

PROGRAM: M. Sc. Mathematics Ist yr

Program Outcome:

- PO1. Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- PO2. Problem Solving:** Solve problems from the disciplines of concern using the knowledge, skills and attitudes acquired from mathematics/ sciences/social sciences/humanities.
- PO3. Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in wide variety of settings.
- PO4. Ethics:** Understand multiple value systems including your own, the moral dimensions of your decisions, and accept responsibility for them.
- PO5. Self-directed and life-long learning:** Demonstrate the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
- PO6. Design/Development of Solutions:** Design solutions for complex science problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO7. Computational Thinking:** Understand data-based reasoning through translation of data into abstract concepts using computing technology-based tools.
- PO8. Aesthetic Engagement:** Demonstrate and master the ability to engage with the arts and draw meaning and value from artistic expression that integrates the intuitive dimensions of participation in the arts with broader social, cultural and theoretical frameworks.

Program Specific Outcome:

- PS01: Rational Thinking:** Students be able to formulate and develop Mathematical arguments in a logical manner to unravel the gist hidden in the problem at hand.
- PS02: Problem solving ability:** Student should be able to think in a critical manner to process the data, and develop Mathematical problem-solving ability.
- PS03: Revisiting the question:** Students should be able to recall basic facts, important milestones, discoveries in Mathematics and inculcate habit of rational thinking by which the problem at hand can be revisited, time and again, that helps in solving it.
- PS04: Analytical ability:** In the growing field of research, it is necessary for students to learn to use some packages like Matlab, Scilab, Mathematica, Maxima, etc, so that

analytical tools be available to investigate the functions, problems through graphs, programming, etc.

*PS05: **Numerical Ability:** Using packages, students can make programs to solve some problems of which exact solutions are not available, using tools of Numerical analysis.*

*PS06: **Simulation Ability:** The problems that cannot be solved directly, can at times be solved through techniques of simulation by students.*

*PS07: **Research:** Students thus motivated would prepare themselves for research studies in Mathematics and related fields.*

*PS08: **Application:** Student will be able to apply their skills and knowledge in Mathematics to various fields of studies including, science, engineering, commerce and management etc.*

M.Sc. Semester I (MATHEMATICS)	
ALGEBRA	
Sem I Paper - I DSC (Core) Code: MMT1T01	<i>Course Outcomes:</i> CO1: Foundational Knowledge: Students will be able to update their basics of Group Theory, Discuss on various topic of group in algebra. CO2: Elementary Skills: Students will be able to understand the importance of Solvable and Nilpotent, Alternating groups. CO3: Basic Analytic skills: The main outcome of the course is to equip students with necessary basic analytic skills for problem solving on Sylow theorems. CO4: Application: By applying the principles of basic theorems of Algebra through the course curriculum, students can solve a variety of logical problems in science and engineering.

M.Sc. Semester (MATHEMATICS)	
TOPOLOGY	
Sem I Paper - II DSC (Core) Code: MMT1T02	<i>Course Outcomes:</i> CO1: Foundational Knowledge: Students will learn the basic concepts of topological space, metric spaces, product topology, closed sets, limit points and continuous function. Students will also get to know about interrelating these concepts with one another. CO2: Elementary Skills: Students will study about the connectedness of topological spaces. They will get to know about connectedness on real line with standard examples CO3: Basic Analytic skills: Students will study about covering spaces and relate it with compactness of the spaces. Students will gain analytical skill to relate compactness on real line, limit point compactness and local compactness. CO4: Application: Students will be able to think critically and apply the knowledge of topological spaces in the study of analysis and will be able to prove the standard results regarding countability and separation axioms.

M.Sc. Semester I (MATHEMATICS)	
ORDINARY DIFFERENTIAL EQUATION	
Sem I Paper - III DSC (Core) Code: MMT1T03	<i>Course Outcomes:</i> CO1: Foundational Knowledge: Students will be able to study basic notions in Differential Equations and use the results in developing advanced mathematics. CO2: Elementary Skills: Students will be able to solve problems modeled using linear differential equations having ordinary points and regular singular points and solve them by method of power series. CO3: Basic Analytic skills: The main outcome of the course is to equip students to develop techniques to solve differential equations that would help students sharpen their understanding of the Mathematical solutions with their characteristics. CO4: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems involving ordinary differential equations in science and engineering.

M.Sc. Semester I (MATHEMATICS) (ELECTIVE – I) INTEGRAL EQUATIONS (Option – A)	
Sem I Paper- IV DSE (Elective) Code: MMT1T04-A	<i>Course Outcomes:</i> CO1: Foundational Knowledge: The new concept of 'Integral Equations' will be introduced to students in which they will study different types of integral equations and various methods to solve them. Also, they will be taught integral transforms such as Hilbert transform. CO2: Elementary Skills: Students will be able to understand integral equations with different types of kernel and will be able to recognize their solving methods. CO3: Basic Analytic skills: The main outcome of the course is to teach student about integral equations and solving them using various transforms such as Laplace transform, Fourier transform, Hilbert transform, etc. CO4: Application: By applying the solving techniques, students can solve Fredholm Integral equations, Volterra Integral equations, Non-linear Integral equations and Integro-differential equations.

M.Sc. Semester I (MATHEMATICS) (ELECTIVE – I) FUZZY MATHEMATICS (Option -B)	
Sem I Paper - IV DSE (Elective) Code: MMT1T04-B	<i>Course Outcomes:</i> <i>Upon successful completion, students will have the knowledge and skills to:</i> CO1. Interpret problems involving uncertainty and its quantification. CO2. Understand fuzzy numbers and fuzzy arithmetic. CO3. Implement fuzzy logic in various problems involving uncertainty. CO4. Understand fuzzy systems and fuzzy control.

M.Sc. Semester I (MATHEMATICS) PRACTICAL - I COMPUTATION WITH C /C++	
Sem I Practical – I Code: MMT1P02	<i>Course Outcomes:</i> <i>Upon successful completion, students will have the knowledge and skills to:</i> <i>CO1. Execute C /C++ programs involving logical statements.</i> <i>CO2. Operate Mathematical operations and Logical operators in determining the general output of the problem.</i> <i>CO3. Determine roots of a cubic equation in general perspective.</i> <i>CO4. Understand in depth nuances of programming that would help them gain confidence and avail them job opportunities.</i>

M.Sc. Semester I: PRACTICAL: II RESEARCH METHODOLOGY IN MATHEMATICS	
Sem I Practical – II Code: MMT1P02 (Mandatory)	Course Outcomes: <i>Upon successful completion, students will have the knowledge and skills to:</i> <i>CO1: Demonstrate installation and compilation of free Miktex software and Tex studio.</i> <i>CO2: Implement their knowledge of Latex in preparing Tex documents which can be converted into .pdf or .dvi files</i> <i>CO3: Prepare question papers of the examination</i> <i>CO4: Develop research article as per the learnings from research methodology.</i>

M.Sc. Semester II (MATHEMATICS) REAL ANALYSIS	
Sem II Paper - I DSC (Core) Code: MMT2T01	<i>Course Outcomes:</i> CO1: Foundational Knowledge: Students will be able to update their basics knowledge in sequence, series, limit, continuity and differentiability. CO2: Elementary Skills: Students will be able to understand the importance of uniform convergence and topological manifold. CO3: Basic Analytic skills: The main outcome of the course is to equip students with necessary basic analytic skills for problem solving with functions of several variables. CO4: Application: By applying the principles of basic tools through the course curriculum, students can solve a variety of practical problems involving Manifold, sub-manifold and differentiable manifold.

M.Sc. Semester II (MATHEMATICS) DIFFERENTIAL GEOMETRY	
Sem II Paper - II DSC (Core) Code: MMT2T02	<i>Course Outcomes:</i> CO1: Foundational Knowledge: Students will be introduced to the fundamentals of Differential Geometry primarily by focusing on the theory of curves and surfaces in three dimensional space . CO2: Elementary Skills: Students will be study about the curves and their global properties. Students will get to know about Geodesic curve and its existence conditions. CO3: Basic Analytic skills: Students will get the knowledge of fundamental quadratic forms of a surface, intrinsic and extrinsic geometry of surface, problem of Metrization and Triangulation. CO4: Application: By applying various definitions, theorems and formulas, students can solve different problems based on curved surfaces and their curvatures. It can be further used to analyse shapes and data on non-flat surfaces.

M.Sc. Semester II (MATHEMATICS)	
ADVANCE NUMERICAL METHODS	
Sem II Paper - III DSC (Core) Code: MMT2T03	<i>Course Outcomes:</i> CO1: Foundational Knowledge: Students will learn the basic methods and tools of numerical methods in root finding for linear and non-linear equations. They will learn about Newton's method, Muller's method and System of non-linear equations. CO2: Elementary Skills: Students will develop skills in analysing the methods of interpolation for a given data using polynomial interpolation, Newton's divided difference, forward differences and Hermite interpolation. CO3: Basic Analytic skills: Students will develop skills to approximate a function using appropriate theorems and numerical methods as a solution to the problems. CO4: Application: Students will be able to think critically to use Trapezoidal rule, Simpson's rule and Newton cotes integration formula for solving Mathematics modelling problems. They will be able to compare results of the problems by different methods.

M.Sc. Semester II (MATHEMATICS) (Elective-II)	
CLASSICAL MECHANICS	
Sem II Paper - IV DSE (Elective-II) Code: MMT2T04-A	<i>Course Outcomes:</i> C01: Foundational Knowledge: Students will be able to update their basics of variational principle. C02: Elementary Skills: Students will be able to understand the importance of Lagrange's equation of motion. C03: Basic Analytic skills: The main outcome of the course is to equip students with necessary basic analytic skills for problem solving using Lagrange's and Hamilton's equations of motion. C04: Application: By applying the course curriculum, students can solve a variety of practical problems in research.

M.Sc. Semester II (MATHEMATICS) (Elective-II)	
OPERATION RESEARCH	
Sem II Paper - IV DSE (Elective-II) Code: MMT2T04-B	<i>Course Outcomes:</i> C01: Foundational Knowledge: Students will be able to update their basics of computational procedures of Linear Programming Problem. C02: Elementary Skills: Students will be able to understand the importance of efficient computational procedures. Revised simplex method is a modification of the simplex method and students would know that it is economical on computer as it computes only relevant information. C03: Basic Analytic skills: The main outcome of the course is to equip students with necessary basic analytic skills for problem solving using a modified computational procedure. C04: Application: By applying the Revised simplex method and Network techniques through the course curriculum, students can solve a variety of practical problems in business, research and development, production & investment Marketing and engineering.

MSc Semester- II: PRACTICAL: III NUMERICAL SOLUTIONS WITH COMPUTER PROGRAMMING (MATLAB / R PROGRAMMING / PYTHON, etc.)	
Sem II Practical - III Code: MMT2P03	Course Outcomes: <i>Students will able to:</i> CO1: <i>Learn about the application of numerical method.</i> CO2: <i>Understand Newton's method, Muller's method and solve System of linear and non-linear equations.</i> CO3: <i>Find the errors in the solution so obtained by various methods.</i> CO4: <i>Derive Numerical integration using Trapezoidal rule, Simpson's rule, Newton-Cotes formulae.</i> CO5: <i>Apply approximate numerical methods to solve the problems with more accuracy.</i> CO6: <i>Learn how to obtain solution of ordinary and partial differential equations numerically.</i> CO7: <i>Compare different methods in numerical analysis efficiently.</i>

M.Sc. Semester II (MATHEMATICS) PRACTICAL - IV ON JOB TRAINING / FIELD PROJECT	
Sem II Practical-IV Code: MMT2P04	<i>Course Outcomes:</i> <i>On completion of course, Students will be able to:</i> CO1: <i>Acquire hands on training</i> CO2: <i>Know different aspects of the Institute/Industry involved in it</i> CO3: <i>Learn how to work in Team set up</i> CO4: <i>Develop aspiration to work up the ladder in the Institute/ Industry</i>