

BSc Mathematics

Programme Outcome (PO)

1. Students acquire basic knowledge in various branches of Mathematics.
2. The programme will improve the logical reasoning and problem solving capabilities of students.
3. The programme helps to improve communication skill and ability to work in groups.
4. Knowledge in applied mathematics can lead to many career opportunities.

Programme Specific Outcome (PSO)

1. The degree programme will provide both mathematical knowledge and communication skills.
2. Acquire knowledge of various Mathematical tools and techniques which can be applied in other scientific and engineering domains
3. The programme will give foundation on matrix theory, group theory, graph theory, differential equations and analysis which have application in various fields.
4. Provide fundamental ideas on various topics in pure mathematics, which makes the students able to pursue higher degrees at reputed institutions.

Course Outcome (CO)

Semester 1

Methods of Mathematics MM 1141

1. Give an overview of the fundamental methods of solving problems viz. the limiting Method.
2. Finding the rate of changes through differentiation method.
3. Finding the area, volume, length by integration method.
4. Applications of Differentiation and Integration.

Semester 2

Foundations of Mathematics MM 1221

1. Gives a deep understanding to make formal statements and proves or disproves it. Also students will be able to apply various techniques of proof to statements.
2. Give an overview of set theory and functions.
3. Students will be able to work with polar coordinates; this includes sketching graphs in polar coordinates, finding area and equations of conics.
4. Give an overview of vectors and its application in the geometry of space .

Semester 3

Elementary Number Theory and Calculus – I MM 1341

1. Get an overview of abstract algebraic structures .
2. Introduces the fundamental facts in elementary number theory.
3. Discuss calculus of vector valued functions.
4. Discuss the multi variable calculus including limits and continuity of multivariable functions, partial derivatives of functions, Lagrange multipliers to solve extremum problems with constraints etc.

Semester 4

Elementary Number Theory and Calculus – II MM 1441

1. Introduces the fundamental facts in elementary number theory.
2. Give idea of congruences, congruence relations and congruence classes, linear congruences and existence of solutions, linear system of congruence equations.

3. Discuss double and triple integrals and their applications.
4. Introduce the concept of line integrals and surface integrals .

Semester 5

Real Analysis-I MM 1541

1. Able to understand the basic concepts about the real number system including axiom of completeness, Archimedian, Density of \mathbb{Q} in \mathbb{R} , countability of \mathbb{Q} and uncountability of \mathbb{R} , Cantor's original proof for uncountability of \mathbb{R} , and Cantor's theorem on power sets.
2. Get the ideas of sequence of real numbers.
3. Get thorough idea of infinite series through examples and theorems.
4. Introduce abstract metric spaces.

Complex Analysis I MM 1542

1. Get the idea of complex numbers .
2. Understand the concept of analytic functions.
2. Get the idea of elementary functions.
3. Able to do complex integration.

Abstract Algebra – Group Theory MM 1543

1. Get the idea of Groups, subgroups and cyclic groups with the help of examples.
2. Understand permutation groups and the concept of isomorphism.
3. Able to prove Lagrange's theorem and apply it.
4. Understand the concept of group homomorphisms.

Differential Equations MM 1544

1. Able to model problems using differential equations .
2. Solve first order differential equations by reducing it to variable separable, exact , Bernoulli equations etc and using integrating factors.
3. Able to solve second order differential equations.
4. Solve differential equations by the method of variation of parameters.

Mathematics Software –Latex & SageMath MM 1545

1. Able to use two mathematical software namely Latex & Sage Math.
2. Latex enable students to typeset the project report which is a compulsory requirement for finishing their undergraduate mathematics programme successfully.
3. Learning Sage Math enable students to see how the computational techniques they have learned in the previous semesters can be put into action with the help of software so as to reduce human effort.
4. They will be able to use this software for further computations in their own in the forthcoming semester.

Operations Research (Open Course) MM 1551.1

1. Able to formulate linear programming models.
2. Graphical solution of Linear Programs in two variables and solution of a linear programming problem using simplex method.
3. Understand how to solve transportation and assignment problems.
4. Understand project management by CPM and PERT.

Project preparation - From selecting the topic to presenting the final report

1. Get idea about the structure of Dissertation.
2. To prepare abstract.

3. Get idea of how to write topics in detail.
4. Get idea of how to prepare layout.

Semester 6

Real Analysis – II MM 1641

1. Get the basic notion of limits of functions and their continuity.
2. Get a deep idea of Derivatives.
3. Get idea of doing Riemann integration of functions.
4. Compare Lebesgue integration and Riemann integration.

Complex Analysis- II MM 1642

1. Understand how to write series representations for analytic functions.
2. Learn improper integrals.
3. Understand the residue theory.
4. Understand the concept of conformal mapping.

Abstract Algebra- Ring Theory MM 1643

1. Understand the concept of rings, subrings, integral domains, fields, and the characteristic of Rings.
2. Learn the properties of ring homomorphisms.
3. Learn results on operations on polynomials such as division algorithm, factor theorem, remainder theorem etc.
4. Understand the divisibility properties of integral domains and definition of primes in a general ring.

Linear Algebra MM 1644

1. Understand the geometrical interpretation of linear equations.

2. Learn to find inverse of matrices by the elimination method.
3. Understand the concepts of vector spaces, linear transformations etc and matrix applications like solving system of equations, finding volume etc.
4. Find eigen values a matrix and diagonalize some special matrices like symmetric and Hermitian matrices.

Integral Transforms MM 1645

1. Learn to find Laplace Transforms of various functions.
2. Apply properties of laplace transforms like linearity, first Shifting, second shifting theorem etc.
3. Learn differentiation and Integration of transforms.
4. Learn Fourier Series, Fourier Transform and Its Inverse.

Graph Theory MM 1661.1

1. Understand the Definition and basic concepts of a Graph and matrix representation of graphs.
2. Get the concepts of Trees and Connectivity.
3. Apply Euler Tours and Hamiltonian Cycles in real world problems.
4. Understand Plane and Planar Graph.

Statistics
Complementary to Mathematics

Semester 1

ST 1131.1: Descriptive Statistics.

1. Learn to understand the characteristics of data and will get acquainted with describing data \ through illustrating examples and exercises.
2. They will also learn to collect, organize and summarize data, create and interpret simple graphs and compute appropriate summary statistics.
3. Understand Bivariate data.
4. Understand the correlation and regression.
5. Learn to do practicals based on Data analysis.

Semester 2

ST 1231.1: Probability and Random variables

1. Familiar with random experiments.
2. Learn conditional probability.
3. Introduce to random variables.
4. Expectation of random variables and its properties.

5. Learn to do practicals based on random variables-expectations and moments.

Semester 3

ST 1331.1: Statistical Distributions

1. Familiar with standard distributions(discrete).
2. Familiar with standard distributions(continuous).
3. Understand Chebychev's inequality, Law of large numbers, convergence in probability, central limit theorem for iid random variables.
4. Learn Sampling distributions.
5. Learn to do practicals based on discrete and continuous probability distributions and applications, law of large numbers and CLT.

Semester 4

ST 1431.1: Statistical Inference

1. Understand Point estimation.
2. Familiar with testing of hypothesis.
3. Understand large and small sample tests.
4. Design of experiments.
5. Learn to do practicals based on these topics.

ST 1432.1 Practical using Excel

1. The students will learn to use statistical tools available in Excel and have hands on training in data analysis.

**Complementary Course in Mathematics
for First Degree Programme in Physics**

Semester 1

Mathematics – I

(Calculus with applications in Physics – I)

Code: MM 1131.1

1. Learn differentiation, integration and its applications in physics.
2. Understand Infinite series and limits.
3. Learn convergence of power series and operations with power series.
4. Study vector algebra.

Semester 2

Mathematics – II

(Calculus with applications in Physics – II)

Code: MM 1231.1

1. Introduce complex numbers and hyperbolic functions.
2. Learn partial differentiation.
3. Study multiple integrals.
4. Learn vector differentiation.

Semester 3

Mathematics – III

(Calculus and Linear Algebra)

Code: MM 1331.1

1. Solution of ordinary differential equations.
2. Learn vector integration.
3. Study Fourier series.
4. Familiar with basic linear algebra.

Semester 4

Mathematics – IV

(Complex Analysis, Special Functions, and Probability Theory) Code: MM 1431.1

1. Introduce advanced complex analysis.
2. Familiar with special functions.
3. Understand basics of probability and statistics.
4. Familiar with standard distributions.

**Complementary Course in Mathematics
for First Degree Programme in Chemistry**

Semester 1

Mathematics – I

(Calculus with applications in Chemistry – I)

Code: MM 1131.2

1. Learn differentiation and its applications in chemistry.
2. Learn complex numbers and hyperbolic functions.
3. Familiar with basic vector algebra.
4. Familiar with Basic integration and its applications to chemistry.

Semester 2

Mathematics – II

(Calculus with applications in Chemistry – II)

Code: MM 1231.2

1. Understand partial differentiation.
2. Learn infinite series and limits.
3. Familiar with vector differentiation.
4. Learn to do multiple integrals.

Semester 3

Mathematics – III

(Linear Algebra, Probability Theory & Numerical Methods)

Code: MM 1331.2

1. Familiar with basic linear algebra.
2. Understand basics of probability and statistics.
3. Familiar with standard distributions.
4. Learn to solve algebraic and transcendental equations by numerical methods.

Semester 4

Mathematics-IV

(Differential Equations, Vector Calculus, and Abstract Algebra) Code: MM 1431.2

1. Learn to solve ordinary differential equations.
2. Learn vector integration – line, surface and volume integrals.
3. Study integral theorems and its physical applications.
4. Introduce abstract algebra and representation theory.

MSc Mathematics

Programme Outcome

1. The Masters degree programme will provide deep knowledge in Mathematics, communication skills and high level of reasoning ability.
2. This programme helps students to acquire basic knowledge in various branches of Mathematics.

3. Equip the student with ability to analyze problems and get reasonable conclusions thereof.
4. Provides efficient communication skill which will be useful to their jobs.
5. Make students capable for pursuing research or careers in mathematical sciences and other allied fields.

Programme Specific Outcome

1. Understanding of the fundamental results in Mathematics and capability of developing ideas based on them.
2. Acquire knowledge of a wide range of Mathematical techniques and tools which can be applied in other scientific and engineering domains.
3. Strong foundation on linear algebra, topology, group theory and analysis which have application in theoretical physics and engineering fields.
4. Provide deep and advanced learning on topics in pure mathematics, empowering the students to pursue higher degrees at reputed institutions.
5. Help students in preparing for various competitive exams like NET, GATE, SET etc.

Course Outcome

Semester-1

MM 211 Linear Algebra

1. Understand Vector spaces, Span and linear independence of vectors and basis.
2. Get the concept of linear maps and their properties, matrix of linear maps and their invertibility
3. Get the idea of Invariant subspaces, Eigen values and vectors.
4. Understand the concept of generalized eigen vectors, characteristic, minimal polynomials and Jordan form of an operator.
5. Get the concept of invertibility of an operator and its determinant.

MM 212 Real Analysis-I

1. Get idea of Functions of bounded variation and rectifiable curves.
2. Understand the concepts of Riemann-Stieltjes integral and its properties
3. Get the idea of point-wise and uniform convergence of sequences of functions.
4. Understand sequences in R^2 , their limits and continuity.
5. Learn to do partial and total differentiation.

MM 213 Differential Equations

1. Learn various methods for solving second order Linear Equations.
2. Learn to find series solutions of first order equations.

3. Learn special functions such as Legendre polynomials, Bessel's functions and Gamma functions.
4. Learn First Order PDE and some solution techniques.
5. Learn second order PDE and its classification.

MM 214 Topology I

1. Understand the concept of metric spaces.
2. Learn continuous functions and equivalence of metric spaces.
3. Learn topological spaces and basic definitions.
4. Get the concept of connected and disconnected spaces.
5. Understand compact spaces and some properties.

Semester 2

MM 221 Abstract Algebra

1. Understand groups, homomorphisms and factor groups.
2. Understand Fundamental theorem of abelian groups and Sylow theorems.
3. Get the idea of rings, fields and integral domains.
4. Learn divisibility in integral domains
5. Study extension fields.

MM 222 Real Analysis-II

1. Understand the concept of Lebesgue Outer Measure.
2. Learn Integration of Non-negative functions.
3. Study Abstract Measure Spaces.

4. Discuss the L^p spaces and Convex Functions.
5. Learn the concepts of Convergence in Measure, Signed Measures and Some Applications of the Radon-Nikodym Theorem.

MM 223 Topology II

1. Introduce Product and Quotient spaces,
2. Study Separation axioms.
3. Learn Convergence and Tychonoff's Theorem.
4. Understand the concept of fundamental group.
5. Learn some examples of fundamental groups and the Brouwer Fixed Point Theorem.

MM 224 Scientific Programming with Python

1. Introduction to Python- learn Functions and modules.
2. Learn to visualize data with graphs
3. Discuss algebra and symbolic math with SymPy and Solving calculus problems.
4. Study Gauss elimination method, interpolation, curve fitting and finding roots of equations
5. Learn numerical integration.

Semester 3

MM 231 Complex Analysis – I

1. Learn elementary properties of analytic functions.
2. Study power series representation of an analytic function.
3. Understand Cauchy's theorem and integral formula.

4. Familiar with singularities and residues.
5. Study the extended plane and its spherical representation.

MM 232 Functional Analysis- I

1. Understand the idea of Normed Spaces and Continuity of Linear maps.
2. Familiar with Hahn-Banach Theorem and Banach spaces .
3. Learn uniform bounded principle –closed and open mapping theorems .
4. Understand bounded inverse theorem, spectrum of a bounded operator.
5. Study weak convergence, reflexivity and compact linear maps.

MM 233 Operations Research (Elective)

1. Formulation of Linear Programming Models and their solution techniques.
2. Understand Transportation and Assignment problems.
3. Learn Project Management .
4. Describes Kuhn-Tucker Theory and Non-Linear programming.
5. Understand Dynamic programming .

MM 234 Geometry of Numbers (Elective)

1. Introduction to Lattice points and straight lines.
2. Discuss Lattice points and area of polygons, Lattice points in circles.
3. Learn Minkowski fundamental Theorem and Applications.
4. Understand Linear transformation and integral lattices, Geometric interpretations of Quadratic forms.
5. Discuss Blichfeldts and applications, Tchebychev's and consequences.

Semester 4

MM 241 Complex Analysis- II

1. Able to understand Compactness and Convergence in the space of Analytic functions.
2. Study Weierstrass factorization Theorem.
3. Able to understand Riemann Zeta function.
4. Understand the concept of analytic continuation and Riemann surfaces.
5. Learn Basic properties of harmonic functions.

MM 242 Functional Analysis-II

1. Understand Spectrum of a compact operator.
2. Learn Inner product spaces, orthonormal sets.
3. Study Approximation and optimization, projection and Riesz representation theorems.
4. Understand Bounded operators and adjoints, normal, unitary and self-adjoint operators.
5. Learn Spectrum and numerical range, compact self-adjoint operators.

MM 243 Coding Theory (Elective)

1. Able to Detect and correct error pattern.
2. Familiar with Linear codes and its distance.
3. Understand Perfect codes, Hamming codes.
4. Understand Cyclic linear codes, Dual cyclic codes, polynomial encoding and decoding.
5. Able to work with BCH codes.

MM244 Analytic Number Theory (Elective)

1. Familiar with The fundamental Theorem of Arithmetic.
2. Familiar with Arithmetical Function.
3. Discuss congruence, the Chinese remainder theorem.
4. Understand quadratic residues.

5. Familiar with primitive roots