

**Government of Andhra Pradesh**  
**Department of School Education**  
**State Council of Educational Research & Training**  
**Category of Post: PGT**  
**Paper II – MATHEMATICS Syllabus**

**Part – I**

**General Knowledge and Current Affairs (Marks: 10)**

**Part – II**

**Perspectives in Education (Marks: 10)**

**1. History of Education :**

- The Education in Ancient India - Pre-Vedic and Post-Vedic period, Medieval Education.
- Education in Pre Independent era - Woods Despatch (1854), Hunter Commission (1882), Hartog Committee (1929), Sargent Committee (1944).
- Education in Post Independent era - Mudaliar Commission (1952-53), Kothari Commission (1964-66), Ishwarbhai Patel committee (1977), NPE-1986, POA-1992

**2. Teacher Empowerment:**

- Need, interventions for empowerment, Professional code of conduct for teachers, Teacher motivation, Professional development of Teachers and Teacher organizations, National / State Level Organizations for Teacher Education, Maintenance of Records and Registers in Schools.

**3. Educational Concerns in Contemporary India:**

- Democracy and Education, Equality, Equity, Quality in Education, Equality of Educational opportunities.
- Economics of Education, Education as Human Capital, Education and Human Resource Development, Literacy - Saakshar Bharat Mission.
- Population Education, Gender - Equality, Equity and Empowerment of Women, Urbanization and migration, Life skills.
- Adolescence Education
- Value Education – Morel Value and Professional Ethics in Education.
- Health and Physical Education
- Inclusive Education - Classroom Management in Inclusive Education
- Role of Education in view of Liberalization, Privatization and Globalization
- Programmes and Projects – APPEP, DPEP, Sarva Siksha Abhiyan, National Programme for Education of Girls at Elementary Level (NPEGEL), Rashtriya Madhyamika Siksha Abhiyan(RMSA), Rashtriya Aveshekar Abhiyan (RAA), KGBVs, Model Schools.
- Incentives and special provisions – Mid Day Meals, Free Books, Scholarship, Awards, Welfare Hostels, Transportation.
- Current Trends in Education – Badi pelusthondi, Badi ki Vasta, Mavuru – Mana Badi, Vidyanjali, Swacha Patasala, Inspire, Kalavutsav.

**4. Acts / Rights:**

- Right of Children to Free and Compulsory Education Act - 2009
- Right to Information Act - 2005

- Child Rights
  - Human Rights.
5. **National Curriculum - Framework, 2005: Perspective, Guiding Principles, Learning and Knowledge, Teaching Learning Process, Assessment, Systemic Reforms.**

### Part - III

#### **Educational Psychology (Marks: 10)**

##### **1. Development Of Child**

- Development, Growth & Maturation — Concept & Nature
- Principles of development and their education implication
- Factors influencing Development — Biological, Psychological, Sociological, emotional.
- Dimensions of Development and their interrelationships — Physical & Motor, Cognitive, Emotional, Social, Moral, Language relating to Infancy, early Childhood, late Child hood, adolescence.
- Understanding Development — Piaget, Kohlberg, Chomsky, Carl Rogers, Erikson
- Individual differences — Infra & Inter Individual differences in the areas of Attitudes, Aptitude, Interest, Habits, Intelligence and their Assessment.
- Development of Personality — Concept, Factors effecting development of personality, self concept.
- Adjustment, Behavioural problems, Mental Health, Defense mechanism.
- Methods and Approaches of Child Development — Introspection, Observation, Interview, Case study, Experimental, Cross sectional and Longitudinal
- Developmental tasks and Hazards

##### **2. Understanding Learning**

- Concept, Nature of Learning — input — process — outcome
- Factors of Learning — Personal and Environmental
- Approaches to Learning and their applicability—Behaviorism (Skinner, Pavlov, Thorndike) Constructivism (Piaget, Vygotsky), Gestalt(Kohler, Koffka) and Observational (Bandura)
- Dimensions of Learning — Cognitive, Affective and Performance.
- Motivation and Sustenance —its role in learning.
- Memory & Forgetting
- Transfer of Learning

##### **3. Pedagogical Concerns**

- Teaching and its relationship with learning and learner.
- Learners in Contexts: Situating learner in the socio-political and cultural context
- Children from diverse contexts—Children With Special Needs (CWSN), Inclusive Education.
- Understanding of pedagogic methods — Enquiry based learning, Project based learning, Survey, Observation and Activity based learning, Cooperative and collaborative learning.
- Individual and Group learning: Issues and concerns with respect to organizing learning in class room like Study habits, Self learning and Learning to learn skills.

- Organizing learning in heterogeneous class room groups — Socio-economic background, Abilities and Interest.
- Paradigms of organizing Learning-Teacher centric, Subject centric and Learner centric.
- Theory of instruction – Bruner
- Teaching as Planned activity — Elements of Planning
- Phases of Teaching — Pre active, Interactive and Post active
- General and Subject related skills, competencies required in teaching and attributes of good facilitator.
- Learning resources — Self, Home, School, Community, Technology.
- Class room Management: Role of student, teacher, Leadership style of teacher, Creation of non threatening learning environment, Managing behaviour problems, Guidance & Counselling, Punishment and its legal implications, Rights of a child, Time Management.
- Distinction between Assessment for Learning & Assessment of Learning, School based Assessment, Continuous & Comprehensive Evaluation : Perspective & Practice.
- Understanding teaching & learning in the context of NCF, 2005 & Right to Education Act, 2009.

#### Part - IV

#### **Content (Marks: 50)**

- 1. Sets:** Sets and their representations. Union and Intersection of sets, Difference of sets, Complement of a set.
- 2. Relations & Functions:** Definition of relation, domain, co-domain and range of a relation. Function as a special kind of relation from one set to another. Domain, co-domain & range of a function, Real valued function of the real variable, domain and range of these functions, constant, identity, polynomial, rational, modulus, signum and greatest integer functions. Sum, difference, product and quotients of functions. Union, intersection and complements of sets, and their algebraic properties, Relations, equivalence relations, mappings, one-one, into and onto mappings, composition of mappings.
- 3. Principle of Mathematical Induction:** Processes of the proof by induction.
- 4. Permutations & Combinations:** Fundamental principle of counting. Factorial n, Permutations and combinations, derivation of formulae and their connections, simple applications.
- 5. Complex Numbers:** Algebraic properties of complex numbers, Argand plane and polar representation of complex numbers, Statement of Fundamental Theorem of Algebra, solution of quadratic equations in the complex number system. Modulus and Argument of a complex number, square root of a complex number, Cube roots of unity, triangle inequality.
- 6. 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, Absolute value, Inequality of means, Cauchy-Schwarz Inequality, Tchebychef's Inequality
- 7. Binomial Theorem:** Statement and proof of the binomial theorem for positive integral indices. Pascal's triangle, general and middle term in binomial expansion, simple applications. Binomial Theorem for any index, Properties of Binomial Coefficients, Simple applications for approximations.
- 8. Sequence and Series:** Arithmetic, Geometric and Harmonic progressions, General

terms 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. Insertion of Arithmetic, Geometric and Harmonic means between two given numbers. Special series, Sum to  $n$  terms of the special series. Arithmetico-Geometric Series, Exponential and Logarithmic series.

- 9. Elementary Number Theory:** Peano's Axioms, Principle of Induction; First Principle, Second Principle, Third Principle, Basic Representation Theorem, Greatest Integer Function Test of Divisibility, Euclid's algorithm, The Unique Factorisation Theorem, Congruence, Sum of divisors of a number. Euler's totient function, Theorems of Fermat and Wilson
- 10. Quadratic Equations:** Quadratic equations in real and complex number system and their solutions. Relation between roots and co-efficients, nature of roots, formation of quadratic equations with given roots; Symmetric functions of roots, equations reducible to quadratic equations – application to practical problems. Polynomial functions, Remainder & Factor Theorems and their converse, Relation between roots and coefficients, Symmetric functions of the roots of an equation. Common roots.
- 11. Matrices and Determinants:** Determinants and matrices of order two and three, properties of determinants, Evaluation of determinants. Area of triangles using determinants, Addition and multiplication of matrices, adjoint and inverse of matrix. Test of consistency and solution of simultaneous linear equations using determinants and matrices.
- 12. Two dimensional Geometry:** Distance formula, section formula, area of a triangle, condition for the collinearity of three points, centroid and in-centre of a triangle, locus and its equation, translation of axes, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes. Various forms of equations of a line, intersection of lines, angle between two lines, conditions for concurrence of three lines, distance of a point from a line, Equations of internal and external bisectors of angles between two lines, coordinates of centroid, orthocentre and circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines, homogeneous equation of second degree in  $x$  and  $y$ , angle between pair of lines through the origin, combined equation of the bisectors of the bisectors of the angles between a pair of lines, condition for the general second degree equation to represent a pair of lines, point of intersection and angle between pair of lines. Standard form of equation of a circle, general form of the equation of a circle, its radius and centre, equation of a circle in the parametric form, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle with the centre at the origin and condition for a line to be tangent to the circle, length of the tangent, equation of the tangent, equation of a family of circles through the intersection of two circles, condition for two intersecting circles to be orthogonal.  
Sections of cones, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, condition for  $y = mx + c$  to be a tangent and points(s) of tangency.
- 13. Trigonometric Functions:** Positive and negative angles, Measuring angles in radians & in degrees and conversion from one measure to another. Definition of trigonometric functions with the help of unit circle. Expressing  $\sin(x+y)$  and  $\cos(x+y)$  in terms of  $\sin x$ ,  $\sin y$ ,  $\cos x$  &  $\cos y$ . Identities related to  $\sin 2x$ ,  $\tan 2x$ ,  $\sin 3x$  and  $\tan 3x$ . Solution of trigonometric equations, proofs and simple applications of sine and cosine formulae. Solution of triangle. Heights and Distances.

**Inverse Trigonometric Functions:** Definition, range, domain, principal value branches. Graphs of inverse trigonometric functions. Elementary properties of inverse trigonometric functions.

- 14. Differential Calculus:** Polynomials, rational, trigonometric, logarithmic and exponential functions, Inverse functions. Graphs of simple functions, Limits, Continuity and differentiability; Derivative, Geometrical interpretation of the derivative, Derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric functions, Derivatives of composite functions; chain rule, derivatives of inverse trigonometric functions, derivative of implicit function, Exponential and logarithmic functions and their derivatives, Logarithmic differentiation, Derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems and their geometric interpretations.

**Applications Of Derivatives:** Applications of derivatives: rate of change, increasing / decreasing functions, tangents & normals, approximation, maxima and minima.

**Integral Calculus:** Integral as an anti-derivative. Fundamental integrals involving algebraic, trigonometric, exponential and logarithmic functions, Integration by substitution, by parts and by partial fractions, Integration using trigonometric identities, Definite integrals as a limit of a sum, Fundamental Theorem of Calculus. Basic Properties of definite integrals and evaluation of definite integrals; Applications of definite integrals in finding the area under simple curves, especially lines, areas of circles / Parabolas / ellipses, area between the two curves.

- 15. Differential Equations:** Definition, order and degree, general and particular solutions of differential equation, Formation of differential equation whose general solution is given, Solution of differential equations by method of separation of variables, homogeneous differential equations of first order and first degree, Solutions of linear differential equation.

- 16. Vectors:** Vectors and scalars, magnitude and direction of a vector, Direction cosines / ratios of vectors, 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. Scalar (dot) product of vectors, projection of a vector on a line. Vector (cross) product of vectors.

- 17. Solid Geometry:** Coordinates of a point in space, distance between two points Section formula, Direction cosines / ratios of a line joining two points -

**The Plane:** Equation of Plane in terms of its intercepts on the axis through the given points, Length of the perpendicular from a given point to a given plane, Bisectors of angles between two Planes, Combined Equation of Two Planes, orthogonal projection on a plane.

**The Line:** Equations of a Line, angle between a line and a Plane, the Condition that a given line may lie in a given plane, the condition that two given lines are coplanar, Number of arbitrary constants in the Equations of a Straight Line. Sets of Conditions which determine a line, the Shortest distance between two lines. The length and Equations of the line of Shortest distance between two straight lines, Length of the perpendicular from a given point to a given line, Intersection of three

planes, Triangular Prism, skew lines.

**The Sphere:** Definition and equation of the Sphere, Equation of the sphere through four given points, Plane section of the sphere, Intersection of Two Spheres; Equation of a Sphere through a given circle : Intersection of a sphere and a line. Power of a point; Tangent Plane; Plane of Contact, Polar Plane, Conjugate points, Conjugate planes: Angle of intersection of Two Spheres. Conditions for two spheres to be orthogonal: Radical Plane, Coaxial System of Spheres; Simplified form of the equation of Two Spheres.

Cones, cylinders and Conicoids: Definitions of a cone, vertex, guiding curve, generators, Equation of the cone with a given vertex and guiding curve, Enveloping cone of a sphere, Quadratic of cones with vertex at origin, Condition that the general equation of the second degree should represent a cone, Condition that a cone may have three mutually perpendicular generators, Intersection of a line and a quadric cone. Tangent lines and tangent plane at a point. Condition that a plane may touch a cone. Reciprocal cones. Intersection of two cones with a common vertex. Right circular cone. Equation of the right circular cone with a given vertex, axis and semi-vertical angle.

Definition of a cylinder, Equation to the cylinder whose generators intersect a given conic and are parallel to a given line, enveloping cylinder of a sphere. The right circular cylinder, Equation of the right circular cylinder with a given axis and radius.

The general equation of the second degree shapes of some surfaces, Nature of Ellipsoid, Nature of Hyperboloid of one sheet.

**18. Statistics:** Measures of central tendency for grouped and ungrouped data. Measures of dispersion; for ungrouped / grouped data. Analysis of frequency distributions with equal means but different variances.

**19. Probability:** Random experiments: outcome, sample spaces. Events: occurrence of events, exhaustive events, mutually exclusive events, Probability of an event, probability of 'not', 'and' & 'or' events., Multiplication theorem on probability. Conditional probability, independent events, Baye's theorem, Random variable and its probability distribution, Binomial and Poisson distributions and their properties.

**20. Linear Algebra:** Examples of vector spaces, vector spaces and subspace, independence in vector spaces, existence of a Basis, the row and column spaces of a matrix, sum and intersection of subspaces. Linear Transformations and Matrices, Kernel, Image, and Isomorphism, change of bases, Similarity, Rank and Nullity. Inner Product spaces, orthonormal sets and the Gram-Schmidt Process, the Method of Least Squares. Basic theory of Eigenvectors and Eigenvalues, algebraic and geometric multiplicity of eigen value, diagonalization of matrices, application to system of linear differential equations. Generalized Inverses of matrices, Moore-Penrose generalized inverse. Real quadratic forms, reduction and classification of quadratic forms, index and signature, triangular reduction of a pair of forms, singular value decomposition, extrema of quadratic forms. Jordan canonical form, vector and matrix decomposition.

Field extensions, fundamental theorem of Galois theory, splitting fields, algebraic closure and normality, Galois group of a polynomial, finite fields, separability, cyclic extensions, solvability by radicals.

**21. Analysis:** Monotone functions and functions of bounded variation, Real valued functions, continuous functions, Absolute continuity of functions, standard properties. Uniform continuity, sequence of functions, uniform convergence, power series and radius of convergence, Riemann-Stieltjes integration, standard properties, multiple integrals and their evaluation by repeated integration, change of variable in multiple integration . Uniform convergence in improper integrals, differentiation under the sign of integral – Leibnitz rule, Dirichlet integral, Liouville’s extension, Introduction to n-dimensional Euclidean space, open and closed intervals (rectangles), compact sets, Bolzano-Weierstrass theorem, Heine-Borel theorem. Maxima-minima of functions of several variables, constrained maxima-minima of functions, Analytic function, Cauchy-Riemann equations, singularities, Statement of Cauchy theorem and of Cauchy integral formula with applications, Residue Statement of Cauchy theorem and of Cauchy integral formula with applications, Residue and contour integration, Fourier and Laplace transforms, Mellin’s inversion theorem.

Conformal Mapping, Elliptic Function. Elementary Functions (Exponential, Logarithm, Complex Exponents, Trigs, Hyperbolic Functions) Integrals (Definite Integrals, Antiderivatives, Cauchy Goursat Theorem, Cauchy Integral Formula, Liouville’s Theorem, Fundamental Theorem of Algebra, Maximum Modulus Principle) Series (Sequences, Convergence of Series, Taylor Series, Laurent Series, Absolute and Uniform Convergence, Power Series techniques) Residues and Poles (Residues, Cauchy’s Residue Theorem, Residue at Infinity, Zeros of Analytic Functions.

**22. Abstract algebra and real analysis:**

**Groups:** Binary operations – Definition and properties, of Groups –Finite groups and group composition tables, sub groups and cyclic sub-groups, cyclic groups, Elementary properties of cyclic groups, subgroups of finite cyclic groups.

**Rings:** definitions and basic properties, homomorphism and isomorphism, fields, divisors of zero and cancellation laws, Integral Domain, the characteristic of a ring. Rings of polynomials. Polynomials in an indeterminate, Ideals and factor rings, Homomorphism and factor rings, Fundamental homomorphism theorem, Maximal and prime ideals.

**Teaching Methodology (Marks: 20)**

1. Meaning and Nature of Mathematics, History of Mathematics.
2. Contributions of Great Mathematicians – Aryabhata, Bhaskaracharya, Srinivasa Ramanujan, Euclid, Pythagoras, George cantor.
3. Aims and Values of teaching Mathematics, Instructional objectives (Blooms taxonomy).
4. Mathematics curriculum: Principles, approaches of curriculum construction, Logical and Psychological, Topical and Concentric, Spiral approaches. Qualities of a good Mathematics text book.
5. Methods of teaching mathematics- Heuristic method, Laboratory method, Inductive and Deductive methods, Analytic and Synthetic methods, Project method and Problem Solving method.

6. Unit Plan, Year Plan, Lesson Planning in Mathematics.
7. Instructional materials, Edgar Dale's Cone of Experience.
8. Evolving strategies for the gifted students and slow learners.
9. Techniques of teaching mathematics like Oral work, Written work, Drilling, Assignment, Project, Speed and Accuracy.
10. Mathematics club, Mathematics structure, Mathematics order and pattern sequence.
11. Evaluation – Types, Tools and Techniques of Evaluation, Preparation of SAT Analysis, Characteristics of a good test.