TEACHERS' RECRUITMENT BOARD, TRIPURA (TRBT)
EDUCATION (SCHOOL) DEPARTMENT, GOVT. OF TRIPURA
SYLLABUS: MATHEMATICS (MCQs OF 150 MARKS)
SELECTION TEST FOR POST GRADUATE TEACHER(STPGT): 2016

1. ALGEBRA

- Sets: Basic concepts of sets, empty set, finite & infinite sets, equal sets, subsets, power set and universal set, Venn diagrams, operation on set, union and intersection, difference of sets, complement of a set, properties of complement sets, problems on union and intersection, some elementary properties of sets including Demorgan's Law.
- Relations & Functions**:** Ordered pairs, Cartesian product of sets, number of elements in the Cartesian product of sets, definition of relation, types of relation, domain, co-domain and range of a relation, number of onto and into relations, equivalence relation, function as a special kind of relation from one set to another, pictorial representation of a function, domain, co-domain & range of a function, real valued function of the real variable, constant, identity, polynomial, rational, modulus, monotone, bounded, signum and greatest integer functions with their graphs, inverse function, composite function, sum, difference, product and quotients of functions, definition of mapping, different types of mappings with examples, composition of mappings and their properties.
- Binary operations and their properties, concept of modulo system, introduction of group theory, grouped, semi group, monoid, definition and examples of group, abelian group.
- Complex Number and Theory of Equation: Need for complex numbers, brief description of algebraic properties of complex numbers, argand plane and polar representation of complex numbers, modulus and amplitude of complex numbers, geometrical representation of complex numbers and their consequences, square-root of a complex number, cube roots of unity and their properties, de-moivre's theorem and its application including the solution of higher degree equation, exponential, sine, cosine and logarithm of complex numbers, definition of a^z ($a\neq0$), statement of fundamental theorem of algebra, solution of quadratic equations in the complex number system, Descartes rule of sign and its application, relation between roots and coefficients, transformation of equations.
- Inequalities: Linear inequalities, algebraic solutions of linear inequalities in one variable and their representation on the number line, graphical solution of linear inequalities in two variables, solution of system of linear inequalities in two variables-graphically, inequalities involving modulus function, problems based on the inequalities A, M, $\geq$ G, M, $\geq$ H, M.
- Permutations & Combinations: Fundamental principle of counting, factorial n (n!), permutations and combinations, derivation of formulae and their connections, applications, cyclic permutation.
- Binomial Theorem: statement of the binomial theorem, general term, middle term, greatest term and greatest coefficient in binomial expansion, applications of binomial theorem including the relation among the binomial coefficients.
- Sequence and Series: Sequence and series, arithmetic progression (a,p,), arithmetic mean (a,m), geometric progression (g,p), geometric mean (g,m), harmonic progression (h,p), harmonic mean (h,m), general term of a,p, and g,p,, sum of *n* terms of a,p and g,p,, relation between a,m, and g,m, arithmetic, geometric and arithmetricogeometric series, infinite g,p, and its sum, sum to *n*

terms of the special series $\sum n$, $\sum n^2$ and $\sum n^3$, concept of convergence and divergence of infinite series, test of convergence of infinite series of non-negative terms using comparison test, root test, ratio test and Rabes test.

- Matrices and Determinants: Concept, notation, order, equality, types of matrices, column matrix, row matrix, square matrix, diagonal matrix, scalar matrix, identity matrix, zero matrix, transpose of a matrix, orthogonal matrix, symmetric and skew symmetric matrices, addition, multiplication and scalar multiplication of matrices, simple properties of addition, multiplication and scalar multiplication, non - commutativity of multiplication of matrices and existence of non-zero matrices whose product is the zero matrix, concept of elementary row and column operations, invertible of real matrices, determinant of a square matrix, properties of determinants, minors, cofactors and application of determinants in finding the area of a triangle, symmetric and skew symmetric determinants and their properties, adjoin and inverse of a square matrix, rank of a matrix, consistency and inconsistency of system of linear equations, solution of system of linear equations using matrix method and Cramer's rule, characteristic equation, Eigen value and Eigen vector, Caley Hamilton's theorem and its application.

2. TRIGONOMETRY

- Positive and negative angles, measuring angles in radians and in degrees and conversion from one measure to another, definition of trigonometric functions with the help of unit circle, signs of trigonometriciate functions and sketch of their graphs.
- Associate angle, compound angle, transformations of sums into products and products into sums.
- Multiple angle and sub multiple angle.
- General solution of trigonometric equations.
- Inverse Trigonometric Functions: Definition, range, domain, principal value, graphs of inverse trigonometric functions, elementary properties of inverse trigonometric functions.
- Application of sine and cosine formulae.

3. COORDINATEGEOMETRY: TWO DIMENSIONS

- Basic concepts of two dimensional geometry, distance formula, section formula, area of triangle.
- Straight Lines: Shifting of origin, slope of a line and angle between two lines, condition of parallelity and perpendicularity of two lines, various forms of equations of a line, parallel to axes, point-slope form, slope-intercept form, two-point form, intercept form and normal form, general equation of a line, concurrence of three straight lines, equation of family of lines passing through the point of intersection of two lines, distance of a point from a line.
- Transformation of Rectangular Axes: Translation, rotation and their combinations, theory of invariants.
- General equation of second degree in two variables, reduction to canonical form.
- Pair of Straight Lines: Condition that the general equation of second degree in two variables may represent two straight lines, point of intersection of intersecting straight lines, angle

between two straight lines represented by the equation $ax^2+2hxy+by^2=0$, angle of bisectors of two straight lines represented by the equation $ax^2+2hxy+by^2=0$.

- Circle, parabola, ellipse and hyperbola: their standard equations and properties.

4. COORDINATE GEOMETRY: THREE DIMENSIONS

- Introduction to three-dimensional geometry, coordinate axes and coordinate planes in three dimensions, coordinates of a point, distance between two points and section formula.
- Direction cosines/ratios of a line joining two points, orthogonal projection of a line segment on a straight line, Cartesian equation of a line, coplanar and skew lines, shortest distance between two lines, equation of line of shortest distance, Cartesian equation of a plane, angle between (i) two lines, (ii) two planes, (iii) a line and a plane, distance of a line and plane from a point, condition of co planarity of two straight lines, condition for a straight line to lie on a plane and simple applications.
- Sphere, general equation, circle, sphere through the intersection of two spheres, properties of sphere.

5. DIFFERENTIAL CALCULUS

- Limits and Derivatives: Intuitive idea of limit, algebra of limits, some standard limit, hospital's rule and its application, derivative introduce as rate of change both as that of distance function and geometrically, definition of derivative, derivative of different kind of functions, geometrical significance of derivative, derivative of different kind of composite functions, second order derivative of different kind of functions.
- Continuity and Differentiability: Continuity of a function at a point and on an interval, continuity of composite functions, piecewise continuous functions, uniform continuity, discontinuities of different kinds, properties of continuous functions on a closed interval, concept of differentiability and differential, chain rule, sign of derivatives, successive derivative, leibnitz theorem and its applications.
- Rolle's Theorem and Lagrange's mean value theorems, their geometric interpretation and applications,
- Applications of Derivatives : Rate of change, increasing/decreasing functions, tangents and normals, approximation, maxima and minima, points of local extremum of a function in an interval, sufficient condition for the existence of a local maximum/minimum of a function at a point, applications in geometrical and physical problems.

6. INTEGRAL CALCULUS

- Integration as inverse process of differentiation.
- Integration of different kind of functions by substitution, by partial fractions and by parts.
- Definite integrals as a limit of a sum.
- Fundamental theorem of integral calculus.

- Basic properties of definite integrals and evaluation of definite integrals.
- Application of the integrals, applications in finding the area bounded under simple curves, especially lines, areas of circles/ parabolas/ellipses, area under the curve y = sin x, y = cos x, area between the two above said curves.
- Ideas of improper integrals, concept of beta & gamma functions and their properties.

7. DIFFERENTIAL EQUATIONS

- Significance of ordinary differential equations, definitions, order and degree, general and particular solutions of a differential equation, formation of different equation whose general solution is given, meaning of the solution of ordinary differential equation, concepts of linear and non-linear differential equations.
- Equations of first order and first degree, separable, homogeneous and exact differential equations, condition of exactness, integrating factor.
- Solutions of linear differential equations.
- Equation of first order but not of first degree, Clairaut's equation, singular solution.
- Higher order linear equations with constant coefficients: complementary function, particular integrals.

8. VECTOR ALGEBRA AND ANALYSIS

- Vectors and scalars, magnitude and direction of a vector, direction cosines/ratios of vectors, type of vectors (equal, unit, zero, parallel and collinear, co planner, dependent and independent vectors), conditions of co linearity of three points and co planarity of four points, position - vectors 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, triangle and parallelogram law of vectors and their applications.
- Scalar (dot) product of vectors, projection of a vector on a line, vector (cross) product of vectors, scalar triple product, geometrical representation of product of vectors, product of four vectors, applications of dot, cross and scalar triplet product including direct applications of vector algebra in (i) geometrical, trigonometrical problems, (ii) work done by coplanar forces, moment of a force about a point.
- Vectorial equations of straight lines and planes, volume of tetrahedron.
- Vector differentiation with reference to a sector variable, vector functions of one scalar variable, derivative of a vector, second derivative of a vector, derivatives of sums and products, velocity and acceleration as derivative, curl, divergence and gradient of vector.

9. LINEAR PROGRAMMING

- Introduction of linear programming problems, definition of related terminology such as constraints, objective function, optimization, different types of linear programming (l, p :) problems, mathematical formulation of l, p, problems, (diet problem, manufacturing problem, transportation problem, investment problem etc).

- Graphical method of solution for problems in two variables, feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions.
- Concepts of convex set, convex combination, extreme point, interior point, boundary point and related problems, theorems related to convex set and their applications.

10. STATISTICS

- Measures of central tendency, mean, median and mode, their properties and applications.
- Measure of dispersion, mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances.
- Introduction of correlation and regression and their applications.

11. PROBABILITY

- Random experiments, outcomes, sample spaces, events: occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events, simple and compound events, classical and frequency definitions of probability and their drawbacks, probability of an event, probability of 'not', 'and' & 'or' events.
- Multiplication theorem on probability, conditional probability, dependent and independent events, total probability, Baye's theorem, random variable and its probability distribution, mean and variance of random variable, mathematical expectation, repeated independent (Bernoulli) trials. Binomial, Poisson and Normal distributions and their properties and applications.

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