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RPSC वरिष्ठ अध्यापक (Senior Teacher, 2nd Grade)

Syllabus — पेपर II — गणित

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RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS OF COMPETITIVE EXAMINATION FOR THE POST OF SENIOR TEACHER
SECONDARY EDUCATION DEPARTMENT
MATHEMATICS

Paper- II

Part-I Secondary and Senior Secondary Standard:

1. Number Systems:

Rational numbers as recurring/terminating decimals. Existence of non-rational numbers (irrational numbers), Real Numbers and their Decimal Expansions, Operations on Real Numbers, Laws of Exponents for Real Numbers. Euclid's division lemma, Fundamental Theorem of Arithmetic.

2. Geometry:

Lines and Angles, Properties of angles at a point, Parallel Lines and a Transversal, Sides and angles of a triangle, Properties of a triangle, Congruency of triangle, Similar triangles, Inequalities in a triangle, Concurrence of medians and altitudes, Quadrilaterals, Properties of angles, sides and diagonals of a Parallelogram, Rectangle, Rhombus, Trapezium and square. The Mid-point Theorem. Circle and terms related to it. Perpendicular from the Centre to a Chord, Equal Chords and their Distances from the Centre. Angle Subtended by an Arc of a Circle, Cyclic Quadrilaterals. Tangents from a Point on a Circle.

3. Mensuration:

(i) Areas: Area of plane figures involving triangles, quadrilaterals and circle. Area of sectors and segments of a circle. Problems based on areas and perimeter/circumference of the above said plane figures.

(ii) Surface Areas and Volumes: Surface areas and volumes of cubes, cuboids, spheres (including hemispheres) and right circular cylinders/cones. Problems involving converting one type of metallic solid into another and other mixed problems.

4. Algebra:

Degree of a polynomial. Constant, linear, quadratic, cubic polynomials; Zeros/roots of a polynomial/equation. Relationship between zeros/roots and coefficients of a polynomial/equation. Problems based on Remainder Theorem and Factor Theorem. Quadratic equations with real coefficients, formation of quadratic equations with given roots, Symmetric functions of roots. Linear and Quadratic inequations. Algebra of

complex numbers, addition, multiplication, conjugation, polar representation, properties of modulus and principal argument, triangle inequality, cube roots of unity, geometric interpretations. Arithmetic and geometric progressions, arithmetic and geometric means, sums of finite arithmetic and geometric progressions, infinite geometric series, Arithmetico-Geometric Progression. Sum of the first n natural numbers, sums of squares and cubes of the first *n* natural numbers, Fundamental principle of counting. Factorial n (n!). Permutations and combinations and simple applications. Binomial theorem for a positive integral index, general term and middle term, properties of Binomial coefficients.

5. Matrices and Determinants:

Matrices, algebra of matrices, type of matrices, transpose of a matrix, symmetric and skew symmetric matrices. Operations on matrices: Addition, multiplication and multiplication with a scalar. Determinants of order two and three, properties of determinants, minors, co-factors and applications of determinants in finding the area of a triangle, Adjoint and inverse of a square matrix, inverse of matrix using elementary transformations, Test of consistency and solution of simultaneous linear equations in two and three variables using determinants and matrices.

6. Sets, Relations and Functions:

Sets and their representations. Different kinds of sets. Venn diagrams. Operation on Sets. De-Morgan's laws and practical problems based on them. Ordered pair, relations, domain and co-domain of relations, equivalence relation. Function as a special case of relation, domain, co-domain, range of functions, invertible functions, even and odd functions, into, onto and one-to-one functions, special functions (polynomial, trigonometric, exponential, logarithmic, absolute value, greatest integer etc.), sum, difference, product and composition of functions.

7. Trigonometry:

Positive and negative angles. Measuring angles in radians and in degrees and conversion from one measure to another. Trigonometric ratios of allied angles. Trigonometric functions and their periodicity, addition and subtraction formulae, formulae involving multiple and sub-multiple angles, general solution of trigonometric equations. Inverse trigonometric functions (principal value only) and their elementary properties. Problems on heights and distances.

8. Analytical Geometry:

(i)Two dimensions:

Cartesian coordinates, distance between two points, section formulae, shift of origin. Equation of a straight line in various forms, slop of line, angle between two lines,

distance of a point from a line, lines through the point of intersection of two given lines, equation of the bisector of the angle between two lines, concurrency of lines. Centroid, orthocenter, incentre and circumcenter of a triangle. Equation of a circle in various forms, equation of tangent, normal and chord of a circle. Parametric equations of a circle, intersection of a circle with a straight line/ circle, equation of a circle through the points of intersection of two circles and those of a circle and a straight line. Equation of a parabola, ellipse, hyperbola and their foci, directrices and eccentricity, parametric equations, equations of tangent and normal. Problems based on locus.

General equation of second degree. Nature of conic. Polar equation of a conic, polar equation of tangent, normal, asymptotes, chord of contact, auxiliary circle, director circle of a conic and related problems.

(ii)Three dimensions:

Distance between two points, direction cosines and direction ratios, equation of a straight line in space, skew lines, shortest distance between two lines, equation of a plane, distance of a point from a plane and a line, Cartesian and vector equation of a plane and a line. Angle between (i) two lines, (ii) two planes (iii) a line and a plane. Coplanar lines.

9. Calculus:

Limits, continuity and differentiability. Differentiation of the sum, difference, product and quotient of two functions. Chain rule, derivative of composite functions, derivatives of trigonometrical, inverse trigonometric functions, derivative of implicit functions. Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Second and third order derivatives. Rolle’s and Lagrange's Mean value Theorems, Applications of derivatives: Rate of change of quantities, monotonic increasing and decreasing functions, Maxima and minima of functions of one variable, tangent and normal. Integral as an anti-derivative, Integration of a variety of functions by substitution, by partial fractions and integration by parts. Integration of rational and irrational functions. Definite integral and their properties, application of definite integrals in finding the area under simple curves, especially lines, arcs of circles/parabolas/ellipses/hyperbola, area between the said curves (the region should be clearly identifiable).

10. Vector Algebra:

Vectors and scalars, magnitude and direction of a vector. Direction cosines/ratios of vectors. Types of vectors (equal, unit, zero, parallel and collinear vectors etc.), 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. Scalar (dot) product of vectors, projection of a vector on a line. Vector (cross) product of vectors. Scalar and Vector triple product and problems related to them.

11. **Statistics and Probability**:

Mean, median, mode of grouped and ungrouped data, calculation of standard deviation, variance and mean deviation for grouped and ungrouped data. Probability: Probability of an event, addition and multiplication theorems of probability, conditional probability, Bayes' theorem, probability distribution of a random variate, Bernoulli trials and binomial distribution.

Part-II Graduation Standard:

1. **Abstract Algebra**:

Definition and example of groups. General properties of groups, Order of an element of a group. Cyclic group, Permutations: Even and Odd permutations. Groups of permutations. Cyclic permutation, Alternating group. Subgroups, Cosets, Lagrange's theorem, Normal subgroup, Conjugate elements, conjugate complexes, Centre of a group, Simple group, Normaliser of an element and of a complex. Quotient Groups. Group homomorphism and isomorphism with elementary basic properties, fundamental theorem of homomorphism in groups. Isomorphism theorems of groups. Cayley's theorem.

2. **Real Analysis:**

Real numbers as a complete ordered field, linear sets, lower and upper bounds, limit points, closed and open sets, Real sequence, limit and convergence of a sequence, convergence of series, tests for convergence of a series, absolute convergence, uniform convergence of sequence and series of functions.

3. **Complex Analysis:**

Functions, Limits, continuity and differentiability of complex functions. Concept of an analytic function, Cartesian and Polar form of Cauchy-Riemann equations. Harmonic function, Conjugate function, Conformal mapping.

4. **Advance Calculus:**

Polar Co-ordinates. Angle between radius vector and the tangent. Angle between two curves in polar form. Length of polar tangent, sub-tangent, normal and subnormal, Pedal equation of a curve, Derivatives of an arc. Curvature, various formulae, Centre of curvature and chord of curvature and related problems. Partial differentiation, Euler's theorem on homogeneous functions, Chain rule of partial differentiation, total differentiation, Maxima and Minima of functions of two

independent variables and of three variables connected by a relation, Lagrange's Method of undetermined multipliers. Asymptotes, double points, curve tracing, Envelopes and evolutes. Theory of Beta and Gamma functions. Differentiation and integration under the sign of integration. Double integral, change of order of integration and changing into polar co-ordinates, applications in finding areas, triple integral, application to find volume. Dirichlet's integral. Quadrature and Rectification. Volume and Surface area of solids of revolution.

5. **Differential Equations:**
   Ordinary differential equations of first order and first degree, differential equations of first order but not of first degree, Clairaut's equations, general and singular solutions, linear differential equations with constant coefficients, homogeneous differential equation, second order linear differential equations, simultaneous linear differential equations of first order.

6. **Vector Calculus:**
   Vector differentiation: Curl, Gradient and Divergence & Identities involving these operators and related problems. Vector integration: line and surface integral, Problems based on Stoke, Green and Gauss theorems.

7. **Analytical Geometry of Three dimensions:**
   - **(i)** Sphere: General Equation, Tangent Plane, Pole and Polar, Intersection of two spheres.
   - **(ii)** Cone: Enveloping cone, Tangent plane, Reciprocal cone, Three mutually Perpendicular generators, right circular cone.
   - **(iii)** Cylinder: Right circular cylinder, Enveloping cylinder.

8. **Statics and Dynamics:**
   Composition and resolution of co-planer forces, component of a force in two given directions, equilibrium of concurrent forces, parallel forces and moment, velocity and acceleration, simple linear motion under constant acceleration, Laws of motion, projectile.

9. **Linear Programming:**
   Introduction, related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constrains). Convex sets and their properties. Simplex Method. Concepts of duality in linear programming. Framing of dual programming. Assignment problems, Transportation problems.

10. Numerical Analysis and Difference Equation:

Difference operators and factorial notation, Differences of polynomial, Newton's formulae for forward and backward interpolations. Divided differences, relation between divided differences and Simple difference. Newton's general interpolation formulae, Lagrange interpolation formula. Central differences, Gauss, Stirling and Bessel interpolation formulae. Numerical Differentiation. Numerical integration, Newton-Cotes quadrature formula, Gauss's quadrature formulae, Trapezoidal, Simpson's and Weddle's rules, Estimation of errors, Solution of Algebraic and Transcendental equations, bisection method, iteration method, Regula Falsi and Newton Raphson methods. Solution of linear difference equations with constant and variable coefficients. First and higher order homogeneous linear difference equations, non-homogenous linear difference equations, Complementary functions, Particular integral.

Part-III Teaching Methods

1. Meaning and Nature of Mathematics. Mathematics as in National Curriculum framework (NCF), Linkage of Mathematics with other school subjects curriculum.
2. Contribution of Indian knowledge system in development of Mathematics.
3. General and Specific objectives of Mathematics Teaching and Bloom Taxonomy.
4. Methods and approaches of Mathematics Teaching (analytic, synthetic, inductive, deductive, Project & Laboratory).
5. Supervised study, Programmed Learning, Experiential and Constructive Learning in Mathematics.
6. Importance & meaning of Lesson Plan (Herbertian Approach), Unit Plan (Morrison Approach).
7. Audio-Visual aids in Mathematics. Technological Pedological content knowledge (TPCK)
8. Academic & Professional characteristics of Mathematics Teacher.
9. Importance and characteristics of Unit test, Achievement test, Diagnostic test and steps of their preparation. Concept of 360 degree assessment in Mathematics.

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For the competitive examination for the post of **Senior Teacher**:-

1. The question paper will carry maximum **300 marks**.
2. Duration of question paper will be **Two Hours Thirty Minutes**.
3. The question paper will carry **150 questions** of multiple choices.
4. Negative marking shall be applicable in the evaluation of answers. For every wrong answer one third of the marks prescribed for that particular question shall be deducted.
5. Paper shall include following subjects:-

(i) Knowledge of Secondary and Senior Secondary Standard about relevant subject matter.
(ii) Knowledge of Graduation Standard about relevant subject matter.
(iii) Teaching Methods of relevant subject.