Department of Mathematics
Satavahana University
M.Sc. [Mathematics]
Course under Choice Based Credit System

SEMESTER-I

Paper Code	Paper Title	HpW	Marks			Credits	Duration of Exam
			Internal	University	Total		
MMAT 101T	Ordinary & Partial Differential Equations	4	20	80	100	4	3 Hrs
MMAT 102T	Elementary Number Theory	4	20	80	100	4	3 Hrs
MMAT 103T	Abstract Algebra	4	20	80	100	4	3 Hrs
MMAT 104T	Mathematical Analysis	4	20	80	100	4	3 Hrs
MMAT 105P	Ordinary & Partial Differential Equations Lab	6	15	60	75	3	3 Hrs
MMAT 106P	Abstract Algebra Lab	6	15	60	75	3	3 Hrs
MMAT 107P	Mathematical Analysis Lab	6	15	60	75	3	3 Hrs
MFCE 101T*	Professional Communication	2	10	40	50	2	2 Hrs
Total		36	135	540	675	27	

SEMESTER-II

Paper Code	Paper Title	HpW	Marks			Credits	Duration of Exam
			Internal	University	Total		
MMAT 201T	Operation Research	4	20	80	100	4	3 Hrs
MMAT 202T	Topology	4	20	80	100	4	3 Hrs
MMAT 203T	Galois Theory	4	20	80	100	4	3 Hrs
MMAT 204T	Lebesgue Measure and Integration	4	20	80	100	4	3 Hrs
MMAT 205P	Operation Research Lab	6	15	60	75	3	3 Hrs
MMAT 206P	Topology Lab	6	15	60	75	3	3 Hrs
MMAT 207P	Galois Theory Lab	6	15	60	75	3	3 Hrs
MFCE 201T*	Professional Communication	2	10	40	50	2	2 Hrs
Total		36	135	540	675	27	

SEMESTER-III

Paper Code	Paper Title	HpW	Marks			Credits	Duration of Exam
			Internal	University	Total		
MMAT 301T	Complex Analysis	4	20	80	100	4	3 Hrs
MMAT 302T	Functional Analysis	4	20	80	100	4	3 Hrs
MMAT 303T(A)	Integral Equations	4	20	80	100	4	3 Hrs
MMAT 303T(B)	Theory of Matrices						
MMAT 303T(C)	Boolean Algebra						
MMAT 304T(A)	Numerical Analysis	4	20	80	100	4	3 Hrs
MMAT 304T(B)	Analytical Mechanics						
MMAT 304T(C)	Fixed Point Theory						
MMAT 305P	Complex Analysis Lab	8	20	80	100	4	3 Hrs
MMAT 306P	Functional Analysis Lab	8	20	80	100	4	3 Hrs
	Seminar		25	-	25	1	
Total		**32**	**145**	**480**	**625**	**25**	

SEMESTER-IV

Paper Code	Paper Title	HpW	Marks			Credits	Duration of Exam
			Internal	University	Total		
MMAT 401T	Advanced Complex Analysis	4	20	80	100	4	3 Hrs
MMAT 402T	Discrete Mathematics	4	20	80	100	4	3 Hrs
MMAT 403T(A)	Calculus of Variations	4	20	80	100	4	3 Hrs
MMAT 403T(B)	Elementary Operator Theory						
MMAT 403T(C)	Mathematical Statistics						
MMAT 404T(A)	Theory of Ordinary Differential Equations	4	20	80	100	4	3 Hrs
MMAT 404T(B)	Algebraic Number Theory						
MMAT 404T(C)	Differential Geometry						
MMAT 405P	Advanced Complex Analysis Lab	8	20	80	100	4	3 Hrs
MMAT 406P	Discrete Mathematics Lab	8	20	80	100	4	3 Hrs
	Seminar		25	-	25	1	
Total		**32**	**145**	**480**	**625**	**25**	

MMAT101T Ordinary and Partial Differential Equations

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Power series solution ODE: Ordinary and singular points, Series Solution about an ordinary point, Series solution about Singular point, Frobenius methods;

Legendre polynomials: Legendre's equation and its solution, Legendre polynomial and its properties, Generating function, Orthogonal properties, Recurrence relations, Laplace definite integrals for $P_n(x)$, Rodrigue's formula.

Unit – II

Bessel functions: Bessel's equations and its Properties, Bessel function of first Kind and its properties, Recurrence relations, Generating function, Orthogonality properties;

Hermite polynomials: Hermite's equation and its solution, Hermite polynomials and its properties, Generating function, Alternative expression (Rodrigue's formula), Orthogonality properties, Recurrence relations.

Unit – III

Partial Differential Equations: Origins of first order PDEs, Linear equations of first order, Lagrange's method of solving of $Pp + Qq = R$, Non-Linear PDE with Constant Coefficients both homogeneous and Non-homogeneous.

Unit – IV

Partial differential equations of order two with variable coefficients: Canonical form, Classification of second order PDEs, Separation of variables method, Monge's method of integrating $Rr + Ss + Tt = V$.

Text Ordinary and partial differential equations, M.D. Raisinghania

References

1. Elements of partial differential equations, Ian Sneddon
2. Differential Equations, S.L. Ross
3. Ordinary differential equations, P. Hartman
4. Ordinary differential equations, G. Birkhoff and G.C. Rota

MMAT102T Elementary Number Theory

Theory: 4 Hours/Week **Credits:** 4

Unit – I

The Fundamental Theorem of Arithmetic: Divisibility, Greatest common divisor, Prime numbers, The Fundamental theorem of arithmetic, The Series of reciprocals of primes, The Euclidean algorithm, The GCD of more than two numbers, Arithmetical Functions: The Mobius Function, The Euler totient function, A relation connecting these functions, A product formula for Euler totient function.

Unit – II

Dirichlet Multiplication: Dirichlet product of arithmetical functions, Dirichlet inverse and the Mobius inverse formula, The Mangoldt function, Multiplicative functions and Dirichlet multiplication, The inverse of a completely multiplicative functions, Liouville's function, The Divisor functions, Generalized convolutions.

Unit – III

Congruences: Definition and basic Properties of congruences, Residue classes and Complete residue system, Linear congruence, Reduced residue systems and Euler-Fermat theorem, Polynomial congruences modulo p, Lagrange's theorem, Applications of Lagrange's theorem, Simultaneous linear congruences, Chinese remainder theorem and its applications, Polynomial congruences with prime power moduli.

Unit – IV

Quadratic Residues and the Quadratic Reciprocity Law: Quadratic residues, Legendre's symbol and its properties, Evaluation of $(-1|p)$ and $(2|p)$, Gauss' lemma, The quadratic reciprocity law, Application of reciprocity law, The Jacobi symbol.

Text Introduction to Analytic Number Theory, T.M. Apostol

References

1. An Introdution to the Theory of Numbers, Ivan Niven and H.S. Zuckerman
2. Elementary Number Theory, D.M. Burton
3. Elementary Number Theory with Applications, Thomas Koshy
4. Elementary Number Theory and its applications, Kenneth Rosen

MMAT103T Abstract Algebra

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Conjugacy and G-Sets, Normal series, Solvable groups, Nilpotent groups.

Unit – II

Structure theorems of groups: Direct Products, Finitely generated abelian groups, Invariants of a finite abelian group, Sylow theorems, Groups of order p^2,pq.

Unit – III

Ideals and Homomorphism, Sum and direct sum of ideals, Maximal and prime ideals, Nilpotent and nil ideals, Zorn's lemma.

Unit – IV

Unique factorization domains, Principle ideal domains, Euclidean Domains, Polynomials rings over UFD, Rings of fractions.

Text Basic abstract algebra, P.B. Bhattacharya, S.K. Jain and S.R. Nagpaul

References

1. Topics in algebra, I.N. Herstein
2. Contemporary abstract algebra, Joseph A. Gallian
3. Basic algebra-I, N. Jacobson
4. Algebra, N. Jacobson

MMAT104T Mathematical Analysis

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Finite, Countable and Uncountable Sets, Metric Spaces, Compact Spaces, Perfect Sets, Connected Sets.

Unit – II

Limits of Functions, Continuous Functions, Continuity and Compactness, Continuity and Connectedness, Discontinuous, Monotone Functions.

Unit – III

Riemann- Stieltjes Integral: Definition and Existence of the Integral, Properties of the Integral, Integration of Vector Valued Functions-Rectifiable Curves.

Unit – IV

Sequences and Series of Functions: Uniform Convergence, Uniform Convergence and Continuity, Uniform Convergence and Integration, Uniform Convergence and Differentiation, Approximation of a Continuous Function by a Sequenece of Polynomials.

Text Principles of Mathematical Analysis, Walter Rudin

References

1. Elements of Real Analysis, R.G. Bartle
2. The Theory of Functions of a Real Variable
3. A first course in Real Analyis, M.H. Protter and C.B. Moray
4. Real and Abstract Analysis, Hewitt and Stromberg .K
5. A Course in Calculus and Real Analysis, S.R. Ghopade and B.V. Limaye
6. Analysis-I & II, Terence Tao

MMAT201T Operations Research

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Modeling with Linear Programming: Two Variable LP Model, Graphical LP Solution, Selected Applications.

Unit – II

The Simplex Method: LP Model in Equation form, Transition from Graphical to Algebraic Solution, The Simplex Method, Artificial starting Solution, Special Cases in the Simplex Method.

Unit – III

Duality: Definition of Dual problem, Primal, Dual relationships, Additional Simplex Algorithms.

Unit – IV

Transportation Model and Its Variants: Definition of Transportation Model, Nontraditional Transportation Models, The Transportation Algorithm, The Assignment Model.

Text Operations An Introdution, Hamdy A. Taha

References

1. Operations Research, S.D. Sharma
2. Introdution to Operation Research, P.R. Vittal

MMAT202T Topology

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Topological Spaces: The definition and some examples, Elementary concepts, Open base and open subbase, Weak topologies, The function algebras $C(X,R)$ and $C(X,C)$.

Unit – II

Compactness: Compact Spaces, Product Spaces, Tychonoff 's theorem and local compact spaces, Compactness for metric spaces, Ascoli's theorem.

Unit – III

Separation: T_1-Space and Hausdorff Spaces, Completely regular spaces and normal spaces, Urysohn's lemma and the Tietze's extension theorem, The Urysohn imbedding theorem.

Unit – IV

Connectedness: Connected Spaces, The components of a space, Totally disconnected spaces, Locally connected spaces.

Text Topology and Modern Analysis, G.F. Simmons

References

1. Topology , J. Munkres
2. Counter Examples in Topology, L. Steen, J. Seebach
3. General Topology, J.L. Kelley
4. Topology, B.D. Gupta

MMAT203T Galois Theory

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Algebraic Extensions of Fields: Irreducible Polynomials and Eisenstein Criterion, Adjunction of Roots, Algebraic Extensions, Algebraically closed fields.

Unit – II

Normal and Separable Extensions: Splitting Fields, Normal Extensions, Multiple roots, Finite fields, Separable extensions.

Unit – III

Galois Theory: Automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of algebra.

Unit – IV

Applications of Galois theory: Roots of unity and Cyclotomic polynomials, Cyclic extensions, Polynomials solvable by radicals, Symmetric function, Ruler and compass constructions.

Text Basic Abstract Algebra, Battacharya, Jain, Nagpaul

References

1. Basic Algebra, N. Jacobson
2. Algebra, S. Lang
3. Contemporary Abstract Algebra, J.A. Gallian
4. Algebra, P.M. Cohen

MMAT204T Lebesgue Measure and Integration

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Lebegue Measure: Lebesgue Outer Measure, The sigma algebra of Lebsgue Measurable Sets, Outer Inner Approximation of Lebesgue Measurable Sets, Countable Additivity, Continuity and Borel Cantelli Lemma.

Unit – II

Lebesgue Measurable Functions: Sums, Products and Compositions, Sequential Pointwise Limits and Simple Approximation, Littlewood's Three Priciples, Egoroff's theorem and Lusin's theorem.

Unit – III

Lebesgue Integration: The Riemann Integral, The Lebesgue Integral of a Bounded Measurable Function over a Set of Finite Measure, The Lebesgue Integral of a Measurable nonnegative Function, The General Lebesgue Integral, Countable Additive and Continuity of Integration.

Unit – IV

Differentiation and Integration: Continuity of Monotone Functions, Differentiability of Monotone Functions, Lebesgue's theorem, Functions of Bounded Variation, Jordan's theorem, Absolutely Continuous Functions, Integrating Derivatives.

Text Real Analysis, H.L. Royden, P.M. Fitzpatrick

References

1. The Elements of Integration and Lebesgue Measure, Robert G. Bartle
2. Measure Theory, P. R. Halmos
3. Real and Complex Analysis, Walter Rudin
4. Real Analysis, G.B. Folland

MMAT301T Complex Analysis

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Regions in the complex Plane, Functions of Complex Variables, Mappings, Mappings by Exponential Function-Limits-Limits involving point at infinity-Continuity.

Unit – II

Derivatives, Cauchy-Riemann-Equations, Sufficient Conditions for Differentiability, Polar Coordinates, Analytic Functions, Harmonic Functions, Uniquely Determined Analytic Functions, Reflection Principle.

Unit – III

The Exponential Function, The Logarithmic Function, Branches and Derivatives of Logarithms, Some Identities Involving Logarithms, Complex Exponents, Trigonometric Functions, Hyperbolic Functions, Inverse Trigonometric and Hyperbolic Functions.

Unit – IV

Derivatives of Functions *w(t),* Definite Integrals of Functions *w(t),* Contours, Contour Integrals, Branch Cuts, Upper Bounds for Moduli of Contour Integrals, Antiderivatives, Cauchy- Goursat Theorem, Simply Connected Domains, Multi Connected Domains, Cauchy Integral Formula, An Extension of the Cauchy Integral Formula-Lioville's Theorem and fundamental theorem of Algebra, Maximum Modulus Priciple.

Text James Ward Brown, Ruel V. Churchil, Complex Variables and Applications.

References

1. Complex Analysis,Ahlfors
2. Foundations of Complex Analysis, S.Ponnuswamy
3. Complex Variables Theory and Applications ,Kasana
4. Functions of One Complex Variables, J.B.Convway

MMAT302T Functional Analysis

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Some Standard inequalities in Metric Spaces, Normed Linear Spaces and Elementary Properties, Subspace, Closed Subspace, Finite Dimesional Normed Linear spaces and Subspaces, Quotient Spaces, Completion of Normed Spaces.

Unit – II

Inner Product Space, Hilbert Space, Cauchy-Bunyakovsky-Schwarz (CBZ) Inequality, Parallelogram Law, Orthogonality, Orthogonal Projection Theorem, Orthogonal Complements, Direct Sum, Orthogonal system, Complete Orthogonal System, Isomorphism between Separable Hilbert Spaces.

Unit – III

Linear Operator, Linear Operators in Normed Linear Spaces, Linear Functionals, The Space of Bounded Linear Operators, Uniform Boundedness Priniciple, Inverse Operators, Banach space with a basis, Hahn- Banach Theorem, Hanh-Banach Theorem for Complex Vector and Normed Linear Space, The General Form Linear Functionals in Certain Functional Spaces, The General Form Linear Functional spaces in Hilbert Spaces.

Unit – IV

Conjugate Spaces and Adjoint Operators, Conjugates (Duals) and Transposes (Adjoints), Closed Graph Theorem, Open Mapping Theorem, Bounded Inverse Theorem, Applications of the Open Mapping Theorem.

Text Rabindranath Sen, A First Course in Functional Analysis Theory and Applications

References

1. Introdution to Topology and Modern Analysis, G.F.Simmons
2. Introductory Functional Analysis with Applications, Kreyszig
3. Functional Analysis A First Course, M.Thamban Nair
4. Topics in Functional Analysis and Applications, S.Kesavan
5. Functional Analysis, B.V.Limaye

MMAT303T (A) Integral Equations

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Volterra Integral Equations: Basic Concepts, Relation between Linear Differential Equations and Volterra Integral Equations, Resolvent Kernel of Volterra Integral Equation, Solution of Integral Equations by Resolvent Kernel, The Method of Successive Approximations.

Unit – II

Convolutions-Type Equations, Solution of Integro-Differential Equations with the Aid of the Laplace Transformation, Volterra Integral Equations with limits $(x,+\infty)$, Volterra Integral Equations of First Kind, Euler Integrals, Abel's Integral Equations and Its Generalizations, Volterra Integral Equations of the First Kind of the Convolution Type.

Unit – III

Characteristic Numbers and Eigen Functions, Solution of Homogeneous Integral Equations with Degenerate Kernel, NonHomogeneous, Symmetric Equations, Fredholm Alternative.

Unit – IV

Construction of Green's Function for Ordinary Differential Equations, Using Green's Function in the Solution of Boundary Value Problems.

Text Problems and Exercises in Integral Equations, M.Krasnov, A. Kiselev, G. Makarenko

References

1. Integral Equations ,Shanti Swarup, Shiv Raj Singh
2. A First Course in integral equations, Abdul-Majid Wazwaz
3. Integral Equations and their applications, M.Rahman

MMAT303T (B) Theory of Matrices

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Inner Product, Length, and Orthogonality, Orthogonal Sets, Orthogonal Projections, Gram-Schmidt Process.

Unit – II

Least Squares Problems, Applications to Linear Models, Inner Product Spaces, Applications of Inner Product Spaces.

Unit – III

Diagonalization of Symmetric Matrices, Quadratic Forms, Constrained Optimization, The Singular Value Decomposition.

Unit – IV

Affine Combinations, Affine independence, Convex Combinations, Hyperplanes, Polytopes, Curves and Surfaces.

Text Linear Algebra and Its Applications, David C. Lay

References

1. Linear Algebra, Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence
2. Linear Algebra, K.Hoffman and R.Kunze
3. Linear Algebra, S.Lang
4. Linear Algebra: A Geometrical Approach, S.Kumaresan

MMAT303T(C) Boolean Algebra

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Algebra of Sets: Introdution, Preliminary definitions, Definitions and properties of Boolean algebra, Disjunctive normal form, Conjunctive normal form, Representation of a Boolean algebra.

Unit – II

Boolean algebra: Introduction, Propositions and definitions of symbols, Truth tables.

Unit – III

Object logic and syntax logic, Material implication, Truth sets for propositions, Quantifiers, Valid arguments, indirect proofs, functionally complete sets of operations, Special problems.

Unit – IV

Switching Algebra: Introduction, Definition of the algebraic symbols, Simplifications of circuits, Non-series-parallel circuits, Design of circuits from given properties, Design of n-terminal circuits, Symmetric functions and their circuits.

Text Boolean Algebra and its applications, J.Eldon.Whitesitt

References

1. Boolean algebra, R.L. Goldstein
2. Logic and Boolean algebra, Bradford Henry Arnold
3. Boolean algebra and switching circuits, Elliott Mendelson
4. Boolean algebra, Prabhat Kr. Choudhary
5. Boolean algebra, A.K. Sharma

MMAT304T (A) Numerical Analysis

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Initial Value Problems for Ordinary Differential Equations**:** The Elementary Theory of Initial Value Problems, Euler's Method, Higher-Order Taylors Methods, Runge-Kutte Methods.

Unit – II

Error Control and Runge-Kutta-Fehlberg Method, Multistep Methods, Variable Step-Size Multistep Methods, Extrapolation Methods, Higher-Order Equations and System of Differential Equations, Stability, Stiff Differential Equations.

Unit – III

Direct Methods for Solving Linear Systems: Linear Systems of Equations, Pivoting Strategies, Linear Algebra and Matrix Inversion, The Determinant of a Matrix, Matrix Factorization, Special Types of Matrices.

Unit – IV

Norms of Vectors and Matrices, Eigen Values and Eigenvectors, The Jacobi and Gauss siedel Iterative Techniques, Relaxation Techniques for Solving Linear Systems, Error Bounds and Iterative Refinement, The Conjugate Gradient Method.

Text Numerical Analysis, Richard L. Burden, J. Douglas Faires

References

1. Elementary Numerical Analysis, K.Atkinson
2. Numeric Methods for Scientific and Engineering, M.K. Jain, S.R.K. Iyengar, R.K. Jain
3. Numerical Methods for Scientists and Engineers, K. Shankara Rao
4. The Numerical Analysis of Ordinary Differential Equations, J.C. Butcher
5. Numerical Analysis and Mathematics of Scientific Computing, David Kinciad & Ward Cheney

MMAT304T(B) Analytical Mechanics

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Newton's Law of Motion: Historical Introduction, Rectilinear Motion: Uniform Acceleration Under a Constant Force, Forces that Depend on position: The Concepts of kinetic and potential Energy, Dynamics of systems of Particles:- Introduction – Center of Mass and Linear Momentum of a system, Angular momentum and kinetic Energy of a system; Mechanics of Rigid bodies Planar motion:- Centre of mass of Rigid body-some theorems of static equilibrium of a Rigid body- Equilibrium in a uniform gravitational field.

Unit – II

Rotation of a Rigid body about a fixed axis, Moment of Inertia:- calculation of moment of Inertia Perpendicular and Parallel axis theorem- Physical Pendulum-A general theorem concerning Angular momentum-Laminar Motion of a Rigid body-Body rolling down an inclined plane(with and without slipping).

Unit – III

Motion of Rigid bodies in three dimension-Angular momentum of Rigid body products of Inertia, Principles axes-Determination of principles axes- Rotational Kinetic Energy of Rigid body – Moment of Inertia of Rigid body about an arbitrary axis – Euler's equation of motion of a Rigid body.

Unit – IV

Lagrange Mechanics:- Generalized Coordinates- Generalised foreces- Lagrange's Equations and their applications – Generalised momentum- Ignorable Coordinates- Hamilton variational principle- Hamilton's Equations- Problems- Theorems.

Text Analytical Mechanics, G.R. Fowles

References

1. Classical Mechanics, R. Douglas gregory
2. Introdution to Classical Mechanics, Nikhil Ranjan Roy
3. Classical Mechanics an introdution, Dieter Strauch
4. An introduction to Classical Mechanics, R.G. Takwale & Puranik
5. Classical Mechanics, Martin W. McCall

MM304T(C) Fixed Point Theory

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Metric Contraction Principles: Banach's Contraction Principle, Further extensions of Banach's Principle, The Caristi – Ekeland Principle, Equivalent of the Caristi-Ekeland Principle, Set – valued contractions, Generalized contractions.

Unit – II

Hyperconvex Spaces: Introduction, Hyperconvexity, Properties of hyperconvex spaces, A fixed point theorem, Intersections of hyperconvex spaces, Approximate fixed points, Isbell's hyperconvex hull.

Unit – III

Normal Structure in Metric Spaces: A fixed point theorem, Structure of the fixed point set, Uniform normal structure, Uniform relative normal structure.

Unit – IV

Quasi- normal structure Stability and normal structure, Ultrametric spaces, Fixed point set structure- separable case.

Text Metric Spaces and Fixed point theory, Mohamed A. Khamsi, William A. Kirk

References

1. Fixed Point Theory, Andrej Granes, James Dugundji
2. Fixed Point Theorems and Their Applications, Ioannis Farmakis, Martin Moskowitz

MMAT401T Advanced Complex Analysis

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Series: Convergence of Sequence, Convergence of Series, Taylor Series, Laurent Series, Absolute and Uniform Convergence of Power Series, Continuity of Sums of Power Series, Integration and Differentiation of Power Series, Uniqueness of Series Representations, Multiplication and Division of Power Series.

Unit – II

Residues and Poles: Isolated singular Points, Residues, Cauchy's Residue Theorem, Residue at Infinity, The Three types of Isolated Singular Points, Residues at Poles, Zeros of Analytic Functions, Zeros and Poles, Behavior of Functions Near Isolated Singular Points.

Unit – III

Evaluation of Improper Integrals, Improper integrals from Fourier Analysis, Jordan's Lemma, Indented Paths, An Indentation Around a Branch Cut, Definite Integrals Involving Sines and cosines , Argument Principle, Rouche's Theorem, Inverse Laplace Transforms.

Unit – IV

Linear Transformations, The Transformation $w = 1/z$, Mappings $1/z$, Linear Fractional Transformations, An Implicit form, Mappings of the Upper Half Plane, The Transformation $w = \sin z$, Mappings by z^2 and Branches of $z^{1/2}$, Square Roots of Polynomials, Riemann Surfaces, Surfaces for Related Functions.

Text Complex Variables and Applications, James Ward Brown, Ruel V. Churchill

Reference

1. Complex Analysis, Ahlfors
2. Foundations of Complex Analysis, S.Ponnuswamy
3. Complex Variables Theory and Applications ,Kasana
4. Functions of One Complex Variables, J.B.Convway

MMAT402T Discrete Mathematics

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Induction and Recursion: Mathematical Induction, Strong Induction and Well Ordering, Recursive Definitions and Structural Induction, Recursive Algorithms, Program Correctness.

Unit – II

Graphs: Graphs and Graph Models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graphs Isomorphism, Connectivity, Euler Hamilton Paths, Shortest-Path Problems, Planner Graphs, Graph Coloring.

Unit – III

Trees: Introdution to Trees, Applications of Trees, Tree Traversal, Spanning Trees, Minimal Spanning Trees.

Unit – IV

Boolean Algebra: Boolean Functions, Representing Boolean Functions, Logic Gates, Minimization of Circuits.

Text Discrete Mathematics and Its Applications, Kenneth H. Rosen

References

1. Discrete mathematical structures with applications to Computer Science, J.P. Tremblay and R. Manohar
2. Elements of Discrete Mathematics, C.L. Liu
3. Discrete Mathematics for Computer Scientists and Mathematicians, J.L. Mott, A. Kandel, T.P. Bakel
4. Discrete Mathematics, Kolman
5. Discrete Mathematical Structures, Roden

MMAT403T(A) Calculus of Variations

Theory: 4 Hours/Week **Credits:** 4

Unit – I

The Variation and its Properties, Euler equation, Functional of the form $\int_{x_0}^{x_1} F(x,\ y_1, y_2, \ldots . y_n,\ y_1',\ y_2', \ldots . y_n'\ )\ dx$ Functionals involving derivatives of higher order, Functionals depending on functions of several independent variables, Parametric representations of variational problems, Some applications.

Unit – II

Simplest problems with movable boundaries, Problems with movable boundaries for functionals of the form $\int_{x_0}^{x_1} F(x, y, z,\ y',\ z')\ dx$.

Unit – III

Problems with movable boundaries for functionals of the form $\int_{x_0}^{x_1} F(x, y,\ y',\ y'')\ dx$, Extremals with cusps, One-sided variations, Mixed problems.

Unit – IV

Constraints of the form $\Phi(x, y_1, y_2, \ldots . , y_n)=0$, Constraints of the form $\Phi(x, y_1, y_2, \ldots . , y_n, y_1', y_2', \ldots , y_n'\ )=0$, Isoperimetric problems.

Text Calculus of Variations, Lev D. Elsgolc

References

1. A First Course in the Calculus of Variations, Mark Kot
2. Introduction to Calculus of Variations, Hans Sagan
3. Calculus of Variations with Applications, George McNaught Ewing
4. The Calculus of Variations, Bruce van Brunt

MMAT403T(B) Elementary Operator Theory

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Compact Linear Operators, Spectrum of a Compact Operator.

Unit – II

Fredholm Alternative, Approximation Solutions.

Unit – III

Adjoint Operators, Self-Adjoint Operators, Quadratic Form, Unitary Operators, Projection Operators.

Unit – IV

Positive Operators, Square Roots of a Positive Operator, Spectrum of Self- Adjoint Operators, Invariant Subspaces, Continuous Spectra and Point Spectra.

Text A First Course in Functional Analysis Theory and Applications, Rabindranath Sen

References

1. Introdution to Topology and Modern Analysis, G.F.Simmons
2. Introductory Functional Analysis with Applications, Kreyszig
3. Functional Analysis A First Course, M.Thamban Nair
4. Topics in Functional Analysis and Applications, S.Kesavan
5. Functional Analysis, B.V.Limaye

MMAT403T(C) Mathematical Statistics

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Random Variables, Types of Random Variables, Jointly Distributed Random Variables, Expectation, Properties of Expected Value, Variance, Covariance and Variance of sums of Random Variables, Moment Generating Functions, Chebyshev's Inequality and Weak law of Large numbers.

Unit – II

Bernoulli and Binomial Random Variables, The Poisson Radom Variable, Hypergeometric Random Variable, Uniform Random Variable, Normal Random Variable, Exponential Random Variables, The Gamma Distribution, Distributions Arising from the Normal, The Logistics Distribution.

Unit – III

Distributions of Sampling Statistics: Introdution, Sample Mean, The Central Limit Theorem, The Sample Variance, Sampling Distributions from Normal Population, Sampling Distribution from a Finite Population.

Unit – IV

Regression: Introdution, Least Squares Estimators of the Regression the Parameters, Distributions of the Estimators, Statistical Inference About the Regression Parameters, The Coefficient of Determination and the Sample Correlation Coefficient, Analysis of Residuals: Assessing the Model; Transforming to Linearity, Weighted Least squares, Polynomial Regression, Multiple Regression, Logistic Regression Models for Binary Output Data.

Text Probability and Statistics for Engineers and Scientists, Sheldon Ross

References

1. Fundamentals of Statistics, S.C. Gupta & V.K. Kapoor
2. A first course in Probability and Statistics, B.L.S. Prakasa Rao

MMAT404T(A) Theory of Ordinary Differential Equations

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Linear Equations with Constant Coefficients: Introduction, The second order homogenous equation, Initial Value Problems for Second order equations, Linear dependence and independence, A formula for the Wronskian , The non-homogeneous equation of order, The homogeneous equation of order n, The initial value problems for n-th order equations, Equations with real constants, The non-homogeneous equation of order n, A special method for solving non homogeneous equation, Algebra of constant operators.

Unit – II

Linear Equations with Variable Constants: Introduction, Initial value problems for the homogeneous equation, Solutions of the homogeneous equations, Wronskian and linear independence, Reduction of the order of a homogeneous equation, The non-homogeneous equation, Homogeneous equations with analytic coefficients, The Legendre equation, Justification of the power series method.

Unit – III

Linear Equations with Regular Singular Points: Introduction, The Euler equation, Second order equations with regular singular points-an example, Second order equations with regular singular points- the general case, A convergence proof, The exceptional cases, The Bessel equation, Regular singular points at infinity.

Unit – IV

Existence and Uniqueness of Solutions to First Order Equations: Introduction, Equations with variable separated, Exact equations, The method of successive approximations, The Lipschitz condition, Convergence of the Successive approximations, Non-local existence of solutions, Approximations to and uniqueness of solutions, Equations with complex-valued functions.

Text An introduction to ordinary differential equations, Earl A. Coddington

References

1. Ordinary Differential Equations and Stability Theory, S.G. Deo, V. Ragvendra, V. Laxmi Kantham
2. Ordinary Differential Equations, William.A. Adkins, Mark G. Davidson

MMAT404T(B) Algebraic Number Theory

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Divisibility: The uniqueness of factorization, A general problem, The Gaussian integers, Rational and Gaussian primes, Congruences, Determination of the Gaussian primes, Fermat's theorem for Gaussian primes.

Unit – II

Algebraic Integers and Integral Bases: Algebraic integers, The integers in a quadratic field, Integral bases, Examples of integral bases.

Unit – III

Arithmetic in Algebraic Number Fields: Units and primes, Units in a quadratic field, The uniqueness of factorization, Ideals in an algebraic number field.

Unit – IV

The Fundamental Theorem of Ideal Theory: Basic properties of ideals, The classical proof of the unique factorization theorem, the modern proof.

Text The Theory Of Algebraic Numbers, Harry Pollard

References

1. Algebraic Number Theory, Jarvis, Frazer
2. Algebraic Number Theory, Serge Lang

MMAT404T(C) Differential Geometry

Theory: 4 Hours/Week **Credits:** 4

Unit – I

Theory of Space Curves: Representation of space curves, Unique parametric representation of a space curve, Arc-length, Tangent and osculating plane, Principal normal and binormal, Curvature and torsion, Behaviour of a curve near one of its points, The curvature and torsion of a curve as a intersection of two surfaces.

Unit – II

Contact between curves and surfaces, Osculating circle and osculating sphere, Locus of centres of spherical curvature, Tangent surfaces, involutes and evolutes, Intrinsic equations of space curves, Fundamental existence theorem for space curve.

Unit – III

The First Fundamental Form and Local Intrinsic Properties of A Surface: Definition of a surface, Nature of points on a surface, Representation of a surface, Curves on surfaces, Tangent plane and surface normal, The general surfaces of revolution, Helicoids, Metric on a surface- The first fundamental form, Direction coefficients on a surface.

Unit – IV

The First Fundamental Form and Local Intrinsic Properties of A Surface: Families of curves, Orthogonal trajectories, Double family of curves, Isometric correspondence, Intrinsic.

Geodesics on a Surface: Geodesics and their differential equations, Canonical geodesic equations, Geodesics on surfaces of revolution, Normal property of geodesics.

Text Differential Geometry, D. Somasundaram

References

1. Lectures on Classical Differential Geometry, D.T. Struik
2. Elementary Topics in Differential Geometry, J.A. Thorpe

M.Sc. (Mathematics)

SCHEME OF EXAMINATIONS

(CBCS 2016–2017)

University Exam (Theory)

Time: 3 Hrs. **Maximum marks: 80**

Section – A (**4**X **5M = 20 Marks**)

Answer all the four questions. Each question carries 4 marks.

Q1. a) From Unit 1
b) From Unit 2
c) From Unit 3
d) From Unit 4

Section – B (**4** X **15M = 60 Marks**)

Answer all the following four questions. Each carries 12 marks.

Q2. (a) or (b) from Unit 1
Q3. (a) or (b) from Unit 2
Q4. (a) or (b) from Unit 3
Q5. (a) or (b) from Unit 4

Internal Exam (Theory)

Time: 1 Hr. **Maximum marks:20**

- Two internal exams (one at the middle of the semester and the other at the end) of one-hour duration are to be conducted carrying 15 marks each.
- Average of the scores of two exams should be taken into account.
- Following is the examination pattern.
  - 10 MCQs (multiple choice questions) of half mark each
  - 10 FIBs (Fill in the Blanks) of half mark each
  - 5 SAQs (short answered questions) of one mark each
  - Totaling 15 marks.
  - 5 marks meant for assignment.

M.Sc. (Mathematics)

SCHEME OF EXAMINATIONS

(CBCS 2016–2017)

University Exam (Practical)

Time: 3 Hrs. **Maximum marks: 60+15=75**

Marks: 60

Answer all the four questions. Each question carries **13** marks.

Q1. (a) or (b) From Unit 1
Q2. (a) or (b) From Unit 2
Q3. (a) or (b) From Unit 3
Q3. (a) or (b) From Unit 4

Viva: 08 marks

Note: The following are titles of practical papers

SEMESTER-I:

Paper-I (Practical)
(i). Ordinary differential equations and partial differential equations
Paper-III (Practical)
(ii). Abstract algebra
Paper-IV (Practical)
(iii). Mathematical Analysis

SEMESTER-II:

Paper-I (Practical)
(i). Operations Research
Paper-II (Practical)
(ii). Topology
Paper-III (Practical)
(iii). Galois Theory

1. Solved 40 questions compulsory by the student
2. Concerned colleges can conduct the internal examination
3. External examiner is appointed by the university department of mathematics

Internal Assessment : Marks: 15

Day to day work and Regularity : 10

Record : 05

M.Sc. (Mathematics)

SCHEME OF EXAMINATIONS

(CBCS 2016–2017)

University Exam (Practical)

Time: 3 Hrs. **Maximum marks: 80+20=100**

Marks: 80

Answer all the four questions. Each question carries **18** marks.

Q1. (a) or (b) From Unit 1
Q2. (a) or (b) From Unit 2
Q3. (a) or (b) From Unit 3
Q3. (a) or (b) From Unit 4

Viva: 08 marks

Note: The following are practical papers

SEMESTER-III :

Paper-I (Practical)
(i). Complex Analysis
Paper-II (Practical)
(ii). Functional Analysis

SEMESTER-IV :

Paper-I (Practical)
(i). Advanced Complex Analysis
Paper-II (Practical)
(ii). Discrete Mathematics

1. Solved 40 questions compulsory by the student
2. Concerned colleges can conduct the internal examination
3. External examiner is appointed by the university department of mathematics

Internal Assessment : **Marks: 20**

Day to day work and Regularity : **10**

Record : **10**

MOOCs [Massive Online Open Courses] Free Resources

E-Learning:

- NPTEL :nptel.ac.in [Core Subjects Certification]
- C++ INSTITUTE :cppinstitute.org [C++ Certification]
- ORACLEEDUCATION :education.oracle.com [Java, DBMS Certification]
- BIG DATA UNIVERSITY :bigdatauniversity.com [Big Data Certification]
- COURSERA :coursera.org [Core Subjects Certification]
- CODEACADEMY :codecademy.com [Coding Certification]
- KHANACADEMY :khanacademy.org [Core Subjects Certification]
- PIXAR IN A BOX :khanacademy.org/partner-content/pixar
- VIDEOLECTURES :videolectures.net
- YOUTUBEEDU :plus.google.com/+YouTubeEDU/posts
- DISNEY RESEARCH :disneyresearch.com
- ALISON :alison.com [Core Subjects Certification]
- INTERNET ARCHIVE :archive.org

Freeware:

- SCILAB : scilab.org [MatLab Equivalent]
- GEOGEBRA :geogebra.org [Software for Class Room Teaching]

Search Engine:

- WOLFRAM ALPHA :wolframalpha.com [Computing Engine]
- CITESEER :citeseerx.ist.psu.edu [Searching Research Articles]
- DOAJ :doaj.org [Open Access to Journals]