Department of Mathematics

Name of the Programme: B.Sc., Mathematics

Programme Specific Outcomes (PSO)

To demonstrate basic manipulate skills in Algebra, Analysis, Geometry, Trigonometry, Calculus, Mechanics, Statistics, Numerical Methods and Programming in C.

To develop the capacity to write the proofs of mathematical statements in a suitable manner.

To get enhancement on Calculus, Algebra, Analysis, Mechanics, Differential equations and Geometry.

To apply the graph theoretical concepts to solve the real life problems.

Course Outcomes (CO)

Course code/ Paper/ Semester	Title	Course Outcomes
S1M1 Core paper 1 Semester I	Differential Calculus, Trigonometry and Matrices	Knowledge gained about Differential Calculus, Trigonometry and Matrices. Students have better understanding in the above mentioned Topics
S2M2 Core paper 2 Semester II	Classical Algebra	Acquire a clear Knowledge regarding methods to find approximate roots of the equations. Apply the appropriate tests to find the convergence or divergence of an infinite series.
S2M3 Core paper 3 Semester I & II	Integral Calculus and Analytical Geometry 3D	Students enrich their knowledge in various types and methods of integral calculus. Students have better understanding of Planes, Straight lines and Spheres in Three Dimensional spaces.
S3M4 Core paper 4 Semester III	Differential Equations and Laplace Transforms	Students enrich their knowledge in various types and methods of Differential Equations. Students have better understanding of Laplace Transform.
S4M5 Core paper 5 Semester IV	Numerical Analysis	Students enrich their knowledge in various methods to solve problems in Numerical Analysis. By this course, students can

		understandthat every problem has solution.
S4M6 Core paper 6 Semester III & IV	Vector Analysis and Fourier Series	Students enrich their knowledge in Vector integrations and Vector differentiations methods of Differential Equations. Students have better understanding of problem solving in various Fourier series.
S5M7 Core paper 7 Semester V	Abstract Algebra	After learning this paper the student can understand the notion of group and ring theory.Students have better understanding the vector space and modules.
S5M8 Core paper 8 Semester V	Real Analysis	Students enrich their knowledge in Equivalence, Diverges and converges, limit of a function, measure and derivatives
S5M9 Core paper 9 Semester V	Statics	Students will acquire knowledge about Particles or body in rest under the given forces. Forces, equilibrium of a particle and centre of mass of various bodies.
S5MEL1A Elective paper 1 Semester V	Fundamentals of Programming in C	Understand the basic structure, operators and statements of C Language. Understand the decision control statement and loop control statement
S5MEL1B Elective paper 1 Semester V	Mathematical Modeling	Learn the applications of mathematics in real life problems. Understand the suitable methods to adopt the problem using several mathematical concepts.
S5MEL1C Elective paper 1 Semester V	Formal Languages and Automata Theory	At the end of the Course, the Student will be able to understand the operations, properties, grammars and languages of automata. Learn various applications of automata
S5MEL2A Elective paper 2 Semester V	Mathematics for Competitive Examinations	Students become familiar with various kinds of mathematical concepts. Use the mathematical concepts and properties to solve real world problems. Analyze the problems and find the accurate method the solve it.
S5MEL2B Elective paper 2 Semester V	Discrete Mathematics	Students will acquire knowledge about connectives and normal forms. Learn theory of inference, predicate, functions and the problem solving.
S5MEL2C Elective paper 2 Semester V	Fuzzy Sets and FuzzyLogic	Understand uncertainty, fuzzy sets and its operations, relations. Learn the measure in fuzzy and its real life applications.
S6M10 Core paper 10 Semester VI	Complex Analysis	Enrich the knowledge about complex variable, complex functions, complex derivative and complex integration. Understand the

		transformation, power series and residues.
S6M11 **Core paper 11** **Semester VI**	Operations Research	Become familiar with various kinds of methods to solve problems. Learn different optimization techniques . Know classification of different structured problems.
S6M12 **Core paper 12** **Semester VI**	Dynamics	Students become familiar with various kinds of mathematical concepts. Use the mathematical concepts and properties to solve real world problems.
S6M13 **Core paper 13** **Semester VI**	Analytic Number Theory	Analyze how analytical methods can be used to tackle problems in number theory. Analyze the interrelationships between various arithmetical functions. Apply multiplicative functions to deal with Dirichet series as functions of a complex variable.
S6MEL3A **Elective paper 3** **Semester VI**	Graph Theory	Learn several basic concepts of graph theory. Understand to relate the objects using relations. To apply the graph theoretical concepts to solve the real life problems.
S6MEL3B **Elective paper 3** **Semester VI**	Astronomy	Enrich the knowledge about the astral events, family of sun. Learn to apply the mathematical concepts to solve movements of the celestial objects.
S6MEL3C **Elective paper 3** **Semester VI**	Coding Theory	Learn to apply various concepts of mathematics in this course. Make knowledge in coding and decoding using numerous methods.
S5MELO1 **Non-Major Elective 1** **Semester V**	Graph Theory	Learn several basic concepts of graph theory. Understand to relate the objects using relations. To apply the graph theoretical concepts to solve the network problems in physics.
S6MELO2 **Non-Major Elective 2** **Semester VI**	Mathematics for Chemists	Develop working knowledge to handle practical problems. Understand the interpolation methods.
S1ASM1 **Allied Paper 1** **For Statistics** **Semester I**	Differential Calculus, Differential Equations and Algebra	After completion of the course, the learners will be able to find the nth derivatives of the function, finding the eigen values and eigen vectors of the given matrix and find the successive approximation and summation of the series.
S2ASM2 **Allied Paper 2** **For Statistics** **Semester II**	Vector Calculus, Laplace Transforms and Fourier Series	Learn the vector differentiation, divergence theorem and problem solving. Understand the importance of transforms. Understand the periodic functions and range of Fourier series.
S2ASM3 **Allied Paper 3** **For Statistics**	Integral Calculus, Analytical Geometry 3D	Learn the basics of integration and its types. Study the general equations and related

Semester I & II		problems of straight line, plane and sphere.
S1AM1 Allied Paper 1 For Physics and Chemistry Semester I	Differential Calculus and Algebra	Understand the successive differentiations. Study the basics of curvature, series and matrices.
S2AM2 Allied Paper 2 For Physics and Chemistry Semester II	Vector Calculus and Analytical Geometry 3D	Learn the fundamental concepts of vector its properties. Study the general equations and related problems of straight line, plane and sphere.
S2AM3 Allied Paper 2 For Physics and Chemistry Semester I & II	Integral Calculus, Differential Equations, Laplace Transforms and Fourier Series	Study the basic properties and types of integration. Gain knowledge in ODE, Laplace transform and Fourier series.
S1ACSM1 Allied Paper 1 for Computer Science Semester I	Numerical Methods and Operations Research	Derive numerical methods for various mathematical operations and tasks, such as solution of algebraic and transcendental equation, numerical differentiation and solution of linear systems. Formulate a given simplified description of a suitable real-world problem as linear programming model in general standard and canonical forms. Operations Research helps the students to apply scientific and mathematical methods for decision making and problem solving.
S2ACSM2 Allied Paper 2 For Computer Science Semester II	Integral Calculus, Vector Calculus, Laplace Transforms and Fourier Series	Students will learn to graph, differentiate, integrate and solve applied problems involving parametric equations and vector-valued functions. Students learn to evaluate definite integrals to solve application problems using various integration techniques. The students will be able to represent periodic functions using Fourier series and understands Laplace transforms.
S2ACSM3 Allied Paper 3 For Computer Science Semester I & II	Probability and Statistics	Express the concept of probability and its features. Explain the concept of a random event. Probability and statistics hold the key for enabling our students to better understand, process, and interpret the vast amounts of quantitative data that exist all around them, and to have a probabilistic sense in situations of uncertainty.

DEPARTMENT OF MATHEMATICS

Name of the Programme: M.Sc., Mathematics

Programme Specific Outcomes (PSO)

To develop the mathematical skills and knowledge for their intrinsic beauty, for proficiency in analytical reasoning, utility in modelling and solving the real world problems by using the concepts of Algebra, Analysis, Dynamics, Differential Equations, Geometry, Topology, Operations Research, Fluid Dynamics and Graph Theory.

To develop computational and logical thinking and the habit of making conclusions based on quantitative information.

To work efficiently and constructively as a part of a team and do project individually.

Course Outcomes (CO)

Course code/ Paper/ Semester	Title	Course Outcomes
S1PMA1 Core paper 1 Semester I	Algebra	Upon successful completion of this course, students will be able to discuss Sylow's theorems, direct product of normal group. Discuss polynomial ring, R-module with related theorems and illustrate with some examples. Recognize the concept of extension field and related theorems. Describe Galois Theory and Finite Fields. Solve problems based on different kinds of transformations.
S1PMA2 Core paper 2 Semester I	Real Analysis	Discuss the basic concepts of topology and illustrate with examples. Apply domain knowledge for Riemann - Stieltjes integral. Explain the sequences and series of functions with the examples. Determine the partial derivatives and directional derivatives. Prove the chain rule, inverse function theorem and Implicit function theorem.
S1PMA3 Core paper 3 Semester I	Programming in C^{++} and Introduction to LATEX	Under completion of the course the student will able to: Understand the difference between the OOP and procedural oriented language and data types in C++, Program using C++ features such as composition of objects, operator overloading, inheritance polymorphism etc., Describes the development process of TeX and LaTeX, Tells the advantages of LaTeX over other more traditional software, List LaTeX compatible operating system and explain how to obtain LaTeX
S1PMAP	Practical in C++ and	On successful completion of this course students will

Practical 1 Semester I	Latex	be able to develop applications. Mathematical documents via LATEX are compiles source file, list LATEX editors ,type paragraphs, text formatting commands, create tables, floating bodies, labels and refers the equations, aligns equations. The basic structures of an article, style/class files of some journals. Preparing presentations of seminars and beamer package.
S1PMAEL1A Elective 1 Semester I	Graph Theory	After the completion of this course students will be able to: Have a strong back ground of graph theory, Solve problems of graph theory, Identify the real life problems of graph theory. Understand the concept of planar graph.
S1PMAEL1B Elective 1 Semester I	Optimization Techniques	At the end of the course students will be able to: Understand several algorithms, such as branch and bound, Gomary's cutting plane algorithms, analyze the ideas of Multistage problems in DPP, understand the ideas of inventory models, comprehend several Queuing system models, namely single server models and multi server models, comprehend several non-linear programming algorithms such as, separable programming algorithm, quadratic programming algorithm, geometric programming algorithm.
S1PMAEL1C Elective 1 Semester I	Random Process	Upon completion of this course students will be able to: understand basic ideas of discrete and continuous distributions with related properties like mean and variance discuss the joint probability distributions and illustrate with simple examples, classify random process with different types, apply the random process in various systems.
S2PMA4 Core paper 4 Semester II	Probability Theory	On the successful completion of the course, students will be able to: simulate random variables, distribution functions, probability mass functions, and probability density functions, multivariate distributions, independence, conditioning and functions of random variables, to compute expectations, moments, and correlation functions, to describe relationships between different experimental conditions and how to translate real-world problems into probability models.
S2PMA5 Core paper 5 Semester II	Differential Equations	After completion of the course, the students will be able to: Find the general solution of homogeneous equation, solving PDEs using various methods and also PDEs with variable coefficient.
S2PMA6 Core paper 6 Semester II	Topology	At the end of the course students will be able to: Understand the concept of basis for a topology, the order topology, the product topology on and the subspace topology, the basics of connected spaces, components and Local connectedness, the concepts of

		compactness and limit point compactness, the Countability axioms, the Separation axioms and Normal spaces, the classical theorems such as, the Uryshon lemma, the Tietze Extension theorem.
S2PMA7 Core paper 7 Semester II	Complex Analysis	After completing this course students are able to: Perform basic mathematical operations (arithmetic, powers, roots) with complex numbers in Cartesian and polar forms; work with multi-valued functions (logarithmic, complex power) and determine branches of these functions; Evaluate a contour integral using parameterization, fundamental theorem of calculus and Cauchy's integral formula; Explain the concepts, state and prove theorems and properties involving the above topics.
S2PMAEL2A Elective 2 Semester II	Advanced Numerical Analysis	At the end of the course students will be able to: Obtain the roots of Polynomial Equations. Solve system of equations by Direct methods and Iteration methods. Apply Hermite Interpolation, Piecewise and Spline interpolation to solve problems. Obtain numerical solutions to integration problems. Obtain numerical solutions to ODE's.
S2PMAEL2B Elective 2 Semester II	Fuzzy Algebra	Apply domain knowledge from classical sets to fuzzy sets with illustrations, Describe the fuzzy arithmetic, Linguistic variables and examine Fuzzy equations, Determine fuzzy logic and fuzzy propositions, Examine fuzzy Decision making problem and Fuzzy Linear programming problem, Classify fuzzy relations and properties of fuzzy relations.
S2PMAEL2C Elective 2 Semester II	MATLAB	Based on the programs for higher degrees and solving Linear programming problems, Solving equation of higher degrees using Bisection method, Solving system of equations by matrix method and find the eigen values, eigen vectors of a matrix of order 4 by 4 and system of non-linear equations and Gauss Jacobi iteration Method, Creating and plotting 2-D and 3-D graphs, Find the integration using Simpsons 3/8 rule, Solving ordinary differential equations using Runge–Kutta Fourth order method.
S3PMA8 Core paper 8 Semester III	Classical Dynamics	Discuss the basic concepts of Mechanical System, Derivation of Lagrange's Equation for holonomic and non holonomic system and solve simple problems, Analyze the applications of Impulsive Motion, Examine the concept of Hamilton's principle and other variational principles, Express the ideas of separability using Stackle's Theorem and solving problems.
S3PMA9	Measure Theory and	After completion of the course students will be able to:

Core paper 9 Semester III	Integration	Introduce the concept of concept of measure of a point set, the motion of Lebesgue integral, apply the basic properties of measurable functions, the various inequalities in measurable spaces.
S3PMA10 Core paper 10 Semester III	Functional Analysis	On successful completion of this course students will be able to, Appreciate how functional analysis uses and unifies ideas from vector spaces, the theory of metrics and complex analysis. Understand and apply fundamental theorems from the theory of normed and Banach spaces, including the Hahn Banach theorem, the open mapping theorem , the closed graphed theorem and the stone-water stress theorem.
S3PMA11 Core paper 11 Semester III	Stochastic Processes	After completion of the course, the learners will be able to: Classify a stochastic process given a real life situation. Apply Markov chain in real life problems. Apply Poisson other appropriate stochastic process in real life problems. Apply queuing theory concept in real life problems.
S3PMAEL3A Elective 3 Semester III	Cryptography	Students undergoing this course are expected to "Learn fundamentals of cryptography and its application to network security. Understand vulnerability analysis of network security. Acquire background on hash functions, authentication, firewalls intrusion detection techniques.
S3PMAEL3B Elective 3 Semester III	Probability and Queuing Theory	Upon completion of this course students will be able to understand Basic ideas of discrete and continuous distributions with related properties like mean and variance. Discuss the queuing models and illustrate with simple examples. Classify queueing models with different types.
S3PMAEL3C Elective 3 Semester III	Linear Algebra	Recognize the concept of vector spaces. Describe some of the canonical forms of linear transformations such as triangular and nilpotent transformations. Discuss about triangular and diagonalization of the linear transformation. Solve problems based on different kinds of decomposition.
S4PMA12 Core paper 12 Semester IV	Differential Geometry	Analytical representation of tangent, normal and binomial. Discuss the first fundamental form and developable surfaces. Understand the intrinsic properties of the surfaces and second fundamental form.
S4PMA13 Core paper 13 Semester IV	Number Theory	On the successful completion of this course, students will be able to: Understand the concept of divisibility and primes, Solve congruence's, Describe quadratic reciprocity, arithmetic functions and recurrence functions.
S4PMAEL4A Elective 4 Semester IV	Discrete Mathematics	Upon completion of this course, students will be able to: Have knowledge of the concepts needed to test the logic of a program. Have an understand in identifying

		structures on many levels. Use logical notation to define and reason mathematically about the fundamental data types and structures. Learn the concept of Boolean Algebras and Basic properties.
S4PMAEL4B Elective 4 Semester IV	Fluid Dynamics	Upon successful completion of this course, students will be able to: Acquire fundamental knowledge in fluid dynamics, Gain the knowledge of inviscid Immissible fluids, Analyze the stream function of fluids, Analyze the standard two-dimensional flows properties of materials, Understand the concepts of some hydro dynamical aspects of conformal transformation.
S4PMAEL4C Elective 4 Semester IV	Fuzzy Graph Theory	On successful completion of this course students will be able to discuss the concept of fuzzy graphs and their properties with examples, examine the concept of Geodesic, distance, covers, bases and Triangle, Parallelogram laws, demonstrate the concept of Fuzzy independent set and fuzzy bipartite graph with algorithm, classify the Dominating set and fuzzy independence set, transcribe the idea of Automorphism of fuzzy graphs and metric in fuzzy graphs.
S4PMAEL5A Elective 5 Semester IV	Transforms, Calculus of Variation and Integral Equations	On successful completion of this course students will be able to introduce the notations of Fourier and Z-Transforms and to study its properties, discuss the calculus of variations, the linear integral equations and its applications, some of the applications of ordinary differential equations.
S4PMAEL5B Elective 5 Semester IV	Algebraic Topology	Upon successful completion of this course students can able to: Understand the basic concepts of Homotopy of Paths, Describe Fundamental group of Sn, Discuss the Jordan separation and curve theorem
S4PMAEL5C Elective 5 Semester IV	Control Theory	Discuss the basic concepts of Observability and illustrate the examples., Explain controllability and nonlinear systems with the examples, Apply the domain knowledge of asymptotic stability of linear systems and perturbed linear systems, Analyze the stabilization via linear feedback control, Solve the matrix Riccati equations.

Department of Mathematics

Name of the Programme: M.Phil, Mathematics

Programme Specific Outcomes (PSO)

To develop research level thinking in the field of pure and applied mathematics.
To assimilate complex mathematical ideas and arguments.
To improve your own learning and performance.
To develop abstract mathematical thinking.

Course Outcomes (CO)

Course code/ Paper/ Semester	Title	Course Outcomes
S1MMA1/ Core paper 1 Semester I	Research Methodology	Make use of variety of Teaching - learning strategies, Instructional Designs in higher education. Apply the domain knowledge of teaching and technology in Lecture, Seminar, Symposium, Panel Discussion, Team Teaching, Project and workshop. Identify the effective teaching methods for classroom management. Demonstrate pursuit of knowledge as a character formation and interpersonal skills.
S1MMA2 Core paper 2 Semester I	Advanced Mathematics	Use computational techniques and algebraic skills essential for the study of Galois theory and its Applications. Analysis and construct mathematical arguments that relate to the study of groups. Demonstrate an understanding of the concept of topological maps and familiarity with the range of Examples. Classifying a branching process according to where it operation its or discrete time whether it has a continues or discrete state space and give examples of the process. Graph coloring provides a helpful tool or quantity and simplify the many moving parts dynamic systems.
S1MPTL3 Core paper 3 Semester I	Teaching and Learning Skills	After completing the course the students will: Develop skills of ICT and apply them in teaching learning content and research. Appreciate the role of ICT in teaching learning and research. Learn how to use instructional technology effectively in a classroom. Develop different teaching skills for putting the content across to targeted audience. Have the ability to use technology for assessment in a classroom.
S1MMA4A Core paper 4 Semester I	Queuing and Reliability Modeling	The successful completion of the course, student will be able to : The required mathematical support in real life problems and develop probabilistic models which can be used in several areas of mathematics
S1MMA4B Core paper 4	Modern Topology	The successful completion of the course, student will be able to : understand the concepts of sequence and

Semester I		compact spaces, uniform continuity, space filling curves etc. Knowing the various topological dimensions.
S1MMA4C Core paper 4 Semester I	Advanced Graph Theory	Upon successful completion of this course, student will be able to : Understand the concept in matching, independence and covering. Knowing the proof techniques in labeling and dominations.
S1MMA4D Core paper 4 Semester I	Metric Topology	Examine how the study of fixed point theory helps to solve problems which are theoretical as well as practical and Realize contraction, contractive maps have elegant results on the existence and uniqueness of fixed points. Analyze the theory of non-expansive fixed point theorems and understand the geometry of the spaces involved. Describe the generalizations of Brouwer's fixed point theorem, viz., Schauder and the use of it in analysis and differential equations. Recognize the ideas behind Applications to Michael's selection theorem.
S1MMA4E Core paper 4 Semester I	Fuzzy Mathematics	Recognize the concept of fuzzy sets and their properties. Apply the domain knowledge for Standard fuzzy operations and DeMargan's Laws in fuzzy sets. Build the domain knowledge for the Representations of fuzzy sets, Image and inverse of fuzzy sets. Analyze the various definitions of fuzzy operations and fuzzy relations. Show the concept of Fuzzy sub groups.
S1MMA4F Core paper 4 Semester I	Mathematical Modeling And its Applications	At the end of the course, students should Have an enhanced knowledge and understand of mathematical modeling and statistical methods in the Analysis of biological systems. Be able to analysis dater from experiments and draw sound conclusion about the underlying processes using their understanding of mathematics. Applying mathematics equations and find the benefits of production planning.
S1MMA4G Core paper 4 Semester I	Fuzzy Algebra and its Applications	Knowing some of the research topics in fuzzy algebra. Enrich the knowledge in algebraic properties of fuzzy algebra and its applications.