Syallabus for Recruitment Examination of PGT Mathematics

PAPER-1

UNIT -1: - SETS & FUNCTION

- **SETS:** - Sets and their representation, empty set, finite and infinite sets, equal sets. subsets of a set. subsets of the set of real numbers. Power set. Universal set. Union and intersection of sets. Difference of two sets. Complement of a set. De-Morgan's laws.

- **RELATION AND FUNCTION :**

  Ordered pair, Cartesian product of sets. Number of elements in the Cartesian product of two finite sets, Cartesian product of a set with itself. Definition of relation, pictorial diagram, domain, co- domain and range of a relation. Function as a special kind of relation from one set to another : Pictorial representation of a function, domain , co-domain and range of a function. Real valued function. Type of functions : constant function , identity function ,polynomial function, rational function, modulus function, signum function and greatest integer function with their graphs. Sum, difference , product and quotient of functions. Composite function and invertible function, binary operations.

- **Trigonometric Functions :-**

  Positive and negative angles: - Radian Measure and Degree measure and their conversion from one measure to another. Definition of trigonometric functions with the help of unit circle. Graph of Trigonometric functions. Expressing $\sin(x+y)$ and $\cos(x+y)$ in terms of sin x, sin y, cos x, and cos y. Identities related to sin2x, cos2x, tan2x, sin3x, cos3x and tan3x. Solutions of a trigonometric equation, solutions of triangles. Heights and distances, inverse trigonometric functions : definition, domain range,Principle value branches and its properties.

Unit-II : ALGEBRA

•Principle of Mathematical induction

Process of the proof by "The Principle of mathematical induction".

•Complex number and Quadratic Equations :-

Imaginary number, Complex numbers, Algebra of complex numbers, Argand plan and polar representation of complex number, statements of fundamental theorem of Algebra ,solution of quadratic equations. Modulus, conjugate and argument (amplitude) of a complex number, square root of a complex number. Cube roots of unity, triangle inequality.

•Linear Inequalities :-

Linear inequalities, Algebraic and graphical solutions of linear inequalities in one variable. Graphical solutions of linear inequalities in two variables. Absolute value, inequalities of means, Cauchy-Schwarz inequality.

•Permutation and Combination

Fundamental Principle of counting, factorial n, permutation and combination, derivation of formulae [$P(n,r)$, $C(n,r)$] and their simple applications.

•Binomial theorem :

Binomial theorem for positive integral index. Pascal's triangle, general and middle term in the binomial expansion, simple applications. Binomial theorem for any index. Properties of Binomial coefficients.

•Sequence and Series ;-

Sequence and series, Arithmetic Progression, Geometric Progression and Harmonic Progression, nth term and sum to n terms of A.P, G.P and H.P. Arithmetic mean (A.M), Geometric Mean (G.M) and Harmonic Mean (H.M), relation between A.M G.M and H.M. Special series.

Unit III :- Two dimensional and 3- dimensional Geometry

•Straight Lines :-

Slope of a line and angle between two lines, various forms of equation of a line. Parallel to axes, point-slope form, slope- intercept form, Two points form, intercept form and normal form, general equation of a line. Distance of a point from a line.

• Conic Section :-

Section of a cone:- Circle , ellipse, parabola and Hyperbola, equation of a circle, Standard equation of a circle, standard equation of parabola, ellipse and hyperbola and their simple properties.

• Three- dimensional Geometry

Coordinates of a point in space , distance between two points, section formula, direction cosines ,direction ratios, direction ratio of a line joining two points. Cartesian and vector equation of a line, coplanar and skew lines, Angle between two lines . Shortest distance between two lines. Cartesian and Vector equations of a plane in different forms, angle between two planes and angle between a line and plane. Distance of a point from a plane.

Unit-IV Calculus:

•Limit and Derivatives :

Derivatives introduced as rate of change: both as that of distance function and geometrically, intuitive idea of limit. Definition of derivative, relate it to slope of tangent of the curve, derivative of sum, difference, product and quotient of functions, derivative of composite functions, chain rule, derivative of inverse trigonometric functions, derivative of implicit function, exponential and logarithmic functions and derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's mean value theorem and their geometric interpretation.

• Application of derivative :-

Rate of change of quantity, increasing and decreasing functions, tangents and normals, approximation, maxima and minima.

• Integral Calculus :-

Integral as an antiderivative, fundamental integrals involved algebraic expression, trigonometric identities, integration by substitution, partial praction by parts, integral of type .... Integration as a limit of sum, fundamental theorem of integral calculus, basic properties of definite integral and evaluation of definite integrals. Application of definite integrals to find the area enclosed between simple curves (lines, circle, parabolas, ellipse & modulus function).

• Differential equation :-

Definition, order and degree, general and particular solution of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations : method of separation of variables, homogenous differential equation and first order linear differential equations.

UNIT-V :- VECTORS

Vector and scalars, magnitude and direction of a vector, a point vector, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point, position vector of a point dividing a line segment in a given ratio. Scalar (dot) product of two vectors, projection of a vector on a line. Vector (Cross) product of two vectors, scalar and vector product of three vectors.

Unit- VI :- Boolean Algebra

Boolean Algebra as an algebraic structure, Principle of duality. The conditional and Bio-conditional statements , valid arguments and their duality. Application of Boolean Algebra to switching circuits.

Unit-VII Linear Algebra, Analysis and Topology

Example of vector space, vector space and sub-space independent in vector spaces, existence of basic of the row and column spaces of a matrix. Monotonic function and functions of bounded variation, real valued functions, continuous functions, absolute functions, continuity of functions at a given point and its standard properties.

PAPER-II

UNIT-I ALGEBRA

Polynomials and polynomial equation, complex roots, symmetric roots, relation between roots and coefficients, Cardon's method of solving a cubic equation.

Set theory: Sets and functions, relations, equivalence relation, partial order relation.

Sequence and Series: - Convergence and divergence sequences, infinite series, Comparison test, Cauchy's roots test, D Alembert's ratio test and Raabe's test for convergence.

Unit- II Abstract Algebra

Abelian group, subgroup, cyclic group, normal sub group, Lagrange's theorem, quotient group, permutation group, Cayley's theorem, Fundamental theorem of Homomorphism, definition and examples of Rings, fields,Integral domains and their properties .

Unit-III Linear Algebra:

Vector space over R and C, Linear dependence and independence, subspaces, Bases and dimensions, quotation spaces, linear transformation. Rank-Nullity theorem, inverse of linear transformation, matrix of a linear transformation.

Algebra of Matrices ;-

Row and column reduction, Echelon form, congruence and similarity , rank of a matrix, inverse of a matrix, Solution of system of linear equations, Eigen value and Eigen Vectors, characteristic of polynomical , Cayley- Hamilton theorem.

Unity-IV:- TRIGONOMETRY

De Moivre's theorem for rational indices, expansion of sinnx and cosnx in power of x, exponential expression for circular functions, complex arguments, Gregory's series, Hyperbolic functions, Summation of Trigonometric series.

Unit-V:-Determinants and matrices ;-

Determinants :- Definition and properties of determinants (of order not more than three), minor and co-factors. Cramer's rule for solution of linear equations.

Matrix:- Symmetric, Skew-symmetric, Hermitian, Skew-Hermitia Adjoint of a matrix, inverse matrices, elementary operation on square matrices, Rank of a matrix, equivalence of row and column rank. Application of matrices to solve a system of linear equations (both homogeneous and non- homogenous)

Unit- VI;- Calculus :

Differential calculus : Limits and continuity , derivative and differential, successive differential, Leibnitz theorem, Cauchy's mean value theorem, Taylor's mean value theorem, expansion of functions, Maclaurin's expansion, different form of remainders, indeterminate forms, tangents and normals, curvature, Asymptotes, singular points.

Advance Calculus: Function of two or more variables, limit and continuity of functions of more than one variables, partial derivatives and differentiability of composite functions . Euler's theorem on homogenous function on n-variables.

Unit-VII: Integral Calculus

Reduction formula for $\int_0$ Sin x dx, $\int_0$ Cos dx, $\int_0$ Sin. Cos dx and its application in more than one variables, partial derivatives and differentiability, higher order partial derivatives. Young's theorem and Schwarz theorem, change of variable, difference of composition of functions, Euler's theorem on homogenous functions on n-variable.

Unit- VIII: Differential Equation

Formation of differential equation of 1st order and first degree, homogenous linear equation, exact differential equation, equation reducible to linear form, clairaut's form of first order but not of first degree equation (up to third degree) solvable for x,y.p, linear differential equation with constant coefficient , orthogonal trajectories. Linear differential equation with variable coefficients, transformation of the equation by changing the independent variable. Simultaneous equation of the form $dx/p = dx/Q = dx/R$, Total differential equations.

Unit IX Co-ordinate Geometry

Two Dimensions: Pair of straight lines, homogenous equation of second degree, angle between a pair of lines, condition for the general second degree equation to represent a pair of lines, point of intersection of pair of parallel and perpendicular lines.

General second degree equation:- Conic and centre of conics, tangents, normals, chord of contact, polar equation of a conic with respect to focus as pole.

Three dimension : Ideas of polar and cylindrical co-ordinates in three dimension, General equation of sphere, intersection of a plane and a sphere, equation of a tangent plane.

Unit- X : Vector Analysis and Real Analysis:

Triple product of vectors, equation of lines, planes and sphere, coplanar vectors. Vector differentiation with respect to a scalar, gradient, curl, divergence and vector identities.

Real Analysis:- The Riemann integral: Definition and conditions of integrability, Darboux theorem, integrability of the sum and difference of integrable functions. Fundamental theorem of calculus , mean value theorems. Definition and existence of R.S integral. Properties of R.S integral.

Unit-XI Statistics and Probability:

Frequency distribution, Measure of location and dispersion, movements, skewness and kurtosis. Method of least square, correlation and regression, coefficient of correlation, regression of lines.

Definition of probability, Baye's theorem, Theorem on total probability, Random variable and probability distribution, Binomial distribution, passion distribution, normal distribution, Mean and variance, moment generating function.

Unit: XII:- Statics & Dynamics :-

Coplanar forces, condition of equilibrium friction, equilibrium on through planes and spherical surface, machine, three system of pulleys. Condition of stability and instability, energy test for stability.

Dynamics :- Moments and product of motion of a right body, motion of the centre of inertia and motion relative to the centre of inertia. Motion about a fixed axis, compound pendulum.

Unit- XIII Linear Programme:

Linear Programming problem, basic solution, basic feasible solution and optional and optimal solution, graphical method of solutions, problem related to diet, manufacturing allocation and transportation problem.

Unit-XIV:- Introduction to computer Programming

What is computer? Mechanical Computer, different generations of computer. Micro-Computer, Super Computer, Micro-processor, Memory System (Internal and External), Software system, application of software categories of Language, Machine language, Assembly Language, High level and fourth generation language.