Master of Arts (Mathematics)

PROGRAMME GUIDE

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INTRODUCTION

Programme aims at providing a comprehensive study of pure and applied Mathematics to develop a critical and analytical approach and students will be equipped with up-to-date knowledge to perform well in academic and research.

ACADEMIC OBJECTIVES

1. To have an awareness of ethical responsibility and have the communication, problem solving and team work skills necessary to function effectively in the multidisciplinary work place.
2. To establish in students an appreciation of the importance and sustainability of mathematical sciences in an academia and industry.
3. To instill in students, the research aptitude towards pursuance of basic and applied mathematics for their academic career.
4. To prepare students effectively for professional employment or doctoral studies in pure as well as applied mathematics.
5. To extend students' comprehension of key mathematical concepts and to provide them depth understanding of pure as well as applied mathematics.

PROGRAMME CODE: 442A-S

DURATION OF THE PROGRAMME:

Minimum Duration: 2 Years

Maximum Duration: 5 Years

MEDIUM OF INSTRUCTION/ EXAMINATION:

Medium of Instruction and Examination shall be **English**.

SCHEME					
COURSE CODE	**COURSE TITLE**	**CR**	**CA**	**ETE**	**ETP**
TERM 1					
DMTH411	REAL ANALYSIS I	4	20	80	0
DMTH412	COMPLEX ANALYSIS	4	20	80	0
DMTH413	ABSTRACT ALGEBRA I	4	20	80	0
DMTH414	STATISTICS I	4	20	80	0
TERM 2					
DMTH415	REAL ANALYSIS II	4	20	80	0
DMTH416	DIFFERENTIAL GEOMETRY	4	20	80	0
DMTH417	ABSTRACT ALGEBRA II	4	20	80	0
DMTH418	STATISTICS II	4	20	80	0
TERM 3					
DMTH511	LINEAR ALGEBRA I	4	20	80	0
DMTH512	TOPOLOGY I	4	20	80	0
DMTH513	DIFFERENTIAL EQUATION	4	20	80	0
DMTH514	MEASURE THEORY	4	20	80	0
TERM 4					
DMTH515	LINEAR ALGEBRA II	4	20	80	0
DMTH516	TOPOLOGY II	4	20	80	0
DMTH517	SPECIAL FUNCTIONS AND INTEGRAL EQUATION	4	20	80	0
DMTH518	FUNCTIONAL ANALYSIS	4	20	80	0
TOTAL CREDITS		**64**			

Course Code	D	M	T	H	4	1	1	Course Title	Real Analysis I

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Set Theory Finite, Countable and Uncountable Sets, Metric spaces; Definition and examples
2.	Compactness of k-cells and Compact Subsets of Euclidean, Space R^k, Perfect sets and Cantor's set, Connected sets in a metric space, Connected subset of Real
3.	Sequences in Metric Spaces, Convergent sequences and Subsequences, Cauchy sequence, complete metric space, Cantor's intersection theorem and Baire's Theorem, Branch contraction Principle.
4.	Limit of functions, continuous functions, Continuity and compactness, continuity and connectedness, Discontinuities and Monotonic functions
5.	Sequences and series: Uniform convergence, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. Walter Rudin: Principles of Mathematical Analysis (3rd edition), Tata McGraw Hills Publishers, New Delhi.

2. T.M. Apostol : Mathematical Analysis, (2nd Edition), Pearsons India Ltd.

3. S.C. Malik : Mathematical Analysis, New Age International Publishers, New Delhi.

4. H.L. Royden: Real Analysis, Pearson India Ltd

Course Code	D	M	T	H	4	1	2	Course Title	Complex Analysis

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Sequences and functions of complex variables, Continuity, Differentiability, Analytic functions, Cauchy-Riemann equations
2.	Cauchy's theorem and Cauchy's integral formula, Liouville's theorem, Maximum Modulus principle, Schwarz Lemma
3.	Conformal mappings, Bilinear transformations
4.	Singularities, Power Series, Taylor's series and Laurent's series
5.	Rouche's theorem, Cauchy's theorem on residues with applications to definite integral evaluation, Fundamental theorem of algebra

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. Ahlfors, D.V.: Complex Analysis, Tata MCGraw Hills PublisDhers, New Delhi
2. Conway, J.B.: Function of one complex variable, Narosa Publishers, Delhi
3. H.S. Kasana: Complex Variables theory and applications, Pearson India Pvt Ltd.
4. Serge Lang: Complex Analysis, Springer, New Yok
5. Shanti Narain: Theory of function of a complex Variable, S. Chand Publishers, New Delhi

Course Code	D	M	T	H	4	1	3	Course Title	Abstract Algebra I

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Groups: Definition and examples, Quotient groups, Cyclic groups, Permutation groups and the alternating groups, Subgroups, normal subgroups and the commutator subgroup, Generating sets, Lagrange's Theorem and Cayley's theorem
2.	Homomorphisms and Automorphisms, Direct products. External and internal direct products
3.	Structure of finite abelian groups, Conjugate elements and class equations of finite groups, Sylow's theorems and their simple applications.
4.	Solvable groups, Jordan-Holder Theorem, Rings, Subrings, Ideals and their operations.
5.	Factor rings and Homomorphisms, Integral domains

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. I.N. Herstein: Topics in Algebra.
2. Dan Saracino: A First Course in Abstract Algebra;
3. Mitchell and Mitchell: An Introduction to Abstract Algebra.
4. John B. Fraleigh: An Introduction to Abstract Algebra (Relevant Portion).
5. Surjit Singh & Qazi: Modern Algebra.
6. I.S. Luther and I.P.S. Passi: Algebra Vol. I – Groups, Vol. II Rings.
7. D.S. Malik, John N, Moderson, M.K. Sen.: Fundamentals of Abstract Algebra, McGraw Hill, 1977.
8. I.N. Herstein: Abstract Algebra. Prentice-Hall, 1996.
9. P.B. Bhattacharya, S.K. Jain & S.R. Nagpal Basic Abstract Algebra, Cambridge Univ. Press, 1997.
10. Vivek Sahai, Vikas Bist: Algebra 1999.

Course Code	D	M	T	H	4	1	4	Course Title	STATISTICS I

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	The sample space, Events, Basic notions of probability, Methods of enumeration of Probability, conditional probability and independence, Baye's theorem.
2.	General notion of a variable, Discrete random variables, Continuous random variables, Functions of random Variables, Two dimensional random variables, Marginal and conditional probability distributions, Independent random variables, Distribution of product and quotient of independent random variables, n-dimensional random variables.
3.	The Moment Generating Function: Examples of moment generating functions, Properties of moment generating function, Reproductive properties
4.	Discrete Distributions : Binomial, Poison, Geometric, Pascal Distributions, Continuous Distributions :Uniform, Normal, Exponential
5.	Basic concepts, The normal failure law, The exponential failure law, Weibul failure law, Reliability of systems

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. Introductory Probability and Statistical Applications by P.L.Meyer
2. Introduction to Mathematical Statistics by Hogg and Craig
3. Fundamentals of Mathematical Statistics by S.C. Gupta and V.K.Kapoor

Course Code	D	M	T	H	4	1	5	Course Title	Real Analysis II

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Equi-continuous families of functions, Arzela's Theorem and Weierstrass Approximation Theorem
2.	Reimann Stieltjes integral, Definition and existence of integral, Properties of integration, R-S integral as a limit of sum
3.	Differentiation and integration, fundamental Theorem of Calculus, Mean value Theorems
4.	Lebesgue Measure: Outer Measure, Measurable sets and Lebesgue measure, A non-measurable set, Measurable functions, Littlewood's three principles
5.	The Lebesgue Integral of bounded functions, Comparison of Riemann and Lebesgue Integrals,The integral of a non-negative function, General Lebesgue integral, Convergence of measure

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. Walter Rudin: Principles of Mathematical Analysis (3rd edition), Tata McGraw Hills Publishers, New Delhi.

2. T.M. Apostol: Mathematical Analysis, (2nd Edition), Pearsons India Ltd.

3. S.C. Malik: Mathematical Analysis, New Age International Publishers, New Delhi.

4. H.L. Royden: Real Analysis, Pearson India Ltd

Course Code	D	M	T	H	4	1	6	Course Title	DIFFERENTIAL GEOMETRY

Weightage		
CA	ETE(Th.)	ETP
20	80	00

COURSE CONTENT:

Sr. No.	Content
1.	Notation and summation convention, transformation law for vectors, Kronecker delta, Cartesian tensors, Addition, multiplication, contraction and quotient law of tensors
2.	Differentiation of Cartesians tensors, metric tensor, contra-variant, Covariant and mixed tensors, Christoffel symbols, Transformation of christoffel symbols and covariant differentiation of a tensor
3.	Theory of space curves: - Tangent, principal normal, binormal, curvature and torsion, Serret-Frenet formulae Contact between curves and surfaces, Locus of Centre of curvature, spherical curvature
4.	Helices, Spherical indicatrix, Bertrand curves, surfaces, envelopes, edge of regression, Developable surfaces, Two fundamental forms
5.	Curves on a surface, Conjugate direction, Principal directions, Lines of Curvature, Principal Curvatures, Asymptotic Lines, Theorem of Beltrami and Enneper, Mainardi-Codazzi equations

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. H.Lass: Vector & Tensor Analysis
2. Shanti Narayan: Tensor Analysis
3. C.E. Weatherburn: Differential Geometry
4. T.J. Wilemore: Introduction to Differential Geometry
5. Bansi Lal: Differential Geometry

Course Code	D	M	T	H	4	1	7	Course Title	Abstract Algebra II

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Polynomial rings, The field of quotients Euclidean domains, Principal Ideal Domains, Unique factorization domain
2.	Prime fields, finite and algebraic extensions, Roots of a polynomial
3.	splitting fields; existence and uniqueness, Separable extensions, Finite fields; the structure, the existence of GF (pn)
4.	Galois theory: Normal extensions, Galois groups
5.	Symmetric functions, fundamental theorem, Constructible polygons, Solvability by radicals.

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. I.N. Herstein: Topics in Algebra.

2. Dan Saracino: A First Course in Abstract Algebra;

3. Mitchell and Mitchell: An Introduction to Abstract Algebra.

4. John B. Fraleigh: An Introduction to Abstract Algebra (Relevant Portion).

5. Surjit Singh & Qazi: Modern Algebra.

6. I.S. Luther and I.P.S. Passi: Algebra Vol. I – Groups, Vol. II Rings.

7. D.S. Malik, John N, Moderson, M.K. Sen.: Fundamentals of Abstract Algebra, McGraw Hill, 1977.

8. I.N. Herstein: Abstract Algebra. Prentice-Hall, 1996

9. P.B. Bhattacharya, S.K. Jain & S.R. Nagpal Basic Abstract Algebra, Cambridge Univ. Press, 1997.

10. Vivek Sahai, Vikas Bist: Algebra 1999.

Course Code	D	M	T	H	4	1	8	Course Title	STATISTICS II

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Weak Law of Large Numbers, Strong Law of Large Number, Central Limit Theorem, Confidence Intervals
2.	The correlation coefficient, Conditional expectation, Regression of the mean
3.	Samples, Sample Statistics, Sampling Distribution of Sample Mean and SampleVariance, t-distribution , Chi Square distribution, F- distribution
4.	Estimation of Parameters: Criteria for estimates, Maximum likelihood estimates, Method of least squares
5.	t-test, chi square Godness of fit, Z-test with examples

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. Introductory Probability and Statistical Applications by P.L.Meyer
2. Introduction to Mathematical Statistics by Hogg and Craig
3. Fundamentals of Mathematical Statistics by S.C. Gupta and V.K.Kapoor

Course Code	D	M	T	H	5	1	1	Course Title	Linear Algebra-I

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Vector Space over fields, Subspaces, Bases and Dimension, Coordinates, Summary of Row-Equivalence, Computation Concerning Subspaces
2.	Linear Transformations, The algebra of linear transformations, The transpose of a linear transformation, Isomorphism, Representation of Transformation by matrices
3.	Linear Functional, The double dual, Introduction and Characteristic Values, Annihilating Polynomials
4.	Invariant Subspaces, Simultaneous triangulation, Simultaneous diagonalization, Direct-Sum Decompositions
5.	Invariant Direct Sums, The Primary Decomposition Theorem, Cyclic Subspaces and Annihilators, Cyclic Decomposition and the rational Form

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. TOPICS IN ALGEBRA by I.N. HERTSTIEN, WILEY
2. LINEAR ALGEBRA by KENNETH HOFFMAN AND RAY KUNZE, PRENTICE HALL

Course Code	D	M	T	H	5	1	2	Course Title	TOPOLOGY-I

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Topological Spaces, Basis for Topology, The order Topology, The Product Topology on X * Y, The Subspace Topology.
2.	Closed Sets and Limit Points, Continuous Functions, The Product Topology, The Metric Topology, The Quotient Topology.
3.	Connected Spaces, Connected Subspaces of Real Line, Components and Local Connectedness,
4.	Compact Spaces, Compact Subspaces of Real Line, Limit Point Compactness, Local Compactness
5.	The Count ability Axioms, The Separation Axioms, Normal Spaces, Regular Spaces, Completely Regular Spaces

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. TOPOLOGY by J.R. MUNKERS, PEARSON
2. INTRODUCTION TO TOPOLOGY PURE AND APPLIED by C.ADOMS AND R.FRANZOSA, PEARSON

Course Code	D	M	T	H	5	1	3	Course Title	Differential Equations

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Existence theorem for solution of the equation dy/dx= f(x,y) [Picard's methods as in Yoshida], general properties of solutions of linear differential equations of order n, total differential equations, simultaneous differential equations, adjoint and self adjoint equations.
2.	Green's function method, Sturm Liouville's boundary value problems, Sturm comparison and separation theorems, orthogonality of solutions.
3.	Classification of partial differential equations, Cauchy's problem and characteristics for first order equations, Classification of integrals of the first order partial differential equations.
4.	Lagrange's methods for solving partial differential equations, Charpit's method for solving partial differential equations, Jacobi's method for solving partial differential equations
5.	Higher order equations with constant coefficients and Monge's method. Classification of second order partial differential equations, Solution of Laplace's equation, Wave and diffusion equations by separation of variable (axially symmetric cases).

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. DIFFERENTIAL EQUATIONS by H.T.H PIAGGIO, GBELL & SONS LTD.
2. ELEMENTS OF PARTIAL DIFFERENTIAL EQUATIONS by IAN N. SNEDDON, DOVER PUBLICATION.

Course Code	D	M	T	H	5	1	4	Course Title	MEASURE THEORY

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Differentiation and Integration: Differentiation of monotone functions, Functions of bounded variation
2.	Differentiation of an integral, Absolute continuity
3.	Spaces, Holder, Minkowski inequalities, Convergence and Completeness
4.	Bounded linear functional on the Lp spaces, Measure spaces, Measurable Functions, Integration
5.	General Convergence Theorems, Signed Measures, Radon-Nikodym theorem

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. G.F. Simmons: Introduction to Topology and Modern Analysis.
2. H.L. Royden: Real Analysis.
3. E. Kreyszig: Introductory Functional Analysis with applications, John- Wiley & Sons, New York, 1978.

Course Code	D	M	T	H	5	1	5	Course Title	Linear Algebra-II

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	The Jordan Form, Computation of Invariant Factors, Semi-Simple Operators
2.	Inner product, Inner Product Space, Linear Functional and Adjoints, Unitary Operators, Normal Operators
3.	Introduction, Forms on Inner Product Spaces, Positive Forms, More on Forms
4.	Spectral Theory, Properties of Normal operators
5.	Bilinear Forms, Symmetric Bilinear Forms, Skew-Symmetric Bilinear Forms, Groups Preserving Bilinear Forms

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. TOPICS IN ALGEBRA by I.N. HERTSTIEN, WILEY
2. LINEAR ALGEBRA by KENNETH HOFFMAN AND RAY KUNZE, PRENTICE HALL

Course Code	D	M	T	H	5	1	6	Course Title	TOPOLOGY-II

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	The Urysohn Lemma, The Urysohn Metrization Theorem, The Tietze Extension Theorem, The Tychonoff Theorem.
2.	The Stone-Cech Compactification, Local Finiteness, Paracompactness.
3.	The Nagata-Smirnov Metrization Theorem, The Smirnov Metrization Theorem.
4.	Complete Metric Spaces, Compactness in Metric Spaces, Pointwise and Compact Convergence, Ascoli's Theorem.
5.	Baire Spaces, Introduction to Dimension Theory

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. TOPOLOGY by J.R. MUNKERS, PEARSON
2. INTRODUCTION TO TOPOLOGY PURE AND APPLIED by C.ADOMS AND R.FRANZOSA, PEARSON

Course Code	D	M	T	H	5	1	7	Course Title	SPECIAL FUNCTIONS AND INTEGRAL EQUATION

Weightage		
CA	ETE(Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Bessel functions, Legendre polynomials, Hermite polynomials, Laguerre polynomials, recurrence relations, generating functions, Rodrigues formula and orthogonality
2.	Integral equations and algebraic system of linear equations, Volterra equation & L2_Kernels and functions.
3.	Volterra equations of the first kind, Volterra integral equations and linear differential equations
4.	Fredholm equations, Solutions by the method of successive approximations.
5.	Neumann's series, Fredholm's equations with Poincere Goursat Kernels, the Fredholm theorems.

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. Rainuile : Special functions
2. Tricomi, F.G. Integral equations (Ch. I and II).
3. Yoshida, K.: Lectures in Differential and Integral Equations.

Course Code	D	M	T	H	5	1	8	Course Title	FUNCTIONAL ANALYSIS

Weightage		
CA	ETE (Th.)	ETP
20	80	0

COURSE CONTENT:

Sr. No.	Content
1.	Banach spaces: Definition and some examples, Continuous linear transformations, The Hahn-Banach theorem
2.	The natural imbedding of N in N**, The open mapping theorem, The closed graph theorem
3.	The conjugate of an operator, The uniform boundedness theorem, The uniform boundedness theorem, Hilbert spaces : The definition and some simple properties
4.	Orthogonal complements, Orthonormal Sets, The conjugate space H*, The Adjoint of an Operator, Self Adjoint Operators
5.	Normal and Unitary Operators, Projections, Finite dimensional spectral theory : the spectrum of an operator on a finite dimensional Hilbert space, the Spectral theorem

READINGS: SELF LEARNING MATERIAL (SLM)

ADDITIONAL READINGS:

1. G.F. Simmons: Introduction to Topology and Modern Analysis.
2. H.L. Royden: Real Analysis.
3. E. Kreyszig: Introductory Functional Analysis with applications, John- Wiley & Sons, New York, 1978.