5] G. Birkhoff and S. Maclane - A Survey of Modern Algebra, Macmillan, New York, 3rd edition,

[6] S. Lang - Algebra, Reading, Mass, Addison Wesley, 1965.4

MT 102 - Linear Algebra I

Unit I

Matrix Operations: The basic operations, Row reduction, Determinants, Permutation matrices, Cramer’s rule.

Unit II

Vector Spaces: Real vector spaces, Abstract fields, Bases and dimensions, Computation with bases, Direct sums.

Unit III

Linear Transformations: The dimension formula, The matrix of a linear transformation, Linear operators and eigenvectors, The characteristic polynomial, Orthogonal matrices and rotations, Diagonalisation, Systems of differential equations, The matrix exponential.

References:

[1] Michael Artin - Algebra, Prentice Hall of India.

[2] K. Hoffmann and R. Kunz - Linear Algebra, Prentice Hall of India, 2nd Edition.

[3] S. Lang - Linear Algebra, Addison Wesley, London, 1970.

[4] Larry Smith - Linear Algebra, Springer Verlag.

[5] Katsumi Nomizu - Fundamentals of Linear Algebra, McGraw Hill Company.

MT 103 - Real Analysis I

Unit I

The real and complex number system: Introduction, Ordered sets, Fields, The real field, The extended real number system, The complex field, Euclidean spaces, Inequalities. Basic topology: Finite, countable and uncountable sets, Metric spaces, Compact sets, Perfect sets, Connected sets.

Unit II

Numerical sequences and series: Convergent sequences, Subsequences, Cauchy sequences, Upper and lower limits, Some special sequences, Series, Series of nonnegative terms, The number e, The root and ratio tests, Power series, Summation by parts, Absolute convergence, Addition and multiplication of series, Rearrangements.

Unit III

Continuity: Limits of functions, Continuous functions, Continuity and compactness, Continuity and connectedness, Discontinuities, Monotonic functions, Infinite limits and limits at infinity.

Unit IV

Differentiation: The derivative of a real function, Mean value theorems, The continuity of derivatives, L' Hospital's rule, Derivatives of higher order, Taylor's theorems, Differentiation of vector valued functions. 10 Hours

References:

[1] Walter Rudin - Principles of Mathematical Analysis, McGraw Hill, 3rd Edition.

[2] R. G. Bartle - The Elements of Real Analysis, Wiley International Edition, New York, 2nd edition.5

[3] T. M. Apostal - Mathematical Analysis, Addison / Wesley, Narosa, New Delhi, 2nd edition.

[4] G. H. Hardy - A Course of Pure Mathematics, S. L. B. S.

[5] R. R. Goldberg - Methods of Real Analysis, Oxford & I. B. H. Publishing Co., New Delhi.

MT 104 - Topology

Unit I

Topological spaces and continuous functions: Topological spaces, Basis for a topology, The order topology, The product topology on $X \times Y$, The subspace topology, Closed sets and limit points, Continuous functions, The product topology, The metric topology, The quotient topology.

Unit II

Connectedness and Compactness:Connected spaces, Connected sets in the real line, Components and path components, Local connectedness, Compact spaces, Compact sets in the real line, Limit point compactness, Local compactness.

References:

[1] J. R. Munkres - Topology, Prentice Hall of India, 1975, 2nd edition, 2000.

[2] G. F. Simmons - Introduction to Topology and Modern Analysis, Mc-Graw Hill, Kogakusha,1968.

[3] S. Willard - General Topology, Addison Wesley, New York, 1968.

[4] J. Dugundji -Topology, Allyn and Bacon, Boston, 1966.

[5] J.L.Kelley - General Topology, Van Nostrand Reinhold Co., New York, 1955.

MT 105 - Numerical Analysis I

Unit I

Transcendental and Polynomial Equations: Introduction, Initial approximations, The bisection method, Iteration methods based on first degree equation, Iteration methods based on second degree equation, Rate of convergence, Rate of convergence of secant and Newton-Raphson method, Iteration methods, First order method, Second order method, High order methods, Acceleration of convergence, Methods for multiple roots, Methods for complex roots, Polynomial equations, Synthetic division, The Birge-Vieta method.

Unit II

System of Linear Algebraic Equations and Eigenvalue problems: Introduction, Direct methods, Cramer's rule, Gauss elimination method, Gauss-Jordan Method, Triangularization method, Cholesky method, Iterative improvement of solution, Iteration methods, Jacobi iteration method, Gauss-Seidel iteration method, Convergence analysis, Eigen values and eigen vectors. The power method.

Unit III

Interpolation and Approximation: Introduction, Lagrange and Newton interpolations, Linear and higher order interpolation, Finite difference operators, Interpolating polynomials using finite differences, Hermite interpolation, Approximation, Least square approximation.

Unit IV

Numerical Differentiation: Introduction, Methods based on interpolation, Methods based on finite differences, Methods based on undetermined coefficients, Extrapolation

methods.

References:

[1] M. K. Jain, S. R. K. Iyengar - R. K. Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern.

[2] C. F. Gerald and P. O. Wheatly - Applied Numerical Analysis, Pearson Education, Inc., 1999.

[3] A. Ralston and P. Rabinowitz - A First Course in Numerical Analysis, 2nd Edition, McGraw - Hill, New York, 1978.

[4] K. Atkinson - Elementary Numerical Analysis, 2nd Edition, John Wiley and Sons, Inc., 1994.

[5] P.Henrici - Elements of Numerical Analysis, John Wiley and Sons, Inc., New York, 1964.

SEMESTER II

MT 201- Algebra II

Unit I

Divisibility in integral domains: Irreducibles, Primes, Unique factorization domains, Euclidean domains.

Unit II

Factorisation of polynomials: Content of polynomials, Primitive polynomials, Gauss lemma, Irreducibility test mod p, Eisenstein's criterion, Unique factorization in R [X], where R is a U.F.D.

Unit III

Fields: Algebraic and transcendental elements, The degree of a field extension, Construction with ruler and compass, Symbolic adjunction of roots, Finite fields, Algebraically closed fields, The fundamental theorem of algebra.

Unit IV

Galois theory: Splitting fields, Primitive elements, The main theorem of Galois theory.

Unit V

Solvabi1ity of polynomials by radicals: Solvable group, Splitting field of x^n □ a , Insolvability of a quintic.

References:

[1] Michael Artin - Algebra, Prentice Hall of India.

[2] I. N. Herstein - Topics in Algebra

[3] David S.Dummit and Richard M.Foot- Abstract Algebra

[4] Joseph A. Gallian - Contemporary Abstract Algebra, Narosa Publishing House.

[5] John B. Fraleigh - A First Course in Abstract Algebra, 5th Edition, Addison Wesley Longman, Inc.

[6] Serge Lang - Algebra, 3rd Edition, Addison Wesley Longman, Inc.

[7] I. S. Luthar and I. B. S. Passi - Algebra Volume 2, Rings, Narosa Publishing House.

MT 202 - Linear Algebra II

Unit I

Bilinear Forms: Definition of bilinear form, Symmetric forms, Orthogonality, The geometry associated to a positive form, Hermitian forms, The spectral theorem, The spectral theorem for normal operators, Skew symmetric forms, Summary of results in matrix notation.

Unit II

Modules: The definition of a module, Matrices, Free modules and bases, Diagonalization of integer matrices, Generators and relations for modules, The structure theorem for abelian groups, Application to linear operators.

References:

[1] Michael Artin - Algebra, Prentice Hall of India.

[2] K. Hoffman and R. Kunz - Linear Algebra, Prentice Hall of India, 2nd Edition.

[3] S. Lang - Linear Algebra, Addison Wesley, London, 1970.

[4] Larry Smith - Linear Algebra, Springer Verlag.

[5] Katsumi Nomizu - Fundamentals of Linear Algebra - McGraw Hill Company.

MT 203 - Real Analysis II

Unit I

The Riemann-Stieltjes Integral: Definition and existence of integrals, Properties of integral, Integration and differentiation, Integration of vector-valued functions, Rectifiable curves.

Unit II

Sequences and Series of Functions: Discussion of main problem, Uniform convergence, uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation, Equicontinuous families of functions, The Stone-Weierstrass theorem.

Unit III

Improper integrals: Definition, Criteria for convergence, Interchanging derivatives and integrals. (Ref: [2])

Unit IV

Functions of several variables: Differentiation, The contraction principle, The inverse function theorem, The implicit function theorem. (Ref: [1])

References:

[1] Walter Rudin, Principles of Mathematical Analysis, 3rd edition, McGraw Hill, Student Edition, 1976

[2] Serge Lang, Analysis I, Addison Wesley Publishing Company 1968.

[3] Sokolnikoff, Advanced Calculus, Mc Graw Hill, Student Edition.

[4] R. G. Bartle, The Elements of Real Analysis, 2nd Edition, Wiley International Edition, New York.

[5] T. M. Apostal - Mathematical Analysis, 2nd Edition, Addison Wesley, Narosa, New Delhi.

[6] D.V. Widder - Advanced Calculus, Prentice Hall of India, New Delhi.

MT 204- Complex Analysis I

Unit I

Complex numbers : The algebra of complex numbers - Arithmetic operations, Square roots, Conjugation, Absolute value, Inequalities.

The geometric representation of complex numbers - Geometric addition and multiplication, The binomial equation, Analytic geometry, The spherical representation.

Complex Functions: Introduction to the concept of analytic function - Limits and continuity, Analytic functions, Polynomials, Rational functions.

Elementary theory of power series, Sequences, Series, Uniform convergence, Power series, Abel's limit theorem.

The exponential and trigonometric functions - The exponential, The trigonometric functions, The periodicity, The logarithm.

Analytic Functions as Mappings: Conformality - Arcs and closed curves, Analytic functions in regions, Conformal mapping, Length and area.

Linear transformation - The linear group. The cross ratio, Symmetry.

Unit II

Complex Integration: Fundamental theorems, Line integrals, Rectifiable arcs, Line integrals as function of arcs, Cauchy's theorem for a rectangle, Cauchy's theorem for a disk.

Cauchy's Integral Formula: The index of a point with respect to a closed curve, The integral formula, Higher derivatives.

Local Properties of Analytical Functions: Removable singularities, Taylor's theorem, Zeros and poles, The local mapping, The maximum principle.

Unit III

The General Form of Cauchy's Theorem: Chains and cycles, Simple connectivity, Homology, The general statement of Cauchy's theorem, Cauchy's theorem (Statement only). Locally exact differentials, Multiply connected regions.

References:

[1] Lars V. Ahlfors - Complex Analysis, McGraw Hill, third edition.

[2] B. R. Ash - Complex Variables, Academic Press, New York.

[3] R. V. Churchill, J. W.Brown and R. F. Verlag - Complex Variables and Applications, Mc Graw Hill.

[4] J. B. Conway - Functions of one Variable, Narosa, New Delhi.

[5] S. Ponnuswamy - Foundations of Complex Analysis, Narosa.

MT 205 - Numerical Analysis II

Unit I

Numerical Integration: Introduction, Methods based on interpolation, Methods based on undetermined coefficients, Gauss-Legendre integration methods, Gauss-Chebyshev integration methods, Gauss-Laguerre integration methods, Gauss-Hermite integration methods, Composite integration methods, Trapezoidal rule, Simpson's rule, Romberg integration.

Unit II

Ordinary Differential Equations: Introduction, Numerical methods, Euler method, Backward Euler method, Mid-point method, Single step methods, Taylor series method, Runge-Kutta methods, Multistep methods, Determination of a_j and b_j, Predictor-corrector methods, Boundary value problems, Difference methods, Boundary value problems for $y \square \square f(x, y)$. Trapezoidal, Dahlquist and Numerov methods.

Unit III

Numerical Solution of Second Order Partial Differential Equations: Introduction, Difference methods, Parabolic equations in one space dimension, Schmidt formula, Du Fort-Frankel scheme, Crank-Nicolson and Crandall schemes, Solution of hyperbolic equation in one dimension by explicit schemes, The CFL condition, Elliptic equations, Dirichlet problem, Neumann problem, Mixed problem.

Unit IV

FORTRAN 77 Programming: Flow charting, Fundamentals of programming, Fortran constants and variables, Fortran statements, The assignment statement, List directed read and write statements, Looping with unconditional GOTO statement, The STOP and END statements, Simple programs, Looping and branching, The computed GOTO statement. The arithmetic IF statement. The logical IF statement, Block IF structures, Common mathematical functions, Controlling input and output, The DO statement, Nested DO loops, Implied DO loop, Subscripted variables and arrays, Subprograms, COMMON, EQUIVALENCE and DATA statements.

References:

[1] M. K. Jain, S. R. K. Iyengar, P. K.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern.

[2] R. H. Hammod, W. B. Rogers, J.B. Crittenden, Introduction to FORTRAN 77 and the personal computer, Mc-Graw Hill Book Company.

[3] C. F. Gerald and P. O. Wheatly, Applied Numerical Analysis, Pearson Education, Inc., 1999.

[4] M. K. Jain - Numerical Solution of Differential Equations, 2nd Edition, New Age International (P) Ltd., New Delhi, 1984.

[5] A. R. Mitchell - Computational Methods in Partial Differential Equations, John Wiley and Sons, Inc., 1969.