DEPARTMENT OF MATHEMATICS

PROGRAMME OUTCOMES AND COURSE OUTCOMES OF UNDER GRADUATE & POST GRADUATE PROGRAMME (2023-2024 ONWARDS)

NAME OF THE PROGRAMME: BACHELOR OF MATHEMATICS– PROGRAMME OUTCOME	
PO1	**Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study
PO2	**Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
PO3	**Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
PO4	**Problem solving:** Capacity to extra polite from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
PO5	**Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
PO6	**Research-related skills:** sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyze, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation
PO7	**Cooperation/Teamwork:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team
PO8	**Scientific reasoning**: Ability to analyze interprets and draws conclusions from quantitative/qualitative data; and critically evaluates ideas, evidence and experiences from an open-minded and reasoned perspective.
PO9	**Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both

	self and society.
PO10	**Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.
PO11	**Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.
PO12	**Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability toeffectivelyengageinamulticulturalsocietyandinteractrespectfullywithdiversegroups.
PO13	**Moral and ethical awareness/reasoning:** Ability to embrace moral/ethical values in conducting one's life, formulate apposition/argument about ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to one's work, avoid unethical behavior such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.
PO14	**Leadership readiness/qualities:** Capability form aping out that asks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in as efficient way.
PO15	**Lifelong learning:** Ability to acquire knowledge and skills, including learning how to learn, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of workplace through knowledge/skill development/reskilling.
PO16	Logical thinking, critical analysis, and reasoning skills will be highly improved.
PO17	Express mathematical ideas clearly and concisely to others.
PO18	Ability to apply suitable mathematical techniques to handle problems in physical and related sciences.
PO19	Select appropriate mathematical models and tools to solve the problems including those in real-life contexts.
PO20	Mathematics has its own universal language of symbols and notations. Students are expected to apply the Mathematics language appropriately while expressing mathematical ideas in both oral and written form.
PO21	Problem-solving techniques in mathematics will enhance the knowledge of students to formulate and solve any real-world problems independently.
PO22	Develop the knowledge of abstract mathematical concepts.
PO23	Enhance the employability skills in both public and private sector jobs

NAME OF THE PROGRAMME: B.Sc Mathematics – COURSE OUTCOMES	
SEMESTER I	
	1. To Classify and solve Reciprocal equations

ALGEBRA AND TRIGONOMETRY	2. To Find the sum of Binomial, Exponential, Logarithmic series 3. To Find Eigen values, Eigen vectors, verify Cayley – Hamilton theorem 4. To Expand the powers and multiples of trigonometric functions in terms of sine and cosine 5. To Determine relationship between circular and hyperbolic functions and the summation of trigonometric series
DIFFERENTIAL CALCULUS	1. To find the n^{th} derivative, form equations involving derivatives and apply Leibnitz formula 2. To find the partial derivative and total derivative coefficient 3. To Determine maxima and minima of functions of two variables and to use the Lagrange's method of undetermined multipliers 4. To Find the envelope of a given family of curves 5. To Find the evolutes and involutes and radius of curvature using polar coordinates
NUMERICAL METHOD-I	1. The student will be able to solve simultaneous linear equations by Gauss elimination method, Gauss-Jordan Method, and Gauss-Seidel method. 2. After studied unit -2, the student will be able to calculate interpolation values by applying Gregory-Newton's forward and backward formulae. 3. After studied unit -3, the student will be able to calculate the central interpolation values by applying central differences formulae. 4. After studied unit -4, the student will be able to estimate one or more missing terms of the given set of data. 5. After studied unit -5, the student will be able to estimate the interpolation value for unequal intervals based on Lagrange's formula of inverse interpolation.
MATHEMATICS FOR COMPETITIVE EXAMINATIONS I	The student will able to answer the questions related to the number system. 2. The student will able to answer real life simple problems by using HCF and LCM. 2. The student will able to apply the correct sequence of operations to find out the value o fa given mathematical expressions. 3. The student will able to solve the problem involving square roots, cube roots and average. 4. The student will able to carry out the problems related to age and simple product.
	1. Prove the binomial theorem and apply it to find the expansions of any $(x + y)^n$ and also ,solve the related problems 2. To Find the various sequences and series and solve the

FOUNDATION COURSE – I – BRIDGEMATHEMATICS	problems related to them. Explain the principle of counting. 3. To Find the number of permutations and combinations indifferent cases. Apply the principle of counting to solve the problems on permutations and combinations 4. To Explain various trigonometric ratios and find them for different angles, including sum of the angles, multiple and sub multiple angles, etc. Also, they can solve the problems using the transformations. 5. To Find the limit and derivative of a function at a point, the definite and indefinite integral of a function. Find the points of min/max of a function.
SEMESTER II	
ANALYTICAL GEOMETRY	1. Understand and apply the concept of homogeneous equations of second degree to represent straight lines in different forms. 2. Derive polar equations for straight lines, circles, and conic sections, and analyze their geometric properties. 3. Formulate general equations of planes, calculate angles between two planes, and determine perpendicular distances. 4. Calculate the angle between a line and a plane, determine the length of perpendiculars, and analyze coplanar and Skew lines. 5. Formulate equations of spheres, determine lengths of tangents, and analyze sections of spheres.
INTEGRAL CALCULUS	1. Determine the integrals of algebraic, trigonometric and logarithmic functions and to find 2. Evaluate double and triple integrals and problems using change of order of integration. 3. Solve multiple integrals and to find the areas of curved surfaces and volumes of solids of revolution. 4. Explain beta and gamma functions and to use them in solving problems of integration. 5. Explain Geometric and Physical applications of integral calculus.
NUMERICAL METHODS II	1. The student will be able to evaluate derivatives by applying Newton's forward and backward differences formulae. 2. After studied unit -2, the student will be able to evaluate integrations by applying the trapezoidal rule, Simpson's rules, and Weddle's rule. 3. After studied unit -3, the student will be able to find a complete solution to linear difference equations. 4. After studied unit -4, the student will be able to estimate approximate numerical solutions of algebraic and transcendental equations. 5. After studied unit -5, the student will be able to estimate approximate numerical solutions of ordinary differential

	equations by Euler, Picard, Taylor, and Runge-Kutta methods.
MATHEMATICS FOR COMPETITIVE EXAMINATIONS II	1. Solve Mathematical Problems using Mathematical formulae. 2: Understand the knowledge of application of Mathematics 3: Understand the concepts of simplification. 4: Calculate the square root and cube root. 5: Solve the problems on age.
SEMESTER III	
DIFFERENTIAL EQUATIONS AND LAPLACE TRANSFORM	1. After studied unit -1, the student will be able to know the various methods of solving the first-order higher degree differential equations. 2. After studied unit -2, the student will be able to carry out the different methods of solving the second order differential equations. 3. After studied unit -3, the student will be able to understand the concepts of total differential equations and solve the problems. 4. After studied unit -4, the student will be able to demonstrate knowledge of Laplace transform and its applications. 5. After studied unit -5, the student will be able to solve partial differential equations.
MATHEMATICAL STSTISTICS I	1. the student will be able to express the techniques of conditional probability and Baye's theorem with examples. 2. After studied unit -2, the student will be able to calculate expectation, and distribution function. 3. After studied unit -3, the student will be able to express Chebychev's inequality and its applications. 4. After studied unit -4, the student will be able to interpret the different types of correlation coefficient and lines of regression with examples. 5. After studied unit -5, the student will be able to apply domain knowledge for discrete and continuous distributions with examples.
SEMESTER IV	
	1. After studied unit -1, the student will be able to demonstrate knowledge of the physical and geometrical meaning of the derivative and its applications. 2. After studied unit -2, the student will be able to know the concepts of divergence,

VECTOR ANALYSIS AND FOURIER SERIES	curl of a vector, and their physical interpretations. 3. After studied unit -3, the student will be able to evaluate the line, surface, and volume integrals. 4. After studied unit -4, the student will be able to know the applications of Stoke's, Gauss divergence, and Green's theorems 5. After studied unit -5, the student will be able to express the given function as a Fourier series.
STATICS	1. After studied unit -1, the student will be able to know about the forces and equilibrium of a particle. 2. After studied unit -2, the student will be able to identify the parallel forces and couples and solve related problems. 3. After studied unit -3, the student will be able to demonstrate knowledge of friction and its applications. 4. After studied unit -4, the student will be able to find the centre of mass of different laminas. 5. After studied unit -5, the student will be able to demonstrate knowledge of sag and suspension bridge and solve related problems
MATHEMATICAL STSTISTICS II	1. The student will be able to demonstrate sampling, parameter, and significance with examples. 2. After studied unit -2, the student will be able to know about Chi-square distribution and its applications. 3. After studied unit -3, the student will be able to illustrate Students t-distribution and the applications of F-distribution. 4. After studied unit -4, the student will be able to state null and alternate hypotheses to the given problem and test the hypothesis. 5. After studied unit -5, the student will be able to apply ANOVA techniques.
SEMESTER V	
ABSTRACT ALGEBRA	1. Students able to identify groups and subgroups. 2. Students able to understand homomorphism and isomorphism. 3. Students able to do the problems in permutation 4. Students able to study the basics of rings, ideals and integral domain. 5. Students able to apply Euclidean rings in theorems**.**
REAL ANALYSIS I	1. know the concept countability 2. Identify convergent, divergent sequences 3.Solve conditional convergence and absolute convergence problems 4. Evaluate limit of a function 5. Know the concepts of open, closed sets.

COMPLEX ANALYSIS –I	1. The students can gain knowledge about Complex functions and its nature, limits and Analytic functions. 2. The students can gain knowledge about elementary transformations. 3. The students can gain knowledge about line integrals and techniques for solving problems.
LINEAR PROGRAMMING	1. Formulate any real world problem as LPP. 2. Understand various techniques of simplex method. 3. Understand analogies between transportation problem and assignment models 4. Interpret the solutions in game theory. 5. Know the concept of simulation.
SEMESTER VI	
LINEAR ALGEBRA .	1. Beginning with Linear Dependence and Linear Independence on Vector Space 2. Knowing about Dual spaces and Inner product spaces on Vector space 3. Learning to study about Algebra of Linear transformations and its characteristic roots. 4. Converting Linear equations of Vector space to Matrices its canonical and triangular forms 5. Deriving Trace and Transpose of Matrices.
REAL ANALYSIS-II	1. Understand the concept of complete metric space. 2. Know the difference between continuity and uniform continuity 3. know Riemann integration and its properties 4. solve problems related to Rolle's theorem , law of mean 5. know the convergence of sequences of functions
COMPLEX ANALYSIS-II	1. The students can gain knowledge about Contour integration and problem solving techniques. 2. The students can learn about singularities and Residues. 3. The students can gain knowledge about power series expansions of analytic functions.
GRAPH THEORY	1. After studying this course the students know about the basic foundations of graphs, subgraphs and trees. 2. The students can learn about connected graphs, Eulerian graphs and Hamiltonian graphs

FUZZY MATHEMATICS	1. To know the fundamentals of fuzzy Algebra. 2. To know the basic definitions of fuzzy theory 3. To know the applications of fuzzy Technology.

NAME OF THE PROGRAMME: MASTER OF MATHEMATICS– PROGRAMME OUTCOME

PO1	**Problem Solving Skill** Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context.
PO2	**Decision Making Skill** Foster analytical and critical thinking abilities for data-based decision- making.
PO3	**Ethical Value** Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities.
PO4	**Communication Skill** Ability to develop communication, managerial and interpersonal skills
PO5	**Individual and Team Leadership Skill** Capability to lead themselves and the team to achieve organizational goals
PO6	**Employability Skill** Inculcate contemporary business practices to enhance employability skills in the competitive environment.
PO7	**Entrepreneurial Skill** Equip with skills and competencies to become an entrepreneur..
PO8	**Contribution to Society** Succeed in career endeavors and contribute significantly to society.
PO9	**Multicultural competence** Possess knowledge of the values and beliefs of multiple cultures and a global perspective.
PO10	**Moral and ethical awareness/reasoning**

	Ability to embrace moral/ethical values in conducting one's life
PO11	Acquire in-depth knowledge of Mathematics both in theory and application.
PO12	Identify mathematical and computational methods in order to solve comprehensive problems.
PO13	Recognize the various specialized areas of advanced mathematics and its applications.
PO14	Analyze and interpret data to create and design new knowledge for complex problems
PO15	Develop the mathematical models for the applications of mathematics in real life situations.
PO16	Exhibit the potential to effectively accomplish tasks independently and as a member or leader in diverse teams, and in multidisciplinary settings.
PO17	Develop the skills to crack the various competitive examinations.
PO18	Ability to engage in life-long learning in the context of the rapid developments in the field.
PO19	Demonstrate the ability to write dissertations, reports, effective presentations and documentation
PO20	Commitment to professional ethics and social responsibilities.

NAME OF THE PROGRAMME: MASTERS IN MATHEMATICS – COURSE OUTCOMES
SEMESTER –I

CORE I – ALGEBRAIC STRUCTURES	1. To Recall basic counting principle, define class equations to solve problems, explain Sylow 's theorems and apply the theorem to find number of Sylow subgroups 2. To Define Solvable groups, define direct products, examine the properties of finite abelian groups, define modules 3. To Define similar Transformations, define invariant subspace, explore the properties of triangular matrix, to find the index of nilpotence to decompose a space into invariant subspaces 4. To Define Jordan, canonical form, Jordan blocks, define rational canonical form, define companion matrix of polynomial, find the elementary devices of transformation, apply the concepts to find characteristic polynomial of linear transformation 5. Define trace, define transpose of a matrix, explain the properties of trace and transpose, to find trace, to find transpose of matrix, to prove Jacobson lemma using the triangular form, define symmetric matrix, skew symmetric matrix, adjoint, to define Hermitian, unitary, normal transformations and to verify whether the transformation in Hermitian, unitary and normal
REAL ANALYSIS I	1. Analyze and evaluate functions of bounded variation and Rectifiable Curves. 2. Describe the concept of Riemann-Stieltjes integral and its properties. 3. Demonstrate the concept of step function, upper function, Lebesgue function and their integrals. 4. Construct various mathematical proofs using the properties of Lebesgue integrals and establish the Levimonotone convergence theorem. 5. Formulate the concept and properties of inner products, norms and measurable functions.
ORDINARY DIFFERENTIAL EQUATIONS	1. Establish the qualitative behavior of solutions of systems of differential equations . 2 Recognize the physical phenomena modeled by differential equations and dynamical systems. 3. Analyze solutions using appropriate methods and give examples. 4.. Formulate Green's function for boundary value problems. 5. Understand and use various theoretical ideas and results that underlie the mathematics in this course
GRAPH THEORY & APLLICATIONS	1. Grasp features and properties of various types of graphs. 2. Demonstrate capacity of illustration for mathematical reasoning through analyzing, providing and explaining concepts of Eulerian circuits and Hamiltonicity in graphs.

	3. Understand the definitions and properties of matching and independent sets. 4. Apply the concepts of graphs to model them in real life situations. 5. Explicate the applications of planarity and colorability..
DISCRETE MATHEMATICS	1. Know the algebraic structures of lattices and Boolean algebra, and sketch the minimization of Boolean polynomials. 2. Model the switching circuits with applications. 3. Understand the finite fields and its mathematics properties. 4. Acquire the notions of the polynomials over finite fields, Irreducibility and factorization of polynomials. 5. Apply the coding theory with the linear and cyclic codes in cryptography.
SEMESTER II	
ADVANCED ALGEBRA	1. Prove theorems applying algebraic ways of thinking. 2. Connect groups with graphs and understanding about Hamiltonian graphs 3. Compose clear and accurate proofs using the concepts of Galois Theory. 4. Bring out insight into Abstract Algebra with focus on axiomatic theories 5. Demonstrate knowledge and understanding of fundamental concepts including extension fields, Algebraicextensions, Finite fields, Class equations and Sylow's theorem
REAL ANALYSIS II	1. Understand and describe the basic concepts of Fourier series and Fourier integrals with respect to orthogonalsystem. 2. Analyze the representation and convergence problems of Fourier series. 3. Analyze and evaluate the difference between transforms of various functions. . 4. Formulate and evaluate complex contour integrals directly and by the fundamental theorem.4. To discuss applications of nanomaterials. 5. Apply the Cauchy integral theorem in its various versions to compute contour integration.
PARTIAL DIFFERENTIAL EQUATIONS	1. To understand and classify second order equations and find general solutions 2. To analyse and solve wave equations in different polar coordinates 3. To solve Vibrating string problem, Heat conduction problem, to identify and solve Laplace and beam equations 4. To apply maximum and minimum principle's and solve Dirichlet, Neumann problems for various boundary conditions 5. To apply Green's function and solve Dirichlet, Laplace problems, to apply Helmholtz operation and to solve Higher dimensional problem.

MATHEMATICAL DOCUMENTATION USING LATEX	1. Inculcate the computer knowledge. 2. Introduce the LaTeX software 3. Train in the Preparation of Project and dissertations using LaTex. 4. Educate the Latex coding. 5.Understand the concepts of Cross References, Footnotes, 6.Margin pars and Endnotes
TENSOR ANALYSIS & RELATIVITY	1. Understand the system of different orders in Tenor Algebra. 2. Explain about Tensor Calculus in Riemann spaces. 3. Understand the concept of Covariant of differentiation and intrinsic differentiation 4. Explain about the theory of relativity and Doppler effect. 5. Analyze about the conservation of mass and energy.
MACHINE LEARNING & ARTIFICIAL INTELLIGENCE	1. To understand fundamental issues and challenges of machine learning. 2. Have an understanding of the strengths and weaknesses of many popular machine learning approaches 3. Appreciate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and unsupervised learning 4.Understand the computation intelligence. 5. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning
SEMESTER III	
COMPLEX ANALYSIS – I	1. Understand the notions of differentiability, analyticity, power series and its consequences. 2. Comprehend the complex integration, Cauchy theorem and its properties. 3. Know the conformal mappings and Mobius transformations. 4. Acquire the concepts of maximum principle, Schwarz‟s lemma and Liouville‟s theorem. 5. Procure the singularities and its classification.
TOPOLOGY	1. Know the basics on open and closed sets and the significance of the topological spaces. 2. Comprehend the continuous functions on topological spaces, product topology and topology induced by the metric 3. Understand the connected spaces, connected subspaces, components and local connectedness. 4. Acquire the notions of compactness, compact subspaces, limit point compactness and local compactness. 5. Procure the strong theoretical background about the count

	ability axioms, the separation axioms and the consequences theorems
DIFFERENTIAL GEOMETRY	1. **1** Understand the concept of a space curve and compute its curvature and torsion. 2. Acquire the knowledge of curves on a surfaceand its intrinsic properties. 3. Analyze the geodesics and its normal properties and also familiar with Gauss Bonnet Theorem 4. Determine the second fundamental form and developable associated with space curves 5. Know Hilbert‟s Lemma and the fundamental existence theorem for surface theory .
OPERATIONS RESEARCH	1. Make decision under various decision-making environments. 2. Acquire the knowledge of replacement analysis in handling problems like staffing problem and equipment renewal problem etc. 3. Work effectively on Dynamic Programming models and their applications in solving.Decision problem 4. Provide a strong foundation in distinction between local, global and inflection extreme points.. 5. Solve non-linear programming problems.
SEMESTER IV	
COMPLEX ANALYSIS – II	1 Understand the concepts of residues and its properties. **2.** Evaluate the contour integrals and its applications. **3.** Know the analytic continuation and Poisson integral formula. Know the analytic continuation and Poisson integral formula. **4.** Acquire the representations of meromorphic and entire functions. **5.** Procure the applications of open mapping, Hurwitz and Riemann mapping theorems.
FLUID DYNAMICS	1. Understand the concepts of kinematics of fluids in motions. . **2.** Find the pressure at a point in a moving fluid. **3.** Discuss Stokes stream function.. **4.** Analyse complex velocity potential for standard two dimensional flows. **5.** Derive the Navier – Stokes equations of motion of a Viscous fluid.
FUNCTIONAL ANALYSIS	1. Analysethe Banachspace withexamples and Able to work comfortably with Continuous linear transformations **2.** Apply the conjugate operator and acquire the knowledge of openmappingtheorem.

	3 Discuss about theHilbertspaces.. **4.** Acquire the knowledge of Banach Algebra and Outline of spectral radius. **5.** Construct the Gelfand-Neumark theorem.
CALCULUS OF VARIATION AND INTEGRAL **EQUATIONS**	1. Analyze the methods for variational problems with fixed boundaries. **2.** Apply and solve the variational problems with moving boundaries. **3.** Define the methods to solve integral equations. **4.** Discuss the method of successive approximation and Fredholmtheory. **5.** Identify and Construct the solutions for real time applications.