SYLLABUS FOR ENTRANCE TEST FOR M.SC. IN MATHEMATICS FROM THE SESSION 2026-27 ONWARDS

GENERAL INSTRUCTIONS:

1. The Entrance Test will be of MCQ (Multiple Choice Questions) objective type, having four options, i.e., A, B, C, D.
2. The total questions will be 100.
3. Total marks of the Entrance Test Question paper will be 100.
4. Each question will be of one mark.
5. Duration of the entrance test will be of two hours.
6. The standard of the question paper will be of Graduate level.
7. The Nomenclature/ Title of the Entrance test question paper will be:
   M.Sc. (Mathematics) Entrance Test from the session 2026-27 onwards.
8. The minimum eligibility condition will be as per the Handbook of Information/ Prospectus.
9. The language of the question paper will be English only.
10. There will be no negative marking.
11. Questions should be set from the prescribed syllabus. It must be ensured that no question requires the use of a calculator.

1. DIFFERENTIAL AND INTEGRAL CALCULUS (15 Marks)

- Definition of logic, propositions, truth table, negation, conjunction and disjunction, conditional and biconditional propositions, Logical equivalences, Predicates and quantifiers.
- Definitions of Sets, subsets, Power set of a set, Set operations, Venn diagrams, Finite and infinite sets, counting principle, De- Morgan's Law, Composition of relations, Types of relations.
- Basic properties of Limit and Continuity, Indeterminate forms (L'Hospital Rule), Types of discontinuities, Differentiability of functions, Successive differentiation, Leibnitz's theorem and its applications.
- Rolle's theorem, Mean Value theorems, Taylor's theorem with Lagrange's and Cauchy's forms of remainder, Taylor's series. Maclaurin's series of sin x, cos x, $e^x, log(1+x), (1+x)^m$.
- Concavity, Convexity & Points of Inflexion, Singular and Double points of curves, Curvature, Polar Coordinates and its relation with Cartesian coordinates.
- Functions of two variables, Limit and Continuity of function of two variables, Partial differentiation, Euler's theorem for homogeneous functions.
- Vectors, scalars, vector algebra. laws of vector algebra, unit vectors. rectangular unit vectors, components of a vector, scalar fields. vector fields dot or scalar products, cross or vector products, triple products.
- Integration of rational and irrational functions, definite integrals, reduction formulae $\int Sin^n x\,dx$, $\int Cos^n dx$, $\int e^{ax} x^n dx$, $\int Sin^n x\, Cos^n x\,dx, \int_0^{\pi/2} Sin^n x\,dx$, $\int_0^{\pi/2} Cos^n x\,dx, \int_0^{\pi/2} Sin^n x Cos^n x\,dx$.

2. ALGEBRA (10 Marks)

- Algebraic equations, identity theorem, the fundamental theorem of algebra, Imaginary roots of equations with real coefficients, Relation between roots and coefficients & discovery of multiple roots.
- Types of matrices and its properties, Elementary operations of a Matrices, computation of matrix inverses using elementary row operations, Solutions of a system of linear equations using the inverse of matrices.
- Rank of a matrix, Reduction to normal form, Matrices in diagonal form. Solutions of linear homogeneous and non-homogeneous equations with number of equations and unknowns upto three**,** eigenvalues and Eigen vectors of matrices**.**

- Vector spaces, subspaces, algebra of subspaces, quotient spaces. Linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.
- Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations.

- Polynomials in one variables: Polynomials, multiplication and division of polynomials, the remainder theorem, synthetic division, Horner's process & highest common divisor of two polynomials.
- Cardan's formulas, trigonometric solution, Descartes' rule of sign.
- Definition and examples of groups, examples of abelian and non-abelian groups, the group Z_n of integers under addition modulo n, Cyclic groups, the permutation group S_n.
- Subgroups, cyclic subgroups, the concept of a subgroup generated by a subset and the commutator subgroup of group, examples of subgroups including the center of a group. Cosets, Index of subgroup, Lagrange's theorem, order of an element.
- Definition and examples of rings (commutative and non-commutative rings), Rings of matrices, polynomial rings, Subrings and ideals, Integral domains and fields.

3. MECHANICS **(10 Marks)**

- Basic concepts, Newton's Laws of motion, parallelogram law and triangle law of forces, resultant of two coplanar forces. λ-μ theorem, moment of a force and Lami's theorem.
- Polygon law of forces, theorem of resolved parts, generalized theorem of resolved parts, coplanar forces. Algebraic method of finding the resultant of any number of coplanar concurrent forces. Resultant of two forces acting on a rigid body. Parallel forces.
- Motion of particle with constant and variable acceleration, Simple harmonic motion and projectiles, trajectory, velocity of projection, angle of projection, range and time of flight.

4. DIFFERENTIAL EQUATIONS **(10 Marks)**

- Differential equations (Definition, formulation and solutions), Differential equations of first order and first degree, Homogeneous differential equations and equations reducible to homogeneous form and their solutions, Linear differential equation (Leibnitz's) and their solutions.
- Exact differential equations and standard rule for finding their integrating factors, Differential equations of first order and higher degree solvable for x, y, p, Clairaut's equation and its solution, Linear homogenous and non-homogenous differential equations with constant coefficients and their solutions.
- The linear differential equations and its variable coefficients (Cauchy- Euler and Legendre's form) and their solutions, Linear differential equations of second order and its solution by the method of variation of parameters.
- Partial differential equations of first order in two independent variables, formation of first order Partial differential equations, solution of Linear first order Partial differential equations (Lagrange's method).
- The Cauchy problems for first order equations, Solution of first order non-linear PDE by Charpit's method.

5. REAL ANALYSIS **(10 Marks)**

- Real line, bounded sets, suprema and infima, completeness property of R, Archimedean property of R, intervals, concept of limit points and statement of Bolzano-Weierstrass theorem.
- Real Sequence, Bounded sequence, Cauchy sequences, and their convergence, Cauchy's theorem on limits of the sequence, bounded and monotone convergence theorems, Cauchy's general principle of convergence.
- Infinite series. Cauchy convergence criterion for series, positive term series, geometric

series, comparison test, convergence of p-series, Cauchy's Root test, D-Alembert Ratio test, Raabe's test, Logarithmic test, Gauss test, alternating series, Leibnitz's test, absolute and conditional convergence, Abel's test (Tests of Convergence without proof).

6. COMPLEX ANALYSIS (10 Marks)

- The algebra of complex numbers, the Lagrange identity, the triangle inequality, the Cauchy inequality, the binomial equation (De Moivre's formula), the geometric representation of complex numbers, Analytic geometry, and the spherical representation.
- Limits and continuity, Analytic functions, Harmonic functions, Polynomials, the Lucas theorem, rational functions, zeros, poles and order of a rational function, the exponential and the trigonometric functions, the periodicity, the logarithm function.

7. NUMERICAL ANALYSIS (05 Marks)

- Bisection method, False position method, Fixed point iteration method, Newton's method, Secant method, LU decomposition. Gauss-Jacobi and Gauss-Siedel iterative methods, Linear and higher order Lagrange and Newton interpolation. Integration: Trapezoidal rule, Simpson's rule.

8. GEOMETRY (10 Marks)

- Coordinates, Straight line, the plane, the straight line in three dimensions, circle, Parabola, ellipse, hyperbola and sphere.

9. OPERATIONS RESEARCH AND GRAPH THEORY (10 Marks)

- Convex sets, introduction to Linear Programming Problem**:** Graphical method of solution, Basic Feasible Solutions, Linear programming; Introduction to the Simplex method. Transportation problems, Assignment problem and Game theory.
- Definition, examples and basic properties of graphs, simple graph, multigraph, pseudographs, degree of a vertex, types of graphs.

10. PROBABILITY AND STATISTICS (10 Marks)

- Measures of central tendency, Measures of dispersion, Moments, skewness and kurtosis.
- Correlation, Karl Pearson's coefficient of correlation
- Probability: Random experiment, sample space, Mathematical and statistical definitions of Probability of an event, Axiom of probability, equally likely, mutually exclusive, independent and compound events, Conditional probability.
- Additive and Multiplicative law of probability, Bayes' Theorem.