

Name of the programme	Bachelor of Science in Mathematics
Short Name of the programme	B.Sc. Mathematics
Code of the programme	MTS

PROGRAMME OUTCOMES - POS

Sl. NO	CO No:	Programme Outcomes
1	PO 1	Acquire the ability to apply the basic principles of logic and science to thoughts, actions and interventions.
2	PO 2	Perceive knowledge as a comprehensive, interrelated and integrated faculty of the human mind.
3	PO 3	Generate hypothesis and articulate assent or dissent by employing both reason and creative thinking.
4	PO 4	Develop the ability to chart out a progressive direction for actions and interventions by learning to recognize the presence of hegemonic ideology within certain dominant notions.
5	PO 5	Develop self-critical abilities and the ability to view positions, problems and social issues from plural perspectives.
6	PO 6	Participate in nation building by adhering to the principles of scientific temper, sovereignty, socialism, secularism, democracy and the values that guide a republic.
7	PO 7	Develop gender sensitive attitudes, environmental awareness, the ability to understand and resist various kinds of discriminations and empathetic social awareness about various kinds of marginalization.
8	PO 8	Understand the issues related to the current environmental problems and apply the principles of science for a sustainable development in an interdisciplinary manner.
9	PO 9	Develop communication skill in English and local languages through different media.
10	PO 10	Learn to articulate analysis, synthesis, and evaluation of situations and themes in a scientific manner.
11	PO 11	Develop aesthetic, social, humanistic and artistic sensibilities for problem solving and evolving a comprehensive perspective.
12	PO 12	Attain a high level of scientific excellence, and develop hand-pick and apply appropriate techniques, resources and modern technologies for sustainable development.

PROGRAMME SPECIFIC OUTCOMES - PSOs

Sl. NO	CO No:	Area	Programme Specific Outcomes
1	PSO 1	Disciplinary knowledge	Capability of demonstrating comprehensive knowledge of mathematics and understanding of one or more disciplines which form a part of an undergraduate programme of study.
2	PSO 2	Communications skills	Ability to communicate various concepts of mathematics effectively using examples and their geometrical visualizations.
3	PSO 2		Ability to use mathematics as a precise language of communication in other branches of human knowledge.
4	PSO 2		Ability to show the importance of mathematics as precursor to various scientific developments since the beginning of the civilization.

5	PSO 3	Critical thinking:	Ability to employ critical thinking in understanding the concepts in every area of mathematics.
6	PSO 4	Analytical reasoning:	Ability to analyze the results and apply them in various problems appearing in different branches of mathematics.
7	PSO 5	Problem solving:	Capability to solve problems using concepts of linear algebra
8	PSO 5		Capability to solve various models such as growth and decay models, radioactive decay model, LCR circuits and population models using techniques of differential equations.
9	PSO 5		Ability to solve linear system of equations, linear programming problems and network flow problems.
10	PSO 5		Ability to provide new solutions using the domain knowledge of mathematics acquired during this programme.
11	PSO 6	Research-related skills:	Capability for inquiring about appropriate questions relating to the concepts in various fields of mathematics
12			To know about the advances in various branches of mathematics.
13	PSO 7	Information/digital literacy	
14	PSO 8	Self-directed learning	Ability to work independently and do in-depth study of various notions of mathematics.
15	PSO 9	Lifelong learning	Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.
16	PSO 10	Application skills:	Ability to apply the acquired knowledge in all aspects.
17	PSO 11	Experimental skills	
18	PSO 12	Moral and ethical awareness/reasoning	Ability to identify unethical behavior such as fabrication, falsification or misrepresentation of data and adopting objective, unbiased and truthful actions in all aspects

COURSE OUTCOMES - COs

Core Course

Semester	Course code	Course Title	CO No:	Course Outcomes
1	MTS1 B01	BASIC LOGIC & NUMBER THEORY	CO1	To Prove results involving divisibility, greatest common divisor, least common multiple and a few applications
			CO2	To Understand the theory and method of solutions of LDE.
			CO3	To Solve linear congruent equations.
			CO4	To Learn three classical theorems viz. Wilson's theorem, Fermat's little theorem and Euler's theorem and a few important consequences
			CO1	To introduce students to the fundamental ideas of limit, continuity and differentiability and also to some basic theorems of differential calculus.

2	MTS2 B02	CALCULUS OF SINGLE VARIABLE-1	CO2	To understand how these ideas can be applied in the problem of sketching of curves and in the solution of some optimization problems of interest in real life.
			CO3	To learn integral calculus, which is motivated by the geometric problem of finding out the area of a planar region.
			CO4	To know Some of the applications of Integral Calculus.
3	MTS3B03	CALCULUS OF SINGLE VARIABLE-2	CO1	To Understand the idea of Natural Logarithm, Exponential function, Hyperbolic functions, L'Hopitals Rule
			CO2	To study a notion of convergence of a series, which is practically done by applying several different tests such as integral test, comparison test and so on . As a special case, a study on power series-their region of convergence, differentiation and integration etc.,-
			CO3	To introduce the idea of improper integrals, their convergence and evaluation.
			CO4	To get the idea of parametrization of curves, they learn how to calculate the arc length, curvature etc. using parametrization and also the area of surface of revolution of a parametrized plane curve.
			CO5	To sketch curves in plane and space given in vector valued form.
4	MTS4B04	LINEAR ALGEBRA	CO1	To study the linear systems of equations, vector spaces, and linear transformations.
			CO2	To understand the modern view of a matrix as a linear transformation.
			CO3	To find the eigenvalues from the characteristic equation and the corresponding eigen vectors
			CO4	To Understand the diagonalization of matrices .
	MTS5B05	ABSTRACT ALGEBRA	CO1	Understand the concept of equivalence relations and equivalence classes.
			CO2	Understand the basic concepts of groups, subgroups and isomorphism of groups
			CO3	Familiarize permutation multiplication and cycles.
			CO4	Understand the notion of cyclic groups and its generators.
			CO5	Understand the concept of order of groups and order of elements in groups
			CO1	To learn and deduce rigorously many properties of real number system by assuming a few fundamental facts about it as axioms.
			CO2	To know about sequences, their limits, several basic and important theorems involving sequences and their applications

5	MTS5B06	BASIC ANALYSIS	CO3	To understand some basic topological properties of real number system such as the concept of open and closed sets, their properties, their characterization and so on.	
			CO4	To get a rigorous introduction to algebraic, geometric and topological structures of complex number system, functions of complex variable, their limit and continuity and so on.	
	MTS5B07	NUMERICAL ANALYSIS	CO1	Understand several methods such as bisection method, fixed point iteration method, regula falsi method etc. to find out the approximate numerical solutions of algebraic and transcendental equations with desired accuracy	
			CO2	Understand the concept of interpolation and also learn some well known interpolation techniques.	
			CO3	Understand a few techniques for numerical differentiation and integration and also realize their merits and demerits.	
			CO4	Find out numerical approximations to solutions of initial value problems and also to understand the efficiency of various methods.	
	MTS5B08	LINEAR PROGRAMMING	CO1	To solve linear programming problems geometrically.	
			CO2	To Understand the drawbacks of geometric methods.	
			CO3	To solve LP problems more effectively using Simplex algorithm .	
			CO4	To understand duality theory, a theory that establishes relationships between linear programming problems of maximization and minimization.	
			CO5	To understand game theory.	
			CO6	To solve transportation and assignment problems by algorithms that take advantage of the simpler nature of these problems	
	MTS5B09	INTRODUCTION TO GEOMETRY AND THEORY OF EQUATIONS	CO1	To Understand several basic facts about parabola, hyperbola and ellipse (conics) such as their equation in standard form, focal length properties, and reflection properties, their tangents and normal.	
			CO2	To Recognise and classify conics.	
			CO3	To Understand Kleinian view of Euclidean geometry.	
			CO4	To Understand affine transformations, the inherent group structure, the idea of parallel projections and the basic properties of parallel projections.	
			CO5	To Learn to solve polynomial equations upto degree four.	
				CO1	Understand several deep and fundamental results of continuous functions on intervals such as boundedness theorem, maximum-minimum theorem, intermediate value theorem, preservation of interval theorem and so on

MTS6B10	REAL ANALYSIS	CO2	Realise the difference between continuity and uniform continuity and equivalence of these ideas for functions on closed and bounded interval.
		CO3	Understand a few basic and fundamental results of integration theory , Cauchy criteria for integrability , two forms of fundamental theorem of calculus and their significance in the practical problem of evaluation of an integral.
		CO4	Prove convergence and divergence of sequences of functions and series and understand the difference between pointwise and uniform convergence of sequences and series of functions
		CO5	Understand the notion of improper integrals, their convergence and relationship among two important improper integrals namely beta and gamma functions that frequently appear in mathematics, statistics, science and engineering.
MTS6B11	COMPLEX ANALYSIS	CO1	Understand the difference between differentiability and analyticity of a complex function and harmonic functions and their connection with analytic functions
		CO2	Understand definition of complex integral, its properties and evaluation., a few fundamental results on contour integration theory such as Cauchy's theorem, Cauchy-Goursat theorem and their applications.
		CO3	Understand and apply Cauchy's integral formula and a few consequences of it such as Liouville's theorem, Morera's theorem and to see the application of Cauchy's integral formula in the derivation of power series expansion of an analytic function.
		CO4	Know a more general type of series expansion analogous to power series expansion viz. Laurent's series expansion for functions having singularity
		CO5	Understand how Laurent's series expansion lead to the concept of residue and to see another application of residue theory in locating the region of zeros of an analytic function.
		CO1	Formulate and work on the idea of limit and continuity for functions of several variables and Understand the notion of partial derivative, their computation and interpretation , the concept of gradient, a few of its properties, application and interpretation.
		CO2	Understand the use of partial derivatives in getting information of tangent plane and normal line and Calculate the maximum and minimum values of a multivariable function using second derivative test and Lagrange multiplier method.

MTS6B12	CALCULUS OF MULTI VARIABLE	CO3	Extend the notion of integral of a function of single variable to integral of functions of two and three variables and address the practical problem of evaluation of double and triple integral using Fubini's theorem and change of variable formula.
		CO4	Realise the advantage of choosing other coordinate systems such as polar, spherical, cylindrical etc. in the evaluation of double and triple integrals and see a few applications of double and triple integral in the problem of finding out surface area, mass of lamina, volume, centre of mass and so on.
		CO5	Understand the notion of a vector field, the idea of curl and divergence of a vector field, their evaluation and interpretation and learn three major results viz. Green's theorem, Gauss's theorem and Stokes' theorem of multivariable calculus and their use in several areas and directions.
MTS6B13	DIFFERENTIAL EQUATIONS	CO1	Identify a number of areas where the modeling process results in a differential equation and learn to solve DEs that are in linear, separable and in exact forms and also to analyze the solution.
		CO2	Realize the basic differences between linear and non linear DEs and also basic results that guarantees a solution in each case.
		CO3	Familiar with the theory and method of solving a second order linear homogeneous and non homogeneous equation with constant coefficients.
		CO4	Learn to find out a series solution for homogeneous equations with variable coefficients near ordinary points and acquire the knowledge of solving a differential equation using Laplace method which is especially suitable to deal with problems arising in engineering field
		CO5	Learn the technique of solving partial differential equations using the method of separation of variables
MTS6B14(E01)	ELECTIVE1-GRAPH THEORY	CO1	Understand and apply the fundamental concepts in graph theory and apply graph theory based tools in solving practical problems
		CO2	Improve the proof writing skills and analyze properties of graphs
		CO3	Understand trees and their properties
		CO4	Distinguish between Eulerian and Hamiltonian graphs and analyze planar graphs
MTS6B14(E02)	ELECTIVE2- TOPOLOGY OF METRIC SPACES	CO1	To perform simple theoretical analysis involving sets in metric spaces and maps between these spaces.
		CO2	To perform simple theoretical analysis involving sets in topological spaces and maps between these spaces

			CO3	To apply these concepts to other areas of mathematics.
	MTS6B14(E03)	ELECTIVE3-MATHEMATICAL PROGRAMMING WITH PYTHON AND LATEX	CO1	To understand basis of Python programming, apply Python programming in plotting mathematical functions, apply Python programming in numerical analysis
			CO2	To understand typesetting using Latex and apply Latex in writing equations
Open Course				
5	MTS5D01	OPEN COURSE-1 APPLIED CALCULUS	CO1	Compute limits, derivatives and write down the equation of the tangent line
			CO2	Determine whether the function is increasing or decreasing using derivatives and Compute convexity, concavity and points of inflection
			CO3	Determine extreme values and Sketch curves
			CO4	Compute the area under a curve, average value of a function using integration and compute anti derivative.
	MTS5D02	OPEN COURSE- 2 DISCRETE MATHEMATICS FOR BASIC AND APPLIED SCIENCE	CO1	Identify correct and incorrect arguments and the criteria for the evaluation of arguments
			CO2	Understand the concept of groups and derive basic theorems on groups
			CO3	Define the concept of Boolean algebra as an algebraic structure and list its properties
			CO4	Define a Graph and identify different classes of graphs and various applications of Graph theory
	MTS5D03	OPEN COURSE- 3 LINEAR MATHEMATICAL MODELS	CO1	Understand the idea of slope of the lines, understand to find solution of Linear Systems by the Echelon Method and Gauss Jordan method.
			CO2	Understand the basic concepts of linear functions, solve system of linear equations using various methods, solve linear programming problems geometrically.
			CO3	Solve LP problems more effectively using Simplex algorithm and also explain duality theory.
	MTS5 D04	OPEN COURSE-4 MATHEMATICS FOR DECISION MAKING	CO1	Understand Various mathematical techniques involved in statistics enables to gather, analyze and draw inferences from the data around us, thereby enabling to make solid decisions.
CO2			Understand various probability concepts and probability distributions are introduced to get a wider understanding on the application of statistics in decision making. distribution in inferential statistics.	
CO3			Student understands the standard normal distribution and learns the conversion of normal variable to standard normal variable	
Complementary Course				

1	MTS1C01	COMPLEMENTARY-1 MATHEMATICS – 1	CO1	To introduce students to the fundamental ideas of limit, continuity and differentiability and also to some basic theorems of differential calculus.
			CO2	To understand how these ideas can be applied in the problem of sketching of curves and in the solution of some optimization problems of interest in real life.
			CO3	To learn integral calculus, which is motivated by the geometric problem of finding out the area of a planar region.
			CO4	To know some of the applications of Integral Calculus.
2	MTS2C02	COMPLEMENTARY-2 MATHEMATICS – 2	CO1	To represent points in polar coordinates and convert from one system to another and graphing in polar coordinates
			CO2	To find the derivatives and anti derivatives of hyperbolic and inverse hyperbolic functions and the arc length and surface area of revolution using definite integrals
			CO3	To find the improper integrals, the limit of sequences, the integral using the trapezoidal rule and Simpson's rule and the convergence and divergence of series
			CO4	To solve a system of linear equations using matrix theory, the rank and inverse of a matrix using elementary row transformations, the eigen values and the corresponding eigen vectors of a matrix and to check whether a matrix is diagonalizable or not.
3	MTS3C03	COMPLEMENTARY-3 MATHEMATICS – 3	CO1	To work on the idea of limit, continuity, and derivative of vector-valued functions
			CO2	To understand the properties and applications of the gradient of a function and to evaluate curl and divergence of a vector field
			CO3	To learn the three important theorems: Green's theorem, Gauss's theorem, and Stokes's theorem and their applications
			CO4	To understand the definition and evaluation of complex integral and learn the fundamental results such as Cauchy-Goursat Theorem, Cauchy's integral formula, Liouville's theorem and the Fundamental Theorem of Algebra.
4	MTS3C04	COMPLEMENTARY-4 MATHEMATICS – 4	CO1	To learn the major classifications of differential equations, the conditions for the existence of solution of first and second order Initial Value problems and how to formulate a mathematical model of a physical process.
			CO2	To learn to solve the first order differential equations, a differential equation using Euler's method and second order equations with constant coefficients.
			CO3	To acquire the knowledge of solving a differential equation using the Laplace method, which is useful to deal with problems in engineering.

			CO4	To familiarize with the Fourier series.
			CO5	To learn the technique of solving partial differential equations using the method of separation of variables.