

## **Annexure VI**

(Enclosure to Notification No. 1479/SS/T9/KGBV/URS/2022, Dt: 16.06.2023 of DSE & EO-SPD, TSS, Hyd.)

### **Syllabus of Written Test for Recruitment of PGCRTs in KGBVs PGCRT - Mathematics**

#### **Part I - General Studies**

1. Current Affairs - Regional, National & International.
2. Indian Constitution; Indian Political System: Governance and Public Policy.
3. Social Exclusion; Rights issues such as Gender, Caste, Tribe, Disability etc., and inclusive policies.
4. Society Culture, Civilization Heritage. Arts and Literature of India and Telangana
5. General Science; India's Achievements in Science and Technology
6. Environmental Issues; Disaster Management- Prevention and Mitigation Strategies and Sustainable Development.
7. Economic and Social Development of India and Telangana.
8. Socio-economic, Political and Cultural History of Telangana with special emphasis on Telangana Statehood Movement and formation of Telangana state.

#### **Part II – Basic Proficiency in English**

1. School Level English Grammar:  
Articles; Tenses; Noun & Pronouns; Adjectives; Adverbs; Verbs; Modals; Subject-verb Agreement; Non-finites; Reported Speech; Degrees of Comparison; Active and Passive Voice; Prepositions; Conjunctions; Conditionals.
2. Vocabulary:  
Synonyms and Antonyms; Phrasal Verbs; Related Pair of Words; Idioms and Phrases; Proverbs.
3. Words and Sentences:  
Use of Words; Choosing appropriate words and words often confused; Sentence Arrangement, Completion, Fillers and Improvement; Transformation of Sentences; Comprehension; Punctuation; Spelling Test; Spotting of Errors.

### Part III - Perspectives in Education

1. **History of Education:** Pre-Vedic and Post-Vedic period, Medieval period Recommendations of various Committees during British period with special reference to Woods Despatch (1854), Hunter Commission (1882), Hartog Committee (1929), Sargent Committee (1944), Recommendations of various Committees in the post independent period with special reference to Mudaliar Commission (1952-53), Kothari Commission (1964-66), Ishwarbhai Patel Committee (1977), National Policy on Education, 1968, National Policy on Education, 1986, Programme of Action, 1992 and National Educational Policy, 2020.

Aims, Objectives, Functions, Unipolar, Bipolar and Tripolar Processes of Education, Types of Education - Formal, Informal and Non-formal Education, their significance and interrelations, Philosophical, Sociological and Psychological Perspectives of Education.

2. **Teacher Education:** Concept, Teacher Preparation, NCFTE-2009, Pre-service and In service Teacher Education Programs, Teacher Motivation, Continuous Professional Development.

**Teacher Empowerment:** Meaning, Interventions for Empowerment, Professional Code of Conduct for Teachers, Role of Teacher Organisations in Professional Development of Teachers, National and State Level Institutions for Teacher Education.

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

**Environmental Education:** Meaning, Scope of Environmental Education, Concept of Sustainable Development, Role of Teacher, School and NGOs in Development and Protection of Environment; **Democracy and Education:** Equality, Equity, Equality of Educational Opportunities, Role of Education in promoting Democracy; **Economics of Education:** Meaning and Scope, Education as Human Capital, Education and Human Resource Development; **Population Education:** Significance of Population Education. Population situation, Approaches to Population Education and Themes of Population Education, Family Life Education, Sustainable development, Adolescence Education, Health Education, Gender Equality, Equity and Empowerment of Women, the Role of School and Teacher, Urbanization and Migration, Life Skills; **Inclusive Education:** Concept, Prevalence, Areas of Disabilities, Disadvantaged Groups, Gender etc., Myths &

Facts, Importance of Early Identification and Assessment, Planning Inclusive Education, Initiatives in Education, Method & Strategies of Classroom Management, Psycho-Social Management, Creation of Awareness – Students, Parents and Society & Sensitization Strategies, Evaluation, Documentation and Maintenance of Records; **Liberalization, Privatization and Globalization; Value Education; Initiatives in Education:** Sarva Siksha Abhiyan (SSA), National Programme for Education of Girls at Elementary Level (NPEGEL), Mid-day-Meal Programme, Rashtriya Madhyamika Siksha Abhiyan (RMSA), Samagra Shiksha and its interventions, KGBVS and Model Schools etc.

4. Constitutional Provisions relevant to Education: Acts/Rights, Right of Children to Free and Compulsory Education Act, 2009, Right to Information Act 2005, Child Rights, Human Rights, PWD Act, 2016 and other Provisions pertaining to Education.
5. National Curriculum Framework, 2005 and NCFSE, 2023.

#### **Part IV - Content**

1. **Number System:** Natural Numbers, Whole Numbers, Integers, Rational Numbers, Real Numbers: Fundamental operations and their properties; HCF and LCM; Fractions and Decimals; divisibility tests; Squares, Square roots, Cubes, Cube roots; Pythagorean triplets; Surds; Euclid division lemma; Fundamental Theorem of Arithmetic; Introduction of logarithms; Conversion of a number in exponential form to a logarithmic form; Properties and laws of logarithms; Sets and their representations; Types of sets; cardinality of sets; Venn diagrams; Sets - subsets - Disjoint sets; operations and properties on sets: Complement of a set; Complex Numbers - Complex number as an ordered pair of real numbers- fundamental operations - Representation of complex numbers in the form  $a+ib$  - Modulus and amplitude of complex numbers – Geometrical and Polar Representation of complex numbers in Argand plane - Argand diagram; De Moivre's Theorem - Integral and Rational indices -  $n^{\text{th}}$  roots of unity- Geometrical Interpretations – Illustrations;
2. **Arithmetic:** Ratio and Proportion - Direct and indirect proportion; Compound ratio; Percentage ; Profit and Loss – Discount – Simple interest – Compound interest; Time & work; Time & Distance.
3. **Algebra:** Exponents and powers-Laws; Algebraic Expressions - fundamental operations - Identities - Factorization; Polynomials - Zero / roots of a polynomial / equation - Division of polynomials - Remainder Theorem - Factor Theorem; Partial fractions - Partial fractions of  $f(x)/g(x)$  when  $g(x)$  contains repeated and/or non-repeated linear

factors - Partial fractions of  $f(x)/g(x)$  when  $g(x)$  contains irreducible factors; Linear Equations in one & Two Variables ; Pair of Linear Equations in Two Variables – Solutions;

Quadratic Equations – Finding the roots - Relationship between discriminant and nature of roots; Quadratic Expressions - Quadratic expressions, equations in one variable - Sign of quadratic expressions – Change in signs – Maximum and minimum values - Quadratic inequations; Theory of Equations - The relation between the roots and the coefficients in an equation - Solving the equations when two or more of its roots are connected by certain relations- Equation with real coefficients - occurrence of complex roots in conjugate pairs and its consequences - Transformation of equations - Reciprocal Equations; Binomial Theorem - Binomial theorem for positive integral index , rational Index - Approximations using Binomial theorem; Progressions – Arithmetic Progression – Mean -  $n^{\text{th}}$  term and sum of first “ $n$ ” terms – Geometric Progression – Mean -  $n^{\text{th}}$  term - sum of first “ $n$ ” terms – Sum of infinity terms.

Functions – Ordered pairs-Types of functions-Inverse Functions- Theorems –Real valued Functions; Mathematical induction –principles of mathematical induction & theorems – applications of Mathematical Induction - problems on divisibility; Matrices- Operations on matrices - Types of matrices – transpose of a matrix – determinants-inverse of a matrix –consistency and inconsistency of system of simultaneous equations – rank of a matrix-solution of simultaneous linear equations

4. **Addition of vectors:** - Introduction - Vectors as a triad of real numbers, some basic concepts- Types of vectors-Sum of vectors-Scalar Multiplication of a vector-Angle between two non-zero vectors-Linear Combination of Vectors-Components of a vector in Three Dimensions-Vector Equations of Line and Plane; Product of Vectors - Introduction- Scalar or dot product of two vectors – Geometrical interpretation - Orthogonal Projections- Properties of dot product-Expression for scalar (dot) product, Angle between two vectors-Geometrical Vector methods-Vector equation of a plane - normal form-Angle between two planes-Vector product (cross product) of two vectors and properties-Vector product in (i, j, k) system-Vector Areas- Scalar triple product-Vector equation of a plane - different forms, skew lines, shortest distance - plane, condition for coplanarity etc- Vector triple product – results
5. **Trigonometry:** Trigonometry -Basic concepts; Trigonometric ratios- Trigonometric ratios of compound angles, multiple and sub- multiple angles -Complementary angles; Trigonometric Identities; Conversions of Trigonometric ratios – Trigonometric transformations - Heights and distances; Trigonometric equations –solutions; Inverse trigonometric functions - graphs and their properties; Hyperbolic functions- Definitions-graphs-Inverse Hyperbolic functions and graphs- Addition formulas of hyperbolic functions; Properties of triangles – relation between sides and angles of a triangles –sine,

cosine and tangent rules-projection rules-half angle formulae and area of a triangle-incircle and excircles of a triangle

6. **Geometry:** Basic geometrical concepts; 3D, 2D shapes – Nets – drawing - representing; Types of Quadrilaterals and their properties – constructions – related theorems; Circle and its components – related theorems; Lines and Angles - Perpendicular bisector and angular bisector - Pairs of angles - Properties of parallel lines with transversal - related Theorems; Symmetry - lines of symmetry - rotational and reflective symmetry - Point of symmetry – Dilations - Tessellations; Triangles – types – properties - Median and Altitude of a triangle, Centroid – Criteria of congruence – Criteria of similar triangles - constructions - related theorems; Euclid’s Geometry – axioms – postulates; Tangents and secants to a circle – related theorems.
  
7. **Coordinate geometry:** Cartesian system-graphs of linear equations- Distance between two points- Collinearity of points- Section formula- Area of a triangle on coordinate plane; Concept of locus-problems connected to it; Transformation and rotation of Axes; Straight line – different forms of straight line and conversions-Intersection of two straight lines- concurrent lines and condition for concurrent lines-properties related to a triangle-Angle between two lines-Length of perpendicular from a point to a line-Distance between two parallel lines; Pair of straight Lines- Introduction- Equations of a pair of lines passing through the origin, Angle between a pair of lines-condition for perpendicular and coincident lines, bisectors of angles- Pair of bisectors of angles- Pair of lines - Second degree general equation- Conditions for parallel lines - Distance between them, Point of intersection of pair of lines- Homogenising a second degree equation with a first degree equation in  $x$  and  $y$ ; - 3-D Geometry;DR’s and DC’s ; Cartesian equation of a plane.  
Circle Equation – standard form, center and radius-Position of a point in plane of circle-Position of a straight line in plane of circle-condition for a line to be a tangent-chord of contact and polar- Relative positions of two circles; System of circles- angles between two intersecting circles- radical axis of two circles ; Conic Section-Parabola-Ellipse- Hyperbola-Standard forms- equation of tangent and normal at a point on the Parabola/Ellipse/Hyperbola
  
8. **Mensuration** - Area and Perimeter -Quadrilaterals –Triangle; Area of rectangular paths; Area of the circle - circular paths (Ring) and area of sector, Circumference of Circle; TSA & CSA of cube, cuboid, right circular cylinder, cone, sphere, hemi sphere; Volume of cube, cuboid, right circular cylinder, cone, sphere, hemi sphere; Volume and capacity; Relationship between surface areas of any two comparable solids; Relationship between volumes of any two comparable solids; surface areas and volumes of combinations of any of the following: cubes, cuboids, spheres, hemispheres and right circular cylinders / cones; Problems involving converting one type of metallic solid into another and other

mixed problems(Problems with combination of not more than two different solids be taken).

- 9. Statistics and Probability** – Data handling-Data- Collection and organisation of data; Pictograph and Bar graphs: Simple pie charts; Measures of central tendency-Mean, Median and Mode of ungrouped and grouped data-Specific usages; Frequency distribution for ungrouped and grouped data- Preparation of frequency distribution table; Frequency graphs (histogram for equal and unequal class intervals, frequency polygon, frequency curve, cumulative frequency curves) and related problems; Usage of different values and central tendencies through Ogives; Measures of dispersion - Range - Mean deviation - Variance and standard deviation of ungrouped/grouped data - Coefficient of variation and analysis of frequency distribution with equal means but different variances;
- Probability- Basic Concepts and definition of Probability - Random experiments and events - Outcomes and chances -Events-Mutually exclusive, possible and impossible, Complementary - Applications of Probability- - Classical definition of probability, Axiomatic approach and addition theorem of probability - Independent and dependent events Conditional probability- multiplication theorem and Bayee's theorem; Random Variables and Probability Distributions- Random Variables - Theoretical discrete distributions – Binomial and Poisson Distributions Permutations and Combinations - Fundamental Principle of counting – linear and circular permutations - Permutations of 'n' dissimilar things taken 'r' at a time - Permutations when repetitions allowed - Circular permutations - Permutations with constraint repetitions - Combinations-definitions and certain theorems;
- 10. Calculus:** Limits and Continuity- Intervals and neighbourhoods- Limits- Standard limits- Continuity; Differentiation – Derivative of a function- Elementary properties- Derivatives of Trigonometric, Inverse Trigonometric, Hyperbolic, Inverse Hyperbolic Functions- Methods of differentiation- Second Order Derivatives; Applications of Derivatives -Errors and approximations- Geometrical interpretation of the derivative- Equations of tangent and normal to a curve- Lengths of tangent, normal, subtangent and subnormal- Angle between two curves and condition for orthogonality of curves- Derivative as a rate of change- Rolle's Theorem and Lagrange's Mean Value Theorem- Increasing and Decreasing functions- Maxima and Minima. Integration – Standard forms – properties of integrals – Integration by the method of substitution - integration of algebraic and trigonometric functions- Integration by parts - integration of exponential, logarithmic and inverse trigonometric functions- Partial fractions method-reduction formulae; Definite Integrals - Definite Integral as the limit of sum- Interpretation of definite integral as an area - The Fundamental Theorem of Integral Calculus- Properties- Reduction Formulae- Applications of definite integral to areas; Differential Equations- Formation of differential equations - Degree and order of an ordinary differential

equation- Solving Differential Equations- Variables separable method- Homogeneous Differential Equation- Non - Homogeneous Differential Equations-) Linear Differential Equations

## **Part V- Pedagogy:**

### **1. Nature and Scope of Mathematics:**

- i. Mathematics: Meaning and Definition
- ii. Nature of Mathematics: Utility, Originality, Abstractness, Truthfulness, logical Conclusions, Nature of Verification, Aesthetics, Co- existence of Provision, Inclusive and Deductive Reasoning, and correlation, Identifying Mathematical Patterns
- iii. Scope of Mathematics
  - a. Use of Mathematics in daily life.
  - b. Correlation with other subjects/ disciplines

### **2. History of Mathematics and Contributions of Mathematicians:** Pythagoras, Euclid, Baudhayana, Aryabhata, Brahmagupta, Bhaskaracharya-II, Srinivasa Ramanujan, P.C.Mahalanobis, Hypatia.

### **3. Aims and Objectives of Learning Mathematics**

#### **(i) Aims and Values**

- a. Aims of Learning Mathematics
- b. Knowledge and Understanding through Mathematics
- c. Relating Mathematics Education to Natural and Social Environment, Technology and Society, Gender & Mathematics, Mathematics for Inclusion.
- d. Imbibing the Values through Mathematics Teaching

#### **(ii) Objectives**

- a. Meaning of Learning Objectives
- b. Developing Learning Objectives, Features of Learning Objectives - Blooms Taxonomy
- c. Anderson and Krathwohl's Taxonomy.
- d. Learning Objectives: Remembering, Understanding, Applying, Analyzing, Evaluating and Creating
- e. Illustrations on Learning Objectives for Upper Primary, Secondary and Higher Secondary Stages

- f. Learning Objectives in the Constructivist Perspective
  - g. Academic Standards in Mathematics 8. Learning
  - h. Learning outcomes
  - i. Professional growth of teacher
- 4. How children learn mathematics: Psychological implications of learning mathematics - Jean Piaget, Jerome Bruner, Lev Vygotsky**
- 5. Pedagogical Shift in Mathematics**
- i. Pedagogical Shift:
    - a. Mathematics as Fixed Body of Knowledge to the Process of Constructing Knowledge
    - b. Nature of Mathematics
    - c. Approaches
    - d. Assessment
    - e. Learner, Learning and Teacher
    - f. Planning Teaching-Learning Experiences-Planning Teaching-Learning: Before shift and After shift
    - g. Mathematics Curriculum, Diversity in Classroom, Information and Communication Technology (ICT)
  - ii. Democratizing Mathematics Learning: Critical Pedagogy and Role of Teachers
  - iii. Content-Cum-Methodology (CCM): Meaning, Concept & Nature, Steps to Content-cum-Methodology, Steps to Pedagogical Analysis, Content and Teaching Skills
- 6. School Curriculum in Mathematics**
- i. Curriculum Framework, Curriculum and Syllabus from Subject-Centred to Behaviourist to Constructivist Approach.
  - ii. Mathematics Curriculum Development and Organisation - Principles and Approaches
  - iii. Recommendations of NCF-2005 and APSCF-2011 on Mathematics Curriculum
  - iv. National Focus Group Position Paper on Mathematics and State Position Paper (2011) on Mathematics
  - v. Moving from Textbook to Teaching-Learning Materials, Going beyond the Textbook
  - vi. Print Resources- Textbooks, Popular Mathematics Book, Journals and Magazines
  - vii. Dale's Cone of Experience- Using the Cone of Experience
  - viii. Teacher as Curriculum Developer- Localized Curriculum, Place for Artisans.



- ix. Knowledge Systems in Curriculum, Local Innovators and Innovative practices in Mathematics.

## **7. Approaches, Strategies and Methods of Teaching and Learning Mathematics**

- i. Approaches and Strategies for Learning Mathematics-Difference between Approach and Strategy, Different Approaches and Strategies of Learning, Selecting appropriate Approach and Strategy, Essential Components of all approaches and strategies.
- ii. Constructivist Approach of Teaching Mathematics and Strategies
- iii. 5 E Learning Model
- iv. Collaborative Learning Approach (CLA)- Ensuring Meaningful Learning, through CLA - Ways of Applying - Steps & Limitations
- v. Problem Solving Approach (PSA)- Steps & Teacher's role
- vi. Concept Mapping- Phases of the Concept Mapping and its uses
- vii. Experiential Learning- Abilities of an Experiential Learner.
- viii. Methods of Teaching mathematics: Activity based, Inductive – Deductive, Analytic-synthetic, Project, Heuristic, project, Laboratory methods

## **8. Learning Resources**

- i. Learning Resources from Immediate Environment
- ii. Pooling of Learning Resources from various sources
- iii. Mathematics Kits
- iv. Mathematics club
- v. Mathematics Lab

## **9. Planning for Teaching-Learning of Mathematics**

- i. Need of Planning for Teaching-Learning.
- ii. Planning Annual Plan, Unit Plan, Lesson Plan /Period plan.
- iii. Identification and Organisation of Concepts for Teaching - Learning of Mathematics
- iv. Elements of a Mathematics Lesson- Learning Objectives and Key Concepts, Pre-existing Knowledge, Teaching-Learning Materials; Introduction, Presentation / Development & Assessment.

Assessment: Acceptable evidences that show learners understand

- (a) Determining Learning Evidences
- (b) Planning of the acceptable Evidences of Learning for Assessment; Extended Learning/Assignment

- v. Planning and Organizing Activities in Mathematics, Laboratory Work and Organizing Laboratory Work and ICT Applications in Teaching Learning of Mathematics.

## **10. Tools and Techniques of Assessment for Learning Mathematics**

- i. Test, Examination, Measurement, Assessment and Evaluation
- ii. Continuous and Comprehensive Evaluation (CCE)- Educational Assessment and Educational Evaluation, Performance-based Assessment: A flexible way of School Based Assessment
- iii. Formative and Summative Assessment -
- iv. Assessment Framework,
  - (a) Purpose of Assessment,
  - (b) Learning Indicators (LI) - Types of Indicators –
    - Assessment of Activity
    - Assessment of Presentation
    - Assessment of Group Work
    - Assessment of Collaborative Learning
  - (c) Tools and Techniques of Assessment - Written test Project Work - Field Trips and Field Diary - Laboratory Work - Interview/Oral Test - Journal Writing - Concept Mapping - Weightage Tables and Blueprint
  - (d) Recording and Reporting, - Measurement of Students' Achievements, Grading System - Measurement of Process Skills Measurement of Attitudes - Portfolio: Its role in evaluating students' performance.