The Talent Search Test in Mathematics and Science (TSTMS)
Syllabus
Mathematics
Classes 6 to 12
B.Sc & M.Sc

The Talent Search Test in Mathematics and Science (TSTMS) is a prestigious competition organised by **the Indian Mathematics and Science Association** that challenges students to increase their knowledge and skills in various areas of science and Mathematics. The exam pattern consists of multiple-choice questions and problem-solving tasks to assess understanding of scientific temperament. The syllabus for TSTMS covers a variety of topics. Participants must apply theoretical knowledge to solve real-world problems and think critically about complex problems. The objectives of teaching mathematics at senior school stage intend to help the students to acquire knowledge and critical understanding.

MATHEMATICS

Class-VI

Number system, Factors and Multiples, Test of divisibility of numbers, HCF and LCM, Decimals and Fractions, Unitary Method, Elementary Properties of Factorial. Mensuration, Parameter and Area of simple curve. Algebraic equations and Expressions, Ratio and Proportion, Percentage and their applications, Symmetry, Making symmetry figures, Reflection and Symmetry. Geometry, Understanding Elementary Shapes of 2 and 3 dimensions, Line segment, Parallel lines, Polygons, The Triangles and its properties, Quadrilaterals, Circle. Data Handling.

Class-VII

Elementary properties of real numbers, LCM and HCF, Divisibility rules, Fractions and Decimals, Exponents and Powers, Digit at Unit and tens place in the power of positive integers, Identities, Comparing Quantities, Percentage, Profit and Loss, Simple interest. Algebraic Equations and Expressions, Law of indices, Exponential Equation. Visualising of Solid Shapes, Lines and Angles, The Triangle and its Properties, Symmetry, Congruence of Triangles, Quadrilaterals, Polygons, Circles. Perimeter and Area of Triangle, Rectangle, Parallelogram, Trapezium, Rhombus, Square, Cube and Cuboid. Data Handling, Arithmetic Mean, Median and Mode.Simple Trigonometrical identities and their properties. Basic concept of Probability.

Class-VIII

Properties of real numbers, LCM and HCF of polynomials, Squares and Square Roots, Cubes and Cube Roots, Exponents and Powers, Comparing Quantities.

Percentage, Simple and Compound Interest, Discount and Partnership, Time and Distance, Work and Time. Algebraic Expressions and Identities, Linear equations and inequations. Plane, Lines, Angles, Triangles, Congruence, Quadrilaterals, Circles Constructions, Mensuration, Visualising Solid Shapes, Circle, Cone, Sphere, Cube and Cuboids Direct and Inverse Proportions, Factorisation, Introduction to Graphs. Data Handling, Mean, Median, Mode and their Simple Properties. Basic concept of Probability. Elementary properties of Sets, Union, Intersection, Venn Diagrams, ordered pairs.

Class-IX

Number Systems, Prime and Composite numbers, Surds and rationalisation of surds, Congruence, Fermat and Wilson theorem, Pythagorean triads, Polynomials, Algebraic expression and identities, Linear Equations in Two Variables, Graph of linear equations Coordinate Geometry, Coordinate of a point, Distance formula, Section formula, Area of Triangle and Quadrilateral.

Introduction to Euclid's Geometry, Lines and Angles, Triangles, Congruent triangle, Condition of similar triangles, Quadrilaterals, Constructions.

Properties of Polygons, Mensuration, Areas of Parallelograms and Triangles, Heron's Formula, Area of Cyclic quadrilateral, Surface Areas and Volumes of cube, cuboid, cylinder, cone, sphere and Circle. Introduction of Statistics, Graphical representation of statistical data, Mean, Median of ungrouped data. Trigonometrical identities and their Properties, Logarithm. Definition of probability, Terms of probability.

Real and Complex Numbers, Polynomials, Pair of Linear Equations in Two Variables, Quadratic Equations and Expressions, Arithmetic Progressions. Concepts of Coordinate Geometry, Straight Lines, Pair of Straight Lines.

Trigonometrical Ratio, compound angles, Multiple angles and Submultiple angles, Conditional Identities, Height and distance.

Geometry of triangle, Circles, Constructions, Mensuration, Areas related to Circles, Surface Areas and Volumes of Cylinder, Cone and Sphere.

Introduction of Statistics, Basic concepts of Mean, Median, Mode, Histograms and Ogive.

Probability of Random experiments, Sample space, Events, simple problem of single events.

Unit 1

1. Sets

Sets and their representations, different kinds of sets, algebra of sets, Subsets, and Subsets of a set of real numbers, intersection, complement, difference and symmetric difference of sets and their algebraic properties, Universal set. Venn diagrams, De-Morgan's laws on union, intersection, difference, Complement of a set. Properties of Complement.

2. Relations & Functions

Ordered pairs. Cartesian product of sets & their properties, Definition of relation, pictorial diagrams, domain, co-domain, and range of a relation. Function as a special type of relation. Pictorial representation of a function, domain, co-domain, and range of a function. Real valued functions, domain, and range of these functions, constant, identity, polynomial, rational, modulus, signum, exponential, logarithmic, and greatest integer functions, with their graphs. Sum, difference, product, and quotients of functions.

3. Trigonometric Functions

Trigonometric identities and functions, Definition of trigonometric functions with the help of unit circle. Domain and range of trigonometric functions and their graphs.

Inverse trigonometric functions their properties, Definition, range, domain, principal value branch. Graphs of inverse trigonometric functions.

Unit-II: Algebra

1. Complex Numbers and Quadratic Equations and Expressions

Algebra of complex numbers, addition, multiplication, conjugation, polar representation, Argand plane, properties of modulus and principal argument, triangle inequality, cube roots of unity, geometric interpretations.

Relations between roots and coefficients, nature of roots, the formation of quadratic equations with given roots, Fundamental Theorem of Algebra, symmetric functions of roots, Common roots of the quadratic equations.

2. Linear Inequalities
Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line.

3. Permutations and Combinations
Fundamental principle of counting. Factorial n. (n!) Permutations and combinations, derivation of Formulae for nPr and nCr and their connections, simple applications, Circular Permutation.

4. Binomial Theorem
Binomial theorem for positive integral indices, Binomial theorem for a positive integral index, general term and middle term and simple applications, simple applications, Properties of Binomial Coefficients.

5. Sequence and Series
Sequence and Series. Arithmetic and Geometric progressions, Harmonic Progressions Arithmetic Mean (A.M.) Geometric Progression (G.P.), general term of a G.P., the sum of n terms of a G.P., infinite G.P., and its sum, Sums of squares and cubes of the first n natural numbers. Logarithms and their properties, geometric mean (G.M.), the relation between A.M, G.M and H.M

Unit-III: Coordinate Geometry

1. Straight Lines
Cartesian system of rectangular coordinates in a plane, distance formula, sections formula, locus and its equation, the slope of a line, parallel and perpendicular lines, intercepts of a line on the co-ordinate axis. Straight line: Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, the distance of a point form a line, co-ordinate of the centroid, orthocenter, Incentre and circumventer of a triangle.

2. Conic Sections
conic sections: A standard form of equations of a circle, the general form of the equation of a circle, its radius and center, equation of a circle when the end points of a diameter are given, Equation of a circle in various forms, equations of tangent, normal and chord, points of intersection of a line and a circle with the center at the origin, Equations of a parabola, ellipse and hyperbola in standard form, their foci, directrix and eccentricity, parametric equations, equations of tangent and normal. Locus problems.

3. Three-Dimensional Geometry
Coordinates of a point in space, the distance between two points, section formula, direction ratios and direction cosines and the angle between two intersecting lines. Equation of a line; Skew lines, the shortest distance between them and its equation. equation of a plane, distance of a point from a plane, angle between two lines, angle between two planes, angle between a line and the plane, coplanar lines.

Unit-IV: Calculus

1. Limits and Derivatives
Real–valued functions, algebra of functions; polynomial, rational, trigonometric, logarithmic and exponential functions; inverse functions. Graphs of simple functions. Limits, continuity and differentiability. Differentiation of the sum, difference, product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivatives of order two.

Unit-V Statistics and Probability

1. Statistics
Measures of Dispersion: calculation of mean, median, mode of grouped and ungrouped data, calculation of standard deviation, variance and mean deviation for grouped and ungrouped data, Range, Mean deviation, variance, and standard deviation of ungrouped/grouped data.

2. Probability
Random experiment, sample space, different types of events (impossible, simple, compound), addition and multiplication rules of probability, conditional probability, independence of events, total probability.

Unit-I: Relations and Functions

1. Relations and Functions

Types of relations: reflexive, symmetric, transitive and equivalence relations. One to one and onto functions, Composition of a Functions Inverse of a Function,

Unit-II: Algebra

1. Matrices

Matrices as a rectangular array of real numbers, equality of matrices, addition, multiplication by a scalar and product of matrices, elementary row and column transformations, transpose of a matrix, symmetric and skew symmetric matrices. Invertible matrices and uniqueness of inverse.

2. Determinants

Determinant of a square matrix, minors, co-factors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear equations by examples, solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.

Unit-III: Calculus

1. Limit, Continuity and Differentiability

Limit of a function at a real number, continuity of a function, limit and continuity of the sum, difference, product and quotient of two functions, L'Hospital rule of evaluation of limits of functions. Continuity of composite functions, intermediate value property of continuous functions

Continuity and differentiability, derivative of composite functions, chain rule, derivative of inverse trigonometric functions, derivative of implicit functions, exponential and logarithmic functions.Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives.

2.Mean Value Theorem

Rolle's theorem and Lagrange's mean value theorem, geometric interpretation of the two theorems, derivatives up to order two of implicit functions, geometric interpretation of derivatives

3. Applications of Derivatives

Applications of derivatives: rate of change of quantities, increasing/decreasing functions, maxima and minima.

4. Integrals

Integral as an anti-derivative, Fundamental integrals involving algebraic, Indefinite integrals of standard functions, trigonometric, exponential and logarithmic functions, definite integrals as the limit of sums, definite integral and their properties, fundamental theorem of integral calculus. Integration by parts, integration by the methods of substitution and partial fractions.

properties of definite integrals. Evaluation of definite integrals.

5. Applications of the Integrals

Applications in finding the area under simple curves as lines, circles, parabolas, ellipses.

6. Differential Equations

Ordinary differential equations, their order and degree, general and particular solutions of a differential equation. Solution of differential equations by method of separation of variables, solutions of homogeneous differential equations of first order and first degree. Solutions of linear differential equation.

Unit-IV: Vectors and Three-Dimensional Geometry

1. Vectors

Vectors and scalars, magnitude and direction of a vector. Direction cosines and direction ratios of a vector. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Definition, Geometrical Interpretation, properties and application of scalar (dot) product of vectors, vector (cross) product of vectors, Scalar and Vector triple product.

2. Three – dimensional Geometry

Direction cosines and direction ratios of a line joining two points. Cartesian equation and vector equation of a line, skew lines, shortest distance between two lines. Angle between two lines.

Unit-V: Linear Programming

1. Linear Programming

Introduction, related terminology such as constraints, objective function, optimization, graphical method of solution for problems in two variables, feasible and infeasible regions (bounded or unbounded), feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

Unit-VI: Probability

1. Probability

Conditional probability, multiplication theorem on probability, independent events, total probability, Bayes' theorem, Random variable and its probability distribution, mean of random variable, computation of probability of events using permutations and combinations.

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MATHEMATICS

The Syllabus of **Talent Search Test in Mathematics and Science (TSTMS)** has been designed in accordance with National curriculum framework Universities of India and based on Competitive Examination as UPSC, NET, GATE & IIT JAM etc. The objectives of teaching mathematics at university/college stage intend to help the students to acquire knowledge and critical understanding.

Candidates can download the syllabus on www.imsaindia.org

Unit 1. Linear Algebra

Vector spaces over R and C, linear dependence and independence, subspaces, bases, dimension, linear transformations, rank and nullity, matrix of a linear transformation. eigenvalues and eigenvectors, characteristic polynomial, Cayley- Hamilton theorem, Matrix representation of linear transformations, Jordan canonical forms, diagonal forms, inner product space, Gram-Schmidt orthonormalization process, self adjoint operator,

Matrices

Matrices, operations of matrix algebra, Kinds of matrices, Transpose adjoint and inverse of the matrix, Product of determinants, row and column reduction, echelon form, Rank and inverse of matrix, Symmetric and skew-symmetric, Hermitian and skew-Hermitian, orthogonal and unitary matrices, congruence and similarity, Solutions of consistent Systems of Linear equation by Cramer's rule. eigenvalues and eigenvectors, characteristic polynomial, Cayley- Hamilton theorem.

Unit 2. Modern Algebra

Binary operation, Notions of group, Abelian group with examples, groups, subgroups, cyclic groups, cosets, Lagrange's theorem, normal subgroups, quotient groups, homomorphism of groups, automorphism, basic isomorphism theorems.

Rings, integral domains, subrings and ideals, integral domain, division ring, polynomial ring, field and their examples.

Unit 3. Real Analysis

Real number system as an ordered field with least upper bound property, Dedekind's theory of real numbers, Canter's construction of real numbers, properties of real numbers sequences, limit of a sequence, Cauchy sequence, completeness of real line, Monotonic

function ,Continuity and uniform continuity of functions, properties of continuous functions on compact sets.

Infinite Series

Infinite series and their convergence, Comparison test, Cauchy root test, Raabe's test, Cauchy condensation test, Integral test, Leibnitz's test, Gauss Test, Kummer's test, de Morgan and Bertrand's test, absolute convergence and rearrangement of series, Pringsheim's theorem, Cauchy's multiplication of series and its convergence.

Unit 4. Calculus

Differential Calculus

functions, limits, continuity, differentiability, indeterminate forms ,successive differentiation, partial derivatives, Leibnitz theorem, Total derivatives, , mean value theorem, Tangent and Normal, Curvature, Taylor's theorem with remainders, asymptotes; curvature.

Integral Calculus

Integration of rational and irrational, Function notion of integral as limit of sum, evaluation of definite integrals, reduction formulae, curve tracing, Areas of curves, Length of curves, Volumes and surface areas of solids of revolution.

Functions of two or three variables, maxima and minima, Lagrange's method of multipliers, Beta and Gamma functions, Jacobian, Fundamental theorem of integral calculus, double and triple integrals, Dirichlet's and Liouville's theorem, Change of order of integration, Areas, surface area using double integral and volumes using triple integral.

Unit 5. Analytic Geometry

Coordinate Geometry

Family of straight lines and circles, Standard equation of Parabola, Ellipse and Hyperbola, General equation of second degree.

General equation of conics and its reduction to normal form , Equation of tangent and normal at a point of conics, equation of chord of contact, pair of tangents and director circle, Polar equation of conics and their properties.

Three Dimension

Cartesian and polar coordinates in three dimensions, second degree equations in three variables, reduction to canonical forms, plane, straight lines, shortest distance between two skew lines. Sphere, Cone, Cylinder, Paraboloid, Ellipsoid, Hyperboloid of one and two sheets and their properties.

Unit 6. Ordinary Differential Equations

Formulation of differential equations, equations of first order and first degree, integrating factor, Bernoulli's equations, equations of first order but not of first degree, Clairaut's equation, singular solution, Second and higher order linear equations with constant coefficients, complementary function, particular integral and general solution.

Second order linear equations with variable coefficients, Homogeneous Equation Higher order, Euler-Cauchy equation; Method of Laplace transformations for solving ordinary differential equations, Power series.

Unit 7. Vectors

Scalar and vector fields, Dot and Cross product of two vectors, Scalar triple product of Vectors, Vector product of three and four vectors, vector identities and vector equations, Applications of vectors in mechanics.

Vector Calculus

Differentiation of vector field of a scalar variable, Gradient, Divergence and Curl in Cartesian and cylindrical coordinates, higher order derivatives, line integrals, surface integrals, Green, Stokes and Gauss theorems

Unit 8. Theory of Equations

Division algorithm, greatest common divisors, polynomials, division algorithm derivative, integral, rational, real and complex roots of a polynomial relation between roots and coefficients, repeated roots, elementary symmetric function, fundamental theorem of algebra.

Evaluation of symmetric functions of roots of cubic and biquadratic equations, solutions of cubic equation by Cardon's method, solution of biquadratic equations by Euler's method, Descartes rule of signs.

Unit 9. Hydrostatistics

Pressure at a point, Equilibrium of fluids under given system of force. centre of pressure, Equilibrium of floating bodies.

Unit 10. Set Theory

Set, Subsets, Power Set, Algebra of Sets, De Morgan's Laws, Cartesian Product of sets, relation, equivalence relation, Definition and examples of partial and total order relation, Countable and uncountable sets, Countability of rational, Real And algebraic number system, Countability of unions.

Equivalence relation induced by a partition of a set, Fundamental theorem of equivalence relation, Composition and factorization of mapping, set mapping,

countability of rational, real and algebraic number system.

Unit 11. Probablity

Event, Probability of an event, sample space, probabilities a finite sample space, mutually exclusively events and complementary events, independent events, conditional probability, multiplication theorem, theorem of total probability, Bayes theorem and independents of events.

Random variables and their probability functions. Mathematical expectation and moment of a random variable, Mean absolute deviation, variance, standard variation, Chebyshev's theorems for a probability distribution and frequency distribution of measurements.

Unit 12. Statistics

Mean, Variance and standard deviation of random variables, Binomial, Poisson and Normal distributions, Correlation and linear regression.

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MATHEMATICS

Unit 1. Algebra

Centre, Normalizer, Conjugacy, class equation, Commutator and commutator sub group

Rings, integral domains, subrings and ideals, integral domain, division ring, polynomial ring, field and their examples.
Automorphism, basic isomorphism theorems, Centre, Normalizer, Conjugacy, class equation, Commutator and commutator sub group

Rings, integral domains, subrings and ideals, integral domain, division ring, polynomial ring, field and their examples.
Permutation groups, Cayley's theorem, Sylow theorems, homomorphisms of rings, Isomorphism, Kernel of a ring homomorphism, quotient rings, Fundamental theorem of homomorphism rings, imbedding of a ring and integral domain in a field, characteristics of a field, polynomials over commutative ring, unique factorization

domain, principal ideal domains, Euclidean domain, polynomial rings, finite fields, field extension, Galois theorem.

Unit 2. Real Analysis:

Riemann sum and Riemann integral, Improper integral, convergence of an improper integral, comparison tests, fundamental theorems of integral calculus. Uniform convergence of sequence and series of functions, Wire strass M-test, uniform convergence and continuity, Dini's test, Abel's test, Dirichlet's Test, Uniform convergence and integration, Uniform convergence and differentiation, Weierstrass sequence and series of functions and their pointwise convergence, continuity, differentiability and integrability for sequences and series of functions, Inverse and Implicit theorems, maxima and minima, Ascoli-Arzela theorem, Contraction mapping principle.

Unit 3. Operation Research:

Linear programming problems, basic solution, basic feasible solution and optimal solution; graphical method, convex set, simplex method of solutions.

Revised simplex method, Infeasible and unbounded linear programming problem,

Big-M Method, Two phase method, duality, transportation , assignment problems, Game theory, two person-zero sum games with mixed strategies, Sequencing, Replacement model, Kuhn-Tucker condition for constrained optimization ,Wolfe's and Beale's methods, Queuing theory, Poisson probability law, Distribution of inter arrival time, Distribution of time between successive arrivals.

Unit 4. Partial differential equations:

Family of surfaces in three dimensions and formulation of partial differential equations, solution of quasi-linear partial differential equations of the first order.

Linear partial differential equations of the second order with constant coefficients, Lagrange's and Charpit's methods for solving first order solving PDEs

Linear partial differential equations of the second order with constant coefficients, Lagrange's and Charpit's methods for solving first order solving PDEs, Cauchy's problem for first order PDEs, Monge's Method ,Method of separation of variables for Laplace, Heat and wave equations.

Unit 5. Numerical Analysis:

Finite differences, Newton's forward and backward interpolation, Lagrange's interpolation, Hermite and spline interpolation, Numerical methods, solution of algebraic and transcendental equations of one variable by bisection, Secant method, iteration method, order of convergence, Regula-Falsi method, Newton-Raphson methods.

Solution of system of linear equations by Gaussian elimination and Gauss-Jordan (direct), Gauss-Seidel (iterative), Relaxation Method, Numerical integration, Trapezoidal rule, Simpson's rules, Gaussian quadrature formula. Numerical solution of ordinary differential equations, Euler, Modified Euler and Runge Kutta-methods, Picard's method

Unit 6. Fluid Dynamics:

Lagrangian and Eulerian methods, Equation of continuity, Euler's equation of motion for inviscid flow, Stream-lines, path of a particle, Potential flow, irrotational and rotational motions, Sources and sinks, vortex motion.
Navier-Stokes equation for a viscous fluid, Bernoulli's theorem, equation of motion by flux method, equation referred to moving axis, impulsive actions.

Unit 7. Complex Analysis:

Algebra of complex numbers, Continuity, Differentiability, Analytic functions, Cauchy-Riemann equations, Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Morera's theorem, Taylor's series, Laurent's series.

Calculus of residue, singularities; Isolated singularity, meromorphic function, Argument Principle, Schwartz lemma, open mapping theorem, Cauchy's residue theorem, Rouche's theorem, fundamental theorem of algebra, contour integration, power series representation of an analytic function, Mobius transformation, Conformal mappings.

Unit 8.Topology:

Metric spaces and their basic properties, open sphere, open set, neighborhoods, closed set, accumulation point, closure and interior, convergence of sequence in a metric space and their properties, Cauchy sequence and complete metric space, continuous mappings, Compactness and their basic properties , finite intersection property, Normed linear space.

Definition and examples of topological space, closed set, closure, Dense subset, Derived set, Bases and sub-spaces, Continuity of functions and homeomorphism, separation axiom T_0, T_1, T_2 spaces their characteristics and basic properties, connectedness

Unit 9.Functional Analysis:

linear space, normed linear space, completion of a normed linear space, quotient space of normed linear space, Banach space and their definition, properties and examples.

Inner product space and Hilbert space and their properties and examples, Orthonormal bases, projection theorem, Riesz representation theorem, spectral theorems for self adjoint operators, Cauchy Schwartz inequality, parallelogram law and polarization identity, Hahn-Banach theorem on real linear space, Open mapping theorem and closed graph theorems, Principle of uniform boundness.