नेपाल सरकार

शिक्षक सेवा आयोग

खुला प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

२०७२

तह : माध्यमिक   विषय : गणित

Section A : Curriculum, Pedagogy and Technolgy in Secondry Level   - 40 Marks

1   Introduction to Mathematics Education

1.1   Meanings and definitions of mathematics and mathematics education

1.2   Growth of mathematics in ancient civilizations

1.3   Goals and objectives, nature, areas, and structure of mathematics in mathematics education

1.4   Philosophies of mathematics and mathematics education: Different philosophies of mathematics, paradigm shift in mathematics educational philosophy, Fallibilists' views of mathematics, social constructivist views on mathematics, genesis of mathematical knowledge, problems of social constructivism

1.5   Place of mathematics in school curriculum

1.6   Different foundations of mathematics education, theoretical model of mathematics education

1.7   Problems and issues of mathematics education in Nepal

1.8   Different ideologies of mathematics education, primary and secondary elements of mathematics education

1.9   New trends in mathematics education, social history of mathematics education. Cultural role of mathematics, cultural and social diversity in mathematics education, cognitive model of difference and social model of difference, family mathematics

1.10   Professional development of mathematics teachers: History, principles of professional developments, models of development of teaching staffs, Components of staff developments, contents for professional development of mathematics educators/teachers.

2   Mathematics Learning Theories

2.1   Overviews of behaviorists and cognitive theories of learning

2.2   Theories of learning mathematics: Piaget, Bruner, Diene's, Gagne, Ausubel, Vygostky, Skemp

2.3   Constructivism in learning mathematics

2.4   Van Hiele model for teaching geometry

2.5   Implications of each learning theory in teaching and learning mathematics.

3   Study of Mathematics Curriculum and Textbooks and Instructional Objectives

3.1 Some views and understanding about curriculum, need and importance of study of mathematics curriculum, implication of broader concepts of curriculum in mathematics curriculum development

3.2 Process of curriculum development in general, steps and strategy of mathematics curriculum development, curriculum materials, change in mathematics curriculum

3.3 Structure of Mathematics curriculum

3.4 Appraisal of mathematics curriculum and textbook (compulsory and optional) in terms of objectives, learner's ability national and social needs, reforms efforts of mathematics curriculum in Nepal

3.5 Implications of social diversity in framing school mathematics curriculum

3.6 Instructional objectives: Meaning, needs, types, criteria for selection, procedure of writing and use of action verbs in writing instructional objectives.

3.7 Relation among objectives in different domains

3.8 Goals and objectives of school mathematics education in Nepal.

4 Instructional Strategies

4.1 Problems of learning mathematics, problems of teaching mathematics: Understanding, assimilation, transfer and permanence

4.2 Learning disabilities of students in mathematics, individual difference in learning mathematics, classroom diversity, mathematics anxiety in students

4.3 Traditional methods of teaching mathematics and its weaknesses, teaching mathematics meaningfully

4.4 Modern trends in teaching of mathematics

4.5 Teaching methods and their applications in classroom: Lecture, laboratory, inductive, deductive, analytic, synthetic, problem solving, guided discovery, cooperative and constructivist approach, project methods, use of ICTs in teaching mathematics

4.6 Appraisal of teaching approaches, classroom questioning techniques.

5 Instructional Materials

5.1 Instructional Materials: Introduction, types and needs in classroom use

5.2 Classification of instructional materials: Reference materials and textbooks, audio-visual materials, manipulative materials' selection and use, locally available teaching materials

5.3 Construction, collection and availablability of instructional materials and their use in teaching mathematics

5.4 Mathematics laboratory: Types and use

5.7 Mathematical games and puzzles

5.8 Modern trends in use of ICTs and mathematical software in teaching mathematics.

6 Instructional Planning and Supervision

6.1 Needs of instructional planning

6.2 Instructional planning: Annual, unit and lesson plan

6.3 Preparation of dodules: Training, instructional and learning module

6.4   Plans for microteaching, classroom management in mathematics instruction

6.5   Need of supervision, techniques of supervision, use of supervision techniques for improving classroom teaching, rating of teachers' teaching using different scales

6.6   Program for self-supervision for instructional improvement.

7   Evaluation

7.1   Evaluation: Meaning, needs, types, and their critical comparison

7.2   Evaluation techniques and tools

7.3   Difference in examination, assessment and evaluation

7.4   Construction and standardization of test items: Planning of test, specification chart, reliability and validity

7.5   Alternative assessment Techniques and their application: CAS, project work, homework and quiz, portfolio assessment

7.5   Different techniques for scoring and use of test result: Point scoring, test item based scoring and analysis of scores

7.6   Use of letter grading in evaluation: Grade descriptors, grade point, assigning grade

7.7   Diagnostic test and error analysis, remedial teaching, strategies of prevention

7.8   Rubrics and its application in assessing students' works

8   Teaching of Secondary School Mathematics

8.1   **Teaching sets and teaching arithmetic:** Numeration system, operations with numbers and their properties, LCM, HCF, square root, ratio and proportion, percent and percentage, unitary method, profit and loss, simple and compound interest, commission and discount, tax, VAT, depreciation, number pattern, home arithmetic, mensuration

8.2   **Teaching Algebra**: Steps of teaching algebra, algebraic expression, polynomials, index, factorization, LCM and HCF, linear and quadratic equation, inequalities, relation and function, surd, linear programming, vectors

8.3   **Teaching Geometry:** Phases of teaching geometry, classification of polygons, triangles and parallelogram, teaching congruence, similarity, theorem, construction, area of triangle and parallelogram, teaching transformation, coordinate geometry

8.4   **Teaching trigonometry:** Trigonometric ratio and their properties, values of trigonometric ratios, solution of trigonometric equations, sine, cosine and tangent graph, area of triangle using trigonometric ratios, height and distant

8.5   **Teaching Statistics:** Meaning and definition, collection, tabular and graphical presentation of data, frequency and cumulative frequencies, measures of central tendencies, measures of dispersions and simple probability.

Section B: Content Knowledge of the Subject Matter   - 40 Marks

9   Algebra, Calculus and Number Theory

9.1   Fundamentals of abstract algebraic concepts, theorems and problems : Groups, rings and fields, matrices and applications

9.2 Fundamentals of calculus: Functions, continuity, limits, derivatives and anti-derivatives, differential equations and their applications.

9.3 Fundamental concepts, divisibility theory, primes and their distributions

9.4 Composite numbers, Goldbach's conjecture, greatest common divisor

9.5 Euclidean algorithms, fundamental theorem of arithmetic, least common multiple

9.6 Diophantine equation, theory of congruence, properties of congruence, system of linear congruence, divisibility tests, Fermat's little theorem, Wilson's theorem, Euler's theorem.

10 Graph Theory and Topology

10.1 **Graph theory:** Introduction, historical development of graph theory, applications of graph theory, concepts basic to graph theory, degree of vertices, sub-graphs, isomorphism of graphs, connectivity, matrix representation of graph

10.2 **Traversability:** Eulerian graphs, Hamiltonian graphs, application of graphs

10.3 **Trees:** Trees and their properties, spanning tree, minimal spanning tree

10.4 **Planar Graphs:** Definition of planar graphs, graph colouring

10.5 **Directed Graphs:** Digraphs, connectivity of digraph, traversability of digraph, tournaments traffic flows

10.6 **Topology:** Topology and geometry, topological curves and regions, topological equivalence. networks, Euler's discovery about networks, Koenisberg bridge problem, polyhedra, Euler's formula for polyhedra, topological surface, Euler's characteristics of surface, four colour theorem, five colour theorem.

11 Numeration System, Symbolic Logic and Linear Programming

11.1 **Numeration system:** Historical development of numeration system, Babylonian, Mayan, Egyptians, Greek, Chinese-Japanese, Roman, and Hindu-Arabic numeration system, characteristics of different numeration systems and bases other than ten

11.2 **Symbolic logic:** Logical connectives, conditional and bi-conditional, more connectives, tautology and contradiction, algebra of propositions, validity of an argument, logical equivalence, logical implications

11.3 **Linear Programming:** Introduction, Formulation of linear programming problems in three or more variables. Solution of linear programming problem: Graphical method, simplex method, dual method. Application of linear programming problem (word/verbal problems)

12 Descriptive Statistics

12.1 **Descriptive Statistics:** Introduction, meaning, definition, function, scope and limitations, collection and classification of data, population and sampling, frequency distribution

12.2 **Measurement scales:** Basic postulates of measurement, scales of measurement: nominal, ordinal, interval and ratio

12.3 **Measures of Central Tendency:** Mean, weighted mean, combined mean, median and mode, geometric mean, harmonic mean, properties, use and relations among them

12.4 **Measures of dispersion:** range, inter-quartile range mean deviation and standard deviation, its properties, use, comparison and relations among them. Coefficient of variation, Z- score

12.5 **Correlation:** Pearson's product moment correlation, rank correlation, ϕ coefficient, probable error and interpretation of correlation

12.6 **Regression:** Regression equation, coefficient, properties, standard error of estimate. Coefficient of determination.

13   Inferential Statistics

13.1 Design of sample survey, basic method of sampling

13.2 **Probability:** Sample space and event, definition, principle of counting, laws of probability, Bayes's Theorem, d its properties

13.3 **Random variable:** random and continuous, random variable discrete and continuous random variable and probability distribution

13.4 **Discrete probability distribution:** Uniform distribution, Poisson distribution, binomial distribution

13.5 **Continuous probability distribution:** Uniform density, gamma distribution, beta distribution, normal distribution an, normal approximation of binomial distribution

13.6 Sampling distribution

13.7 **Estimation of parameters:** Point estimation and interval estimation

13.8 **Test of Hypothesis:** null hypothesis, alternate hypothesis, one tailed and two tailed test, type I and type II errors, level of significance, critical region, critical values, test statistics, steps of hypothesis testing, tests concerning Z-test: t-test: chi-square test: r-test, F- test.

14   Euclidean Geometry

14.1 Introduction Euclidean geometry an it's Elements

14.2 Foundations of Euclidean geometry and its foundation properties

14.3 Axioms of incidence geometries, Hilbert axioms for Euclidean geometry, Birkhff's model for Euclidean geometry

14.4 SMSG postulate for Euclidean geometry

14.5 Congruence, Parallelism, The Sachheri Legendre theorem, area and volume, similarity, convexity, circular and circular arcs.

15   Non-Euclidean Geometry

15.1 Euclid's fifth postulates, substitute for the fifth postulates, attempts to prove the fifth postulate, discovery of non-Euclidean geometry

15.2 **Hyperbolic Geometry:** Hyperbolic parallel postulate, boundary parallels, angle of parallelism, Ideal points, ultra ideal points, trilateral, quadrilateral and triangles, defect of a triangle, area of triangle in hyperbolic geometry, and its features, hyperbolic results concerning polygon

15.3 **Elliptical geometry:** Models for elliptic geometry, elliptic parallel postulates, quadrilaterals and triangles, and features. Comparison of properties of Euclidean, hyperbolic and elliptic geometry.

16   Transformation and Projective Geometry

16.1   **Projective Geometry:** Fundamental concepts, The real projective plane, projective properties, duality. Perspectivity, Desgargues theorem. Projective transformation

16.2   **Transformation geometry:** Isometric transformations: Reflection, translation, half-turn, rotation, glide reflection and their equations in analytic and in matrix form

16.3   **Non-isomeric transformation:** Dilation, enlargement and reduction, stretch, shear and their equations in analytic and in matrix form

16.4   **Inversion transformations:** Inverse point, feature of inversion, geometric construction of inverse points. Inverse of a line, a circles and a curve and related equations.

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16   **Transformation and Projective Geometry**