B.Sc. MATHEMATICS MODEL I

PROGRAMME OUTCOMES

PO1	Apply domain based knowledge to real life situations.
PO2	Acquire strong communication skills to function effectively in a diverse social atmosphere.
PO3	Adopt environmental values to enable sustainable living in the world.

UNDER GRADUATE PROGRAMME SPECIFIC OUTCOMES

	After the completion of the programme, the students will be able to:
PSO1	Utilize the mathematical tools to face the modern challenges in Mathematics.
PSO2	Acquire analytic and problem solving skills for careers and graduate works.
PSO3	Provide a holistic and logical framework in specific areas of Mathematics.

B.SC. COURSE OUTCOMES

Sl. No.	Name of the Paper	Course Outcomes
		After the completion of the course, the students will be able:
1	**SEMESTER I** Core Course: MM1CRT01 Foundations of Mathematics	**CO1 :** To explain the concepts of mathematical logic methods. **CO2 :** To illustrate the idea of sets, functions and relations **CO3 :** To solve polynomial equations using numerical methods.
2	**SEMESTER II** Core Course: MM2CRT02 Analytic Geometry , Trigonometry and Differential Calculus	**CO1 :** To interpret the ideas of conic sections, tangents and normal to a conic and their properties. **CO2 :**.To apply the concepts of trigonometric functions, their properties and summation of trigonometric series. **CO3 :** To solve problems involving successive differentiation and indeterminate forms.
3	**SEMESTER III** Core Course: MM3CRT03 Calculus	**CO1 :** To determine series expansions of given functions and, curvature and related parameters of given curve. **CO2 :** To calculate the partial derivatives, maxima and minima of functions and Lagrange multipliers for extremum problems. **CO3 :** To solve the area and volume problems using multiple integrals.

4	**SEMESTER IV** Core Course: MM4CRT04 Vector Calculus, Theory of Numbers and Laplace transform	**CO1 :** To examine the applications of vector valued functions and vector integration. **CO2 :** To apply the concept of congruence, Fermat's theorem, Wilson's theorem and Euler's phi function. **CO3 :** To determine the Laplace transform of a given function.
5	**SEMESTER V** Core Course: MM5CRT05 Mathematical Analysis	**CO1 :** To use the ideas of finite and infinite sets and the properties of set of real numbers. **CO2 :** To detect the convergence and divergence of sequence and series. **CO3 :** To apply the concept of limit of functions.
6	**SEMESTER V** Core Course: MM5CRT06 Differential Equations	**CO1 :** To explain the concepts of nature of solutions of differential equations, exact equations and homogeneous equations **CO2 :** To determine the solutions of second order linear differential equations and first order partial differential equations using different methods. **CO3 :** To compute the solutions of second order linear differential equations using the power series method.
7	**SEMESTER V** Core Course: MM5CRT07 Abstract Algebra	**CO1 :** To demonstrate different group structures and the basic results related to them. **CO2 :** To analyse the concepts of homomorphism of groups and factor groups using theorems and examples. **CO3 :** To explain the concepts of ideals and factor rings from the concepts of normal subgroups and factor groups.
8	**SEMESTER V** Core Course: MM5CRT08 Human Right and Mathematics for Environmental Studies	**CO1 :** To explain different kinds of environmental pollution and its causes. **CO2 :** To apply knowledge about Fibonacci numbers and Golden ratio. **CO3:** To describe various rules protecting human rights.
9	**SEMESTER V** Open Course: MM5OPT02 Applicable Mathematics	**CO1 :** To apply shortcut methods for solving problems. and improve mathematical skills **CO2 :** To describe the definitions of trigonometric ratios. **CO3 :** To acquire the basic arithmetic skills involving percentage, average, time and distance and elementary algebra.
10	**SEMESTER VI** Core Course: MM6CRT09 Real Analysis	**CO1:** To explain the meaning of continuity ,discontinuity and derivative of a function. **CO2:** To acquire the idea about Riemann integrability and Riemann integration. **CO3 :** To explain uniform convergence of a series.
11	**SEMESTER VI** Core Course: MM6CRT10 Graph Theory and Metric Spaces	**CO1 :** To explain basic concepts of graphs, directed graphs ,weighted graphs, trees, spanning trees, cut vertices and connectivity. **CO2 :** To examine Eulerian and Hamiltonian graphs. **CO3 :** To explain the basic concepts of metric spaces-

		open sets, closed sets and Cantor set, convergence, completeness and continuous mapping in metric spaces.
12	**SEMESTER VI** Core Course: MM6CRT11 Complex Analysis	**CO1 :** To explain the concepts of limit, continuity of complex functions and analytic functions. **CO2 :** To apply the concept of complex integration and the convergence of complex sequence and series. **CO3 :** To detect singular points and residues.
13	**SEMESTER VI** Core Course: MM6CRT12 Linear Algebra	**CO1 :** To illustrate the properties of matrices in solving system of linear equations. **CO2 :** To illustrate the concepts of vector spaces and basic results related to them. **CO3 :** To discuss linear transformation and related concepts using matrices.
14	**SEMESTER VI** Choice Based Course: MM6CBT01 Operations Research	**CO1 :** To apply linear programming problem solving methods and the concept of duality in real world problems. **CO2 :** To solve transportation and assignment problems. **CO3 :** To describe the concept of Game theory.
15	**SEMESTER VI** MM6PRT01: Project	**CO1 :** To demonstrate their own work. **CO2 :** To produce a mature oral presentation of a non-trivial mathematical topic. **CO3 :** To investigate their awareness in relation to the wider research field.
16	**SEMESTER I** Complementary Course: MM1CMT01 Partial Differentiation, Matrices, Trigonometry and Numerical Methods.	**CO1 :** To discuss the concept of partial derivatives. **CO2 :** To practice questions to find the rank of a matrix using elementary transformations and solve linear equations. **CO3 :** To compute summation of infinite series, solutions of algebraic and transcendental equations.
17	**SEMESTER II** Complementary Course: MM2CMT02 Integral Calculus and Differential Equations	**CO1 :** To apply definite integrals to find volumes, length of plane curves and area of surfaces of revolution. **CO2 :** To use multiple integrals to find volume of a solid and area of bounded regions. **CO3 :** To solve first order differential equations and partial differential equations.
18	**SEMESTER III** Complementary Course: MM3CMT03 Vector Calculus, Analytic Geometry and Abstract Algebra	**CO1 :** To solve problems involving vector valued functions, green's theorem, stokes theorem to integrate in vector fields. **CO2** : To illustrate the idea about conic sections, polar coordinates and conics in polar coordinates. **CO3:** To use the concepts of groups, cyclic groups and homomorphism of groups.
19	**SEMESTER IV** Complementary Course: MM4CMT04 Fourier Series, Laplace Transform and Complex Analysis	**CO1 :** To discuss periodic functions, trigonometric series Fourier series and power series method. **CO2 :** To explain Laplace transforms. **CO3 :** To discuss the concepts of complex numbers and analytic functions.

STATISTICS

1	**SEMESTER I** Complementary Course: Descriptive Statistics	**CO1:** To understand the basic knowledge on data collection **CO2:** To discuss the different data summarizing tools. **CO3:** To discuss different types of index numbers and the property satisfied by the good index number.
2	**SEMESTER II** Complementary Course: Probability Theory	**CO1:** To explain the concept of random variable and the probability distributions. **CO2:** To analyse the inter relation between two or more phenomena with the help of curve fitting, correlation –regression analysis. **CO3:** To develop critical thinking in theory of probability and its applications in real life problems.
3	**SEMESTER III** Complementary Course: Distribution Theory	**CO1:** To make a bridge between the elementary statistical tool and probability theory. **CO2:** To understand the standard statistical distribution found in statistical practice and its properties. **CO3:** To develop the knowledge on exact sampling distribution which are essential for statistical inference.
4	**SEMESTER IV** Complementary Course: Statistical Inference	**CO1:** To understand the notation of point and interval estimation of the parametric models and their desirable properties. **CO2:** To understand the problems those are faced in testing a hypothesis with reference to the errors in decision making. **CO3:** To apply the different testing tools like Z-test, t-test, F-test, χ^2 distribution etc. to analyse the relevant real life problems.

M.Sc. MATHEMATICS

POST GRADUATE PROGRAMME SPECIFIC OUTCOMES

	After the completion of the programme, the students will be able to:
PSO1	Evaluate hypothesis, theories, methods and evidence within their proper contexts.
PSO2	Use the concepts and theories of mathematics and their application in the real world to an advanced level in a systematic manner.
PSO3	Prepare for research studies in Mathematics & related fields and enhance career prospects in a huge array of fields.

M.Sc. Course Outcomes

Sl. No	Name of the Paper	Course Outcomes
		After the completion of the course, the students will be able:
1	**SEMESTER I** ME010101: Abstract Algebra	**CO1 :** To analyze fundamental homomorphism theorem and group action on a set. **CO2 :** To apply isomorphism theorems and Sylow theorems. **CO3 :** To demonstrate the knowledge of factorization of polynomials over a field, ring homomorphism, quotient rings, prime and maximal ideals.
2	**SEMESTER I** ME010102: Linear Algebra	**CO1 :** To illustrate basic concepts of vector spaces and the properties of determinant function. **CO2 :** To differentiate different linear transformations, their algebra and representation of transformations by matrices. **CO3 :** To implement the ideas of canonical forms, characteristic values and annihilating polynomials.
3	**SEMESTER I** ME010103: Basic Topology	**CO1 :** To analyse the concept of topological spaces, base and subbase. **CO2 :** To apply the concept of continuity , quotient spaces and connectedness on different topologies. **CO3 :** To differentiate levels of spaces based on axioms.
4	**SEMESTER I** ME010104: Real Analysis	**CO1 :** To explain theorems associated with bounded variation and rectifiable curves. **CO2 :** To acquire the idea about Riemann-Stieltjes integral and the concept of uniform convergence. **CO3 :** To acquire the idea about special functions.
5	**SEMESTER I** ME010105: Graph Theory	**CO1 :** To discuss about basic concepts of graph theory **CO2 :** To use the application of trees in everyday problems. **CO3 :** To practice problems on Eulerian and Hamiltonian graphs, graph coloring and planarity of graph.

6	**SEMESTER II** ME010201: Advanced Abstract Algebra	**CO1 :**.To explain the properties of finite fields. **CO2 :** To apply the concepts of UFD, ED and field automorphisms **CO3 :** To describe Galois group and Galois theory.
7	**SEMESTER II** ME010202: Advanced Topology	**CO1 :** To explain Urysohn characterization of normality, Tietze characterization of normality, products and co-products. **CO2 :** To analyse embedding lemma, Tychonoff embedding and metrization theorem. **CO3 :** To develop the idea of convergence of nets, compactness and variations of compactness.
8	**SEMESTER II** ME010203: Numerical analysis with Python 3	**CO1 :** To develop basic python programming involving symbolic mathematical operations. **CO2 :** To interpret the concepts of Gaussian elimination, interpolation, curve fitting and finding roots of equations using python programme. **CO3 :** To illustrate the concept of numerical integration using python.
9	**SEMESTER II** ME010204: Complex Analysis	**CO1 :** To explain spherical representation of complex plane and elementary properties of analytic functions. **CO2 :** To analyse power series representation of analytic functions. **CO3 :** To examine the concept of singularities and residues.
10	**SEMESTER II** ME010205: Measure Theory and Integration	**CO1 :** To use knowledge about Lebesgue measure and Lebesgue measurable functions. **CO2:**To describe general measurable space and measurable functions. **CO3:** To apply integration over general measurable space and product measure
11	**SEMESTER III** ME010301: Advanced Complex Analysis	**CO1 :** To apply the concept of harmonic and subharmonic functions. **CO2 :** To explain Weierstrass's theorem, Gamma function, Hadamard's theorem, Riemann zeta function and normal families. **CO3 :**To illustrate Riemann mapping theorem and Weierstrass's theory.
12	**SEMESTER III** ME010302: Partial Differential Equations	**CO1 :** To explain PDEs of first order, second and higher orders. **CO2 :** To apply various analytic methods for computing solutions of various PDEs. **CO3 :** To determine integral surfaces passing through a curve, characteristic curves of second order PDE and compatible systems. **CO4 :** To analyse behavior of solutions of PDEs using technique of separation of variables.

13	**SEMESTER III** ME010303: Multivariate Calculus and Integral Transforms	**CO1 :** To acquire the concepts of integral transforms convolutions and multivariable differential calculus.. **CO2 :** To discuss implicit functions and extremum problems. **CO3 :** To explain integration of differential forms.
14	**SEMESTER III** ME010304: Functional Analysis	**CO1 :** To acquire the concepts of normed spaces, properties of normed space,linear operators on finite dimensional spaces and dual space. **CO2 :** To illustrate inner product spaces and properties of orthonormal sequences using examples and theorems. **CO3 :** To demonstrate different forms of Hahn-Banach Theorems.
15	**SEMESTER III** ME010305: Optimization Techniques	**CO1 :** To determine solutions to linear programming problems and integer programming problems using different methods. **CO2 :** To analyse the concepts of flow and potential in networks and goal programming. **CO3 :** To discuss different methods for solving non-linear programming problems.
16	**SEMESTER IV** ME010401: Spectral Theory	**CO1 :** To distinguish different forms of convergence of operators and open mapping theorem. **CO2 :** To apply the concept of Banach fixed point theorem and properties of resolvent and spectrum. **CO3 :** To discuss properties of compact linear operators, bounded self adjoint linear operators, positive operators and properties of projections.
17	**SEMESTER IV** ME010402: Analytic Number Theory	**CO1 :** To apply the properties of arithmetical functions for solving problems. **CO2 :** To acquire the knowledge about the theory of prime numbers. **CO3 :** To utilize the concepts of congruences, Chinese remainder theorem and Legendre symbol. **CO4 :** To implement Euler's theorem, Wilson's theorem and Mobius inversion formula.
18	**SEMESTER IV** ME800401 (Elective): Differential Geometry	**CO1 :** To interpret the ideas of graphs and level sets, vector fields, the tangent space and vector fields on surfaces and orientation. **CO2 :** To summarize the fundamentals of Gauss map, geodesics and parallel transport. **CO3 :** To describe the ideas of Weingarten map, curvature of plane curves and line integrals,curvature of surfaces and parametrized surfaces.
19	**SEMESTER IV** ME800402 (Elective): Algorithmic Graph Theory	**CO1 :** To implement basic concepts of graphs using algorithms. **CO2 :** To establish the max-flow min-cut algorithm and Menger's theorem for finding connectivity. **CO3 :** To examine algorithms for finding maximum

		matching in bipartite graphs, factorizations and block designs.
20	**SEMESTER IV** ME800403 (Elective): Combinatorics	**CO1:** To apply the concepts of permutation, combinations problems,pigeonhole principle and Ramsey numbers. **CO2:** To use principles of inclusion and exclusion for solving problems. **CO3:** To compute generating functions and recurrence relations.
21	**SEMESTER IV** ME010403 & ME010104: Dissertation and Viva-voce	**CO1 :** To deduce their arguments in a comprehensible and scholarly manner. **CO2 :** To develop the spirit of research in their mind. **CO3 :** To validate scientific integrity.