

Session: 2022-2023

Name of College:	School of Applied and Life Sciences
Program Name:	M.Sc. Mathematics
Program Code:	32

Program Educational Objectives- PEO, Program Specific Outcomes- PSO, Program Outcomes-PO, Course Outcomes-CO

Program Educational Objectives (PEO)

PEO-1	To equip students with knowledge, abilities and insight in mathematics and related fields and enable them to work as a mathematical professional and qualify for training as scientific researcher.
PEO-2	To exhibit the ability to utilize the mathematical problem-solving methods such as analysis, modelling, and programming and mathematical software applications in addressing the practical and heuristic issues.
PEO-3	To equip students with the ability to translate and synthesize their understanding towards nature, human and development and need for the ability to engage in life-long learning.
PEO-4	Masters will use their course as a pillar to develop their positive attitude, skills which will enable them to become a multi facet personality shining in any chosen field.
PEO-5	The masters will work and communicate effectively in inter-disciplinary environment, either independently or in a team, and demonstrate leadership qualities.

Program Outcomes-(PO)

PO-1	Disciplinary knowledge: Communicate advances of mathematics effectively to the solution of problems related to industry or society.
PO-2	Critical thinking and analytical reasoning: Analyze the results and apply them in various problems appearing in different branches of mathematics with the help of computational/ analytical/statistical techniques.
PO-3	Problem solving: Design & develop the solutions for scientific using the domain knowledge of mathematics with consideration for industry, society and environment.
PO-4	Research-related skills: Inquiring about appropriate questions and advances relating to the concepts in various fields of mathematics & demonstrate these traits to do research work.
PO-5	Information/digital literacy: Create, select, and apply appropriate techniques, resources, and modern scientific and IT tools with their limitations through seminar, presentations and workshop.
PO-6	Self-directed learning: Work independently and do in-depth study of various notions of mathematics using research-based knowledge and research methods including design of experiments, analysis and interpretation of data.
PO-7	Lifelong learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

PSO-1	Acquire knowledge pertaining to concepts of pure and applied mathematics (Mathematical analysis, Algebra, Operation Research, Differential Geometry, Discrete mathematics, Calculus of Variation, graph theory, Differential Equation, Numerical Methods, Fluid Dynamics, Algebraic Number theory etc.) essential for pursuing higher studies and appearing in national level examinations.
PSO-2	Exhibit ability to create, select and apply appropriate mathematical techniques, analysis and interpretation of data in multidisciplinary environment along with inculcation of research-oriented learning through seminar, academic assignments and presentations.
PSO-3	Develop critical thinking skills and the power of imagination to solve complex scientific problems with consideration for industry, society and environment.
PSO-4	On completion of program the students will be well poised to pursue career in academia, industry, organizations, research laboratory and will be able to identify the applications of mathematics in other allied fields.

Semester- I

Course Name: Algebra-I

Course Code (CC): MMT-101

MMT-101-CO-1	Acquire the advance knowledge about class equation, conjugacy and normal series.
MMT-101-CO-2	Enhance the knowledge about polynomial ring, field of quotient and factorization of polynomial ring.
MMT-101-CO-3	Develop abilities in proving Jordan's holding theorem, Sylow's theorems, Cauchy's theorem, and factorization theorem, as well as analysing the applications of these theorems.
MMT-101-CO-4	Develop the sound knowledge about reducibility and irreducibility.

Course Name: Operations Research

Course Code (CC): MMT-102

MMT-102-CO-1	Acquire the knowledge about operation research methodology, modelling in O.R. and applications of O.R.
MMT-102-CO-2	Acquire sound knowledge of Inventory, various form viz. deterministic, stochastic and its application and its impact on multidisciplinary environment.
MMT-102-CO-3	Attain and acknowledge the application of queuing theory and its broad aspects in research field.
MMT-102-CO-4	Enhanced the critical thinking skills in field of Replacement Problems and network problems.

Course Name: Real Analysis

Course Code (CC): MMT-103

MMT-103-CO-1	Demonstrate an understanding of Riemann-Stieltjes integral and their properties.
MMT-103-CO-2	Develop ability to find pointwise and uniform convergence of sequence of function.
MMT-103-CO-3	Enhance critical thinking ability by learning application of Beta-gamma functions, convergence theorem, piece-wise continuous and monotonic functions and its advanced knowledge.
MMT-103-CO-4	Application of conceptual techniques of mathematical analysis like Beta-gamma functions, convergence of series and continuity in multidisciplinary environment and real-world problems.

Course Name: Complex Analysis

Course Code (CC): MMT-104

MMT-104-CO-1	Obtain the idea of power series and its implementation's, various theorems and their explanations through their applications.
MMT-104-CO-2	Enhance critical thinking ability by solving integration of complex functions.
MMT-104-CO-3	Learn and apply appropriate techniques such as Cauchy Residue Theorem, Complex Integration, Taylors and Laurent's series to evaluate various problems of complex and its applications to multidisciplinary environment.
MMT-104-CO-4	Develop the concept of Hadamard, three circle theorem, Maximum modulus Theorem, Mittag- Leffler theorem, Conformal mapping properties, Weierstrass factorization theorem for understanding real life problems.

Course Name: Computer Applications

Course Code (CC): MMT-105

MMT-105-CO-1	Demonstrate and understanding the fundamental of computer hardware and software, and apply application software in an office environment.
MMT-105-CO-2	Create documents that makes student efficient in the use of word processing, database and presentation applications.
MMT-105-CO-3	Acquire the sound knowledge of different mathematical operation and plotting in Mathematica Software.
MMT-105-CO-4	Adapt to work on MATLAB.

Semester- II

Course Name: Algebra-II

Course Code (CC): MMT-201

MMT-201-CO-1	Analyze the fundamental concepts of splitting field, field extension, simple and normal extension.
MMT-201-CO-2	Developed critical thinking skills in the area of automorphism in field extension.
MMT-201-CO-3	Enhance knowledge of Galois's theory and its application in research.
MMT-201-CO-4	Design and interpret the idea about constructible numbers and its impossibility.

Course Name: Topology

Course Code (CC): MMT-202

MMT-202-CO-	Learn the basic concept of topology and its applications in real world
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1	problems.
MMT-202-CO-2	Knowledge of topological approach in Biological and Ecological systems.
MMT-202-CO-3	Develop the concept of cantor's intersection theorem, Bolzano-weierastrass theorem, metrization theorem and tychonoff theorem and understanding applications in real life problems.
MMT-202-CO-4	Understanding the basic concepts of, metric spaces with various properties and creates the critical thinking skills and applies for topological spaces, Product topologies and quotient topologies.

Course Name: Graph Theory

Course Code (CC): MMT-203

MMT-203-CO-1	Acquire the strong knowledge of graphs and its applications in real life problems.
MMT-203-CO-2	Develop the knowledge of tree, weighted graph and its applicability in various branch of mathematics.
MMT-203-CO-3	Explore the idea of Isomorphism graph, Homomorphic graph, connectivity, separability, planarity and geometric dual to solve many real-world problems.
MMT-203-CO-4	Develop and analyze the concept of incidence matrix, fundamental circuit matrix, chromatic problems and covering.

Course Name: Fluid Dynamics

Course Code (CC): MMT-204

MMT-204-CO-1	Acquire the advanced knowledge related to fluid dynamics, fluid flow, equation of continuity and its application.
MMT-204-CO-2	Enhance critical thinking ability by learning different types of fluid, equations, motion, conservation field and their applications.
MMT-204-CO-3	Develop the concept of Stoke's theorem, Green's theorem, Kelvin's circulation theorem, various type of theorems and analysed applications in real life problems.
MMT-204-CO-4	Appraise the concept of motion in two dimensions, Stream function, Source, Sink and their solutions in engineering field.

Course Name: Algebraic Number Theory

Course Code (CC): MMT-205

MMT-205-CO-1	Understanding of technique for Prime numbers with the concept of Unique factorisation theorem, and congruence.
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MMT-205-CO-2	Acquire the knowledge about Quadratic Reciprocity law, Primitive roots, Fermat's theorem and its applications.
MMT-205-CO-3	Develop the appropriate techniques to evaluate the solution of Diophantine equations.
MMT-205-CO-4	Understanding and create the elementary results for arithmetic functions (Mu, Tau, Phi and Sigma) and apply to specific research problems in mathematics, cryptography or in other fields.

Semester- III

Course Name: Advance Differential Equation

Course Code (CC): MMT-301

MMT-301-CO-1	Acquire the basic knowledge of Existence and uniqueness for differential equations and its application in real life environment and society.
MMT-301-CO-2	Understanding the concept of Laplace equation, green function and extremum principles and their application in real life situations.
MMT-301-CO-3	Create the ideas for producing the solution and Green function of wave equations and their applications.
MMT-301-CO-4	Ability to improve the critical thinking skills for ADEs, like diffusion equation with IBVP.

Course Name: Calculus of Variation

Course Code (CC): MMT-302

MMT-302-CO-1	Understand the foundations of calculus of variations and its practical applications in multi-disciplinary environment.
MMT-302-CO-2	Enhance the critical thinking skills by solving vibrational problems arising in dynamics.
MMT-302-CO-3	Develop the idea for handle moving boundaries problems arising in engineering and physics.
MMT-302-CO-4	Create the idea of Isoperimetric problem for determination of enclose maximum area and to gain the knowledge of Canonical transformation and direct methods.

Course Name: Discrete Mathematics

Course Code (CC): MMT-303

MMT-303-CO-1	Developed the idea of equivalence relation, partial order relation and mathematical logics.
MMT-303-CO-2	Explore the concept of Boolean algebra and its application in problems related to electric circuits.
MMT-303-CO-	Enhance the knowledge of DNF , CNF and Karnaugh map.

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MMT-303-CO-4	Design and interpret Finite state machine, grammar and language.

Course Name: Tensor Analysis and Relativity Theory

Course Code (CC): MMT-304(1)

MMT-304(1)-CO-1	Acquire the knowledge about foundations of Summation Convention, Kronecker Symbols, Transformation, Covariant and Contravariant vectors.
MMT-304(1)-CO-2	Enhance the critical thinking skills by of Riemannian Space, Christoffel Symbols and their properties with applications.
MMT-304(1)-CO-3	Develop the concept of Lorentz Transformation equations and its applications.
MMT-304(1)-CO-4	Appraise and discuss the concepts of Momentum, Energy Momentum energy four vector, Force Conservation of Energy Mass and understanding applications in real life problems.

Course Name: Differential Geometry

Course Code (CC): MMT-304(2)

MMT-304(2)-CO-1	Acquire the advance knowledge of tangent, normal, binormal, curvature and torsion.
MMT-304(2)-CO-2	Enhance critical thinking ability by learning curves in space, osculating circle, osculating sphere, helix, Bertrand curves, spherical indicatrix and its applications.
MMT-304(2)-CO-3	Appraise and discuss the concepts of surface, curvature, family of curves edge of regression, ruled surfaces and central points.
MMT-304(2)-CO-4	Develop the concept of Rodrigues and Monge's theorem, Euler's theorem, Joachimsthal's theorem, Dupin indicatrix, third fundamental form and understanding applications in real life problems.

Course Name: Actuarial Mathematics

Course Code (CC): MMT-304(3)

MMT-304(3)-CO-1	Analyse the liabilities of simple assurance and annuity contracts mortgages, refinancing a loan and their applications.
MMT-304(3)-CO-2	Show how the relationship between the pricing basis and reserving basis affects the emergence of profit for simple assurance and annuity contracts.
MMT-304(3)-CO-3	Calculate present values and accumulated values of cash flows at a specified rate of interest, using a single decrement model to take account of the probability of the payments being made.
MMT-304(3)-CO-4	Gain knowledge in foundational areas of mathematics as well as finance and annual premium policies, economics essential to the actuarial field.

Course Name: Mathematical Modelling

Course Code (CC): MMT-304(4)

MMT-304(4)-CO-1	Demonstrate understanding of powerful mathematical tools such as calculus of several variables, differential equations and elementary dynamical systems theory.
MMT-304(4)-CO-2	Develop and apply the Simulation and mathematical Modelling in real life situations.
MMT-304(4)-CO-3	Recognise the power of mathematical modelling and analysis and be able to apply their understanding to their further studies.
MMT-304(4)-CO-4	Ability to assess and prepare the critical thinking skills of LPP Model: graphical solution arithmetical solution, simplex method, sensitivity analysis & optimization modelling.

Course Name: Fundamentals of Artificial Intelligence & Machine Learning

Course Code (CC): MMT-304(5)

MMT-304(5)-CO-1	Develop the theoretical knowledge of fundamentals of the AI and practice of AI.
MMT-304(5)-CO-2	Formulate machine-learning problems corresponding to different applications.
MMT-304(5)-CO-3	Utilize a range of ML algorithms along with their strengths and weakness.
MMT-304(5)-CO-4	Utilize the basic theory of underlying machine learning and apply machine-learning algorithms to solve problems of moderate complexity.

Course Name: Total Quality Management

Course Code (CC): MMT-304(6)

MMT-304(6)-CO-1	Understand the concept of quality, ISO & various ISO standards.
MMT-304(6)-CO-2	Create and develop SOPs & documentation for management systems.
MMT-304(6)-CO-3	Know about regulatory bodies and environmental standards.
MMT-304(6)-CO-4	Access and analysis data by using modern computational & statistical methods for problem solution.

Course Name: Fundamental of Data Science

Course Code (CC): MMT-304(7)

MMT-304(7)-CO-1	Identify the need for data science and solve basic problems using Python built-in data types and their methods.
MMT-304(7)-	Design an application with user-defined modules and packages using

CO-2	OOP concept
MMT-304(7)-CO-3	Employ efficient storage and data operations using NumPy arrays.
MMT-304(7)-CO-4	Apply powerful data manipulations using Pandas and data preprocessing and visualization.

Course Name: Research Methodology and Ethics

Course Code (CC): MMT-305

MMT-305-CO-1	Recognize the basics of philosophy of science with research ethics.
MMT-305-CO-2	Familiarize with important issues in research ethics, integrity & scientific misconduct.
MMT-305-CO-3	Analyze the best practices for publications, publication ethics and identify the predatory publishers & journals.
MMT-305-CO-4	Demonstrate & use of plagiarism software tools, citation databases, research metrics and publish credible & scholarly publications in peer-reviewed journals.

Course Name: Minor Project

Course Code (CC): MMP-306

MMP-306-CO-1	Identify the research problem by being aware to the current scientific issues.
MMP-306-CO-2	Develop ethics and skills regarding research methodology and techniques
MMP-306-CO-3	Develop and enhancing the skills and competency part of technical education.
MMP-306-CO-4	Demonstrate a sound technical knowledge of their selected project topic.

Semester- IV

Course Name: Measure Theory

Course Code (CC): MMT-401

MMT-401-CO-1	Learn the concept of Lebesgue theory and integration and its applications.
MMT-401-CO-2	Develop the basic concepts of measure theory with random variables, product measures and discrete parameter.
MMT-401-CO-3	Acquire knowledge of Holder and Murkowski inequalities in L_p spaces, and its applications.
MMT-401-CO-4	Ability to assess and prepare the techniques of Lebesgue differentiation and integration. Learn the concept of integration in such concrete subjects as the theory of probability or financial mathematics.

Course Name: Functional Analysis

Course Code (CC): MMT-402

MMT-402-CO-1	Develop the concept of functional analysis, linear spaces and its applications.
MMT-402-CO-2	Acquire the knowledge about linear space, Banach spaces, Hahn-Banach theorem and linear transformation and boundedness.
MMT-402-CO-3	Enhance critical thinking ability by learning Dual spaces, Reflexive spaces, Weak convergence, compactness and their applications.
MMT-402-CO-4	Appraise and discuss the concept of Inner product spaces, Hilbert spaces, Riesz theorems, projection, operators and understanding applications in real life problems.

Course Name: Advanced Numerical Methods

Course Code (CC): MMT-403

MMT-403-CO-1	Analyze and develop the numerical methods for solution of transcendental, non-linear algebraic equation which are appearing in many engineering problems.
MMT-403-CO-2	Learn numerical methods and evaluated double, triple integral and solution of integral equations arising in various problems.
MMT-403-CO-3	Formulation of numerical techniques for the solution of differential equation and BVP which are useful in research work.
MMT-403-CO-4	Develop the ability to classify partial differential equations (PDEs) and applied numerical methods for solution of PDEs.

Course Name: Number Theory & Cryptography

Course Code (CC): MMT-404(1)

MMT-404(1)-CO-1	Acquire the basic and advance knowledge of arithmetic, divisibility and Euclidean algorithm, Congruence and its applications in real life environment and society.
MMT-404(1)-CO-2	Create the ideas of crypto systems, Enciphering matrices, Finite fields, Quadratic residues and reciprocity and its appropriate applications.
MMT-404(1)-CO-3	Construct and develop the idea of public key cryptography, RSA, Discrete log, Knapsack and its applications in security systems.
MMT-404(1)-CO-4	Develop the understanding of Pseudo primes, the Rho method, Fermat factorization, Continued fraction method and quadratic Sieve method and its real-life applications.

Course Name: Fuzzy Mathematics

Course Code (CC): MMT-404(2)

MMT-404(2)- CO-1	Acquire the basic knowledge of fuzzy set Theory and extensions principal for fuzzy sets, related theorems with real life applications.
MMT-404(2)- CO-2	Create the ideas of Fuzzy complement theorem, Generator intersection, theorems on t norms, fuzzy unions, t conforms, combination of operations.
MMT-404(2)- CO-3	Acquire the knowledge Fuzzy numbers, fuzzy equations, Crips and fuzzy relations, projections, fuzzy relations with some properties and learn its application to higher studies.
MMT-404(2)- CO-4	Develop the concept of fuzzy logic in fuzzy decision making, fuzzy linear programming, linear Regression with fuzzy parameters.

Course Name: Probability Theory and Statistics

Course Code (CC): MMT-404(3)

MMT-404(3)- CO-1	Acquire the knowledge about probability, Probability Distributions, and its real-life applications.
MMT-404(3)- CO-2	Develop the concept of various forms of discrete and continuous probability distribution functions and its application in real world problems.
MMT-404(3)- CO-3	Appraise and discuss the concept estimation, Max Likelihood method, Method of moments, least square method, Unbiasedness, Efficiency, Consistency, Sufficient Statistics and its application in field of research and innovation.
MMT-404(3)- CO-4	Adapt different statistical technique such as curve fitting, correlation and regression and analyze critical problems associated.

Course Name: Linear Integral Equations & Boundary Value Problems

Course Code (CC): MMT-404(4)

MMT-404(4)- CO-1	Create a classification concept for volterra and fredholm type integral equations.
MMT-404(4)- CO-2	Developed critical thinking skills in the area of iterated, resolve and degenerated kernel to solve integral equation.
MMT-404(4)- CO-3	Develop the idea of Neumann series method, Abel's integral equation and Formulate the solution of integral equation using Laplace and Fourier transform..
MMT-404(4)- CO-4	Explore the concept of Green function and its properties.

Course Name: Major Project/Dissertation

Course Code (CC): MMP-405

MMP-405-CO-1	Develop knowledge related to recent scientific research of mathematical science and applied science through assigned topic.
MMP-405-CO-2	Acquire skills to operate various analytical techniques and instruments, identify their applicability in research and utilize modern tools, e-resources for literature survey and data compilation
MMP-405-CO-3	Demonstrate technical skills to conduct software-based experiments and ability to record observation and interpret data to derive a solution/conclusion to complex problem.
MMP-405-CO-4	Exhibit competent writing (with critical analysis), communication and presentation skills.

Course Name: Application of R Software

Course Code (CC): VAC-M1

VAC-M1-CO-1	Develop understanding about various operations, tools and calculation techniques in R Software.
VAC-M1-CO-2	Develop understanding of R Programming and to enhance problem solving and Data analytics skills needed in a industry and organizations.