**COURSE OUTCOMES**

**Department of Mathematics:**

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| **S No** | **Class & Semester** | **Course & Course Code** | **COs** | **Course Outcomes** |
| 01 | M.Sc & I-Sem | Algebra-I & MMT6101T | CO1 | List the fundamental properties of Sylow's theorems and isomorphism theorems. |
| CO2 | Explain the role of normal series and solvability in group theory. |
| CO3 | Demonstrate the use of polynomial irreducibility criteria to determine the properties of extensions. |
| CO4 | Critically examine the implications of the Jordan-Hölder theorem and the Fundamental Theorem of Galois Theory. |
| CO5 | Assess the conditions under which polynomial equations can be solved by radicals. |
| 02 | M.Sc & I-Sem | Real Analysis &  MMT6102T | CO1 | Define algebras and Borel sets, Lebesgue measure, and measurable sets. |
| CO2 | Apply Egorov's theorem and the concept of convergence in measure to analyze sequences of functions. |
| CO3 | Apply the Weierstrass theorem and Lebesgue integral concepts to analyze and solve problems involving continuous and bounded measurable functions |
| CO4 | Solve problems involving Fourier series expansion and the computation of Fourier coefficients |
| CO5 | Analyze the relationships between summability, integrability, and orthogonality in Fourier analysis. |
| 03 | M.Sc & I-Sem | Differential Equations-I &  MMT6103T | CO1 | Recall the forms and methods of solving Riccati's equations and total differential equations. |
| CO2 | Explain the geometrical meaning and necessary conditions for the existence of solutions to total differential equations. |
| CO3 | Apply the Frobenius method and series solution techniques to solve ordinary differential equations around regular singular points. |
| CO4 | Use Cauchy-Euler equations to analyze and solve practical differential equation problems. |
| CO5 | Analyze second-order partial differential equations with variable coefficients and solve them using Monge's method. |
| 04 | M.Sc & I-Sem | Tensor Analysis & Riemannian Geometry &  MMT6104T | CO1 | Explain the concepts of Riemannian space, metric tensor, permutation symbols, and relative tensors. |
| CO2 | Solve problems involving Ricci’s theorem, geodesic equations, and geodesic coordinates. |
| CO3 | Apply Bianchi's identity and Schur’s theorem to analyze curvature properties of Einstein spaces and isotropic points. |
| CO4 | Apply Serret-Frenet formulas, curvature, and torsion to solve problems involving space curves and their properties. |
| CO5 | Analyze complex geometrical and physical problems using tensors, geodesics, and curvature properties in Riemannian spaces and space curves. |
| 05 | M.Sc & I-Sem | Calculus of Variation and Special Function-I  &  MMT6105T | CO1 | **Analyze the properties and solutions of variational problems** with fixed boundaries using Euler's equation and identify the extremals for given functionals. |
| CO2 | **Examine the behavior of functionan is** dependent on higher-order derivatives and multiple independent variables, and solve variational problems in parametric forms. |
| CO3 | **Differentiate and compare the properties of Gauss hypergeometric functions,** derive integral representations, and apply transformation formulas. |
| CO4 | **Investigate the relationships between solutions of the Gauss hypergeometric equation,** analyze contiguous function relations, and apply differentiation and transformation formulas. |
| CO5 | **Decompose the properties and applications of Legendre polynomials and functions** Pn(x) and Qn(x)) in solving boundary value problems. |
| 06 | M.Sc & II-Sem | Research Methodology & MMT6201T | CO1 | Explain the introduction, definition, characteristics, Objectives, Nature, and importance of Research. |
| CO2 | Analyze the differences between research methods and research processes, distinguishing scientific methods from non-scientific methods, and applying inductive and deductive reasoning effectively in research scenarios. |
| CO3 | Evaluate research problems and systematically formulate research questions, identifying the steps involved in the formulation process to address specific research objectives. |
| CO4 | Analyze the characteristics and types of hypotheses, critically assess their significance, and choose appropriate hypothesis types for diverse research contexts. |
| CO5 | Examine the distinctions between primary and secondary data, and determine the most effective methods and techniques for data collection and processing based on the research context. |
| 07 | M.Sc & II-Sem | Algebra-II &  MMT6202T | CO1 | Define and describe linear transformations, dual spaces, dual basis, and annihilators. |
| CO2 | Explain matrix representations of linear maps, eigenvalues, eigenvectors, rank, nullity, and invertibility. |
| CO3 | Apply determinant properties and compute characteristic and minimal polynomials. |
| CO4 | Analyze real inner product spaces and prove inequalities such as Schwartz’s inequality. |
| CO5 | Examine orthogonality, self-adjoint transformations, and the Principal Axis Theorem with examples. |
| 08 | M.Sc & II-Sem | Differential Equations-II &  MMT6203T | CO1 | Recall the classification of second-order linear partial differential equations and identify their canonical forms and applications. |
| CO2 | Explain the concepts of eigenvalues, eigenfunctions, and orthogonality in linear homogeneous boundary value problems, and describe the Sturm-Liouville system and its properties. |
| CO3 | Solve non-homogeneous boundary value problems using the method of eigenfunction expansion and apply the method of separation of variables to Laplace, wave, and diffusion equations. |
| CO4 | Compute Green’s functions for non-homogeneous Sturm-Liouville boundary value problems and use them to solve boundary value problems with various boundary conditions. |
| CO5 | Analyze the properties of Green's functions, including the bilinear formula, and evaluate their role in solving boundary value problems with inhomogeneous conditions. |
| 09 | M.Sc & II-Sem | Differential Geometry &  MMT6204T | CO1 | Recall and describe types of surfaces like conoids, developable surfaces, and ruled surfaces, and explain their fundamental properties. |
| CO2 | Apply knowledge of metrics and fundamental forms to compute the First, Second, and Third fundamental forms of given surfaces. |
| CO3 | Derive and solve differential equations of asymptotic lines, lines of curvature, and geodesics for complex surfaces. |
| CO4 | Apply Gauss’s formulae, the Mainardi-Codazzi equations, and the Gauss-Bonnet theorem to analyze surface properties and establish relationships between them. |
| CO5 | Investigate and calculate properties of parallel surfaces and geodesics, including their curvature and torsion, for surfaces of revolution. |
| 10 | M.Sc & II-Sem | Special Function-II &  MMT62045 | CO1 | Define Bessel functions Jn(x) and recall their key properties. |
| CO2 | Identify the recurrence relations and orthogonality conditions for Jacobi polynomials. |
| CO3 | Apply these functions to solve problems involving series expansions and recurrence relations. |
| CO4 | Analyze and solve problems involving series expansions of Jacobi polynomials in different contexts. |
| CO5 | Explain the solutions of Chebyshev’s equation and their significance. |
| 11 | M.Sc & III-Sem | Functional Analysis-I &  MAT-301 | CO1 | Define key terms such as metric spaces, bounded/unbounded spaces, open/closed sets, and dense/non-dense sets. |
| CO2 | Explain concepts like continuity, contraction mappings, and fixed point theorems in metric spaces. |
| CO3 | Solve problems using Cantor’s intersection theorem or fixed point theorems to deduce results in metric spaces. |
| CO4 | Apply the definitions of interior, closure, and boundary to specific subsets in given metric spaces. |
| CO5 | Examine the interplay between continuity, convergence, and fixed point theorems in problem-solving scenarios. |
| 12 | M.Sc & III-Sem | Topology-I &  MAT-302 | CO1 | Recall and explain the concepts of countable and uncountable sets, the axiom of choice, and cardinal arithmetic. |
| CO2 | Demonstrate understanding by analyzing examples of topological spaces, closed sets, and derived sets. |
| CO3 | Apply the concepts of bases, subspaces, and countability to solve problems involving topological structures. |
| CO4 | Analyze and evaluate separation axioms and apply Urysohn's lemma and the Tietze extension theorem in specific contexts. |
| CO5 | Assess compactness, continuity, and local compactness properties in topological spaces using theoretical and practical examples. |
| 13 | M.Sc & III-Sem | Operations Research-I &  MAT-303 | CO1 | Describe the principles of duality and the Dual Simplex method. |
| CO2 | Perform sensitivity analysis to evaluate the impact of changes in parameters on the optimal solution. |
| CO3 | Solve game theory problems using linear programming techniques. |
| CO4 | Solve optimization problems involving integer programming constraints. |
| CO5 | Explain concepts of shortest path problems, PERT (Program Evaluation and Review Technique), and CPM (Critical Path Method). |
| 14 | M.Sc & III-Sem | Fluid Dynamics-I &  MAT-304 | CO1 | Define and explain the basic concepts of kinematics, streamlines, velocity potential, and vortex lines. |
| CO2 | Solve problems related to Lagrange’s and Euler’s equations of motion and analyze the effects of flux-based equations of motion. |
| CO3 | Examine equations referred to moving axes, impulse reactions, and stream functions in two-dimensional flows. |
| CO4 | Interpret and construct complex velocity potentials using sources, sinks, doublets, and conformal mapping techniques. |
| CO5 | Evaluate the motion of cylinders in an infinite mass of liquid, compute kinetic energy, and apply Blasius' theorem in fluid flow. |
| 15 | M.Sc & III-Sem | Programming in C with ANSI Features-I &  MAT-305 | CO1 | Define programming concepts and the classification of programming languages. |
| CO2 | Identify the components of a C program, including functions, variables, and constants. |
| CO3 | Explain the use of assignment statements, formatting conventions, and preprocessor directives in C programming. |
| CO4 | Apply control structures like loops, conditional branching, and the switch statement to solve basic programming problems. |
| CO5 | Examine the interplay between continuity, convergence, and fixed point theorems in problem-solving scenarios. Analyze the precedence and associativity of operators in complex expressions. |
| 16 | M.Sc & IV-Sem | Functional Analysis-II &  MAT-401 | CO1 | Describe the definitions and statements of key theorems like the Riesz lemma, Hahn-Banach theorem, and open mapping theorem. |
| CO2 | Discuss the significance of the closed graph theorem and uniform boundedness theorem in the context of continuous linear transformations. |
| CO3 | Use the Gram-Schmidt process to construct orthonormal sets and apply the Riesz representation theorem to identify functional spaces. |
| CO4 | Evaluate projections and orthogonality concepts in Hilbert spaces and solve related problems using the Pythagorean theorem and Bessel’s inequality. |
| CO5 | Synthesize knowledge of orthogonal projections and operator theory to explore invariance and functional representation in Hilbert spaces. |
| 17 | M.Sc & IV-Sem | Topology-II &  MAT-402 | CO1 | Recall definitions and properties of compactness in metric spaces. |
| CO2 | Explain the concepts of connected spaces and their significance in topology. |
| CO3 | Use the Tychonoff theorem to solve problems related to product topology and compactness. |
| CO4 | Distinguish between various separation axioms and analyze their role in topological constructions. |
| CO5 | Apply the Urysohn theorem to practical cases of embedding in metrizable spaces. |
| 18 | M.Sc & IV-Sem | Operations Research-II &  MAT-403 | CO1 | Explain the difference between deterministic and probabilistic approaches in dynamic programming. |
| CO2 | Apply analytical techniques to solve simple deterministic inventory problems. |
| CO3 | Solve multivariable optimization problems using nonlinear programming methods. |
| CO4 | Implement quadratic programming models to solve optimization problems. |
| CO5 | Solve queuing problems involving limited waiting space using mathematical modeling. |
| 19 | M.Sc & IV-Sem | Fluid Dynamics-II &  MAT-404 | CO1 | Define the motion of a sphere through a liquid at rest and describe Stokes’ stream function. |
| CO2 | Solve problems involving stress and velocity relationships in complex fluid systems. |
| CO3 | Compare the behavior of fluid flow under different coordinate systems. |
| CO4 | Solve problems related to lubrication theory and fluid flow through uniform cross-sectional tubes. |
| CO5 | Explain the boundary layer thickness, displacement thickness, and Karman integral conditions. |
| 20 | M.Sc & IV-Sem | Programming in C with ANSI Features-II &  MAT-405 | CO1 | Recall and explain the use of relational, logical, bitwise, and memory operators in solving basic problems. |
| CO2 | Demonstrate the use of arrays and pointers for data manipulation, including encryption, decryption, and sorting algorithms. |
| CO3 | Utilize multidimensional arrays, strings, and dynamic memory allocation to manage complex data structures effectively. |
| CO4 | Design and develop modular solutions using structures, unions, recursion, and function pointers to address complex problems. |
| CO5 | Implement preprocessing directives and file handling techniques, including random access, buffering, and error handling, in programming tasks. |