Uchch Madhyamika Sikshak – Teacher Selection Test
Subject – Mathematics

Unit 1 Arithmetic : Numbers (natural numbers, whole numbers, integers, rational numbers, rational numbers, irrational numbers and real numbers, complex numbers), unitary method, average, profit & loss, simple interest, compound interest, length, mass, capacity, time, simple fractions, decimal, percentage, ratio & proportion, multiple & factor, lowest common multiple & highest common factor.

Mensuration : Perimeter and area of triangle and quadrilateral. Surface area and volume of cubs, cuboids, cones, spheres, and cylinders.

Unit 2 . Elementary Number Theory: Piano's Axioms, Principle of Induction; First Principle, Second Principle, Third Principle, Basis, 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.

Unit 3. Matrices and Determinants : Definition and Types of Matrices, Addition and Product of Matrices up to order 3x3, Transpose Matrices, Symmetric and Skew-symmetrical Matrices, Definition of determinant, Minors and Cofactor of a Matrix, Inverse of a Matrix, Solution of the simultaneous equation of three unknown quantities with the help of the Inverse of a Matrix. expansion of determinants up to order 3×3, Camer's rule.

Unit 4. Relations & Functions : Ordered pairs, Cartesian product of sets. Number of elements in the cartesian product of two finite sets. Cartesian product of the reals with itself (upto $R \times R \times R$). Definition of relation, pictorial diagrams, domain. co-domain and range of a relation. Function as a special kind of relation from one set to another. Pictorial representation a function, 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 with their graphs. Sum, difference, product, and quotients of functions. Sets and their Representations. Union, intersection and complements of sets, and their algebraic properties, Relations, equivalence relations, mappings, one-one, into and onto mappings, composition of mappings. Binary operations.

Unit 5. Geometry and Coordinate Geometry : Angle & their types, parallel lines. triangle -types & properties, congruency of triangles, quadrilateral - types & properties, parallel lines, theorems on triangle, quadrilateral & circle, and questions based on theorems, geometrical shapes, constructions & properties.

Three-dimensional Coordinate Geometry : Coordinate axes and coordinate planes in three-dimensional space. Coordinates of a point in space. Distance between two points. Section formula. Direction cosines and direction ratios of a line. Equation of a line in a space. Angle between two lines. Shortest distance between two lines. Plane. Coplanarity of two lines. Distance of a point from a plane. Angle between a line and a plane Coordinates of a point, line, pairs of lines, circle and family of circles, conic section, three-dimensional geometry, sphere.

Unit 6. Mathematical Reasoning - Statements, New statement from Old, Special Words/Phrases, Implications, Validating Statements.

Mathematical Induction and Binomial Theorem: The principle of mathematical induction, Binomial theorem, General and Middle terms.

Permutation and Combination : Fundamental principle of counting, Permutations, Combinations.

Unit 7. linear Algebra : Linear independence & dependence of row & column matrices, Row rank, column rank and rank of a matrix, Equivalence of column and row ranks. Eigen values, eigen vectors and characteristics equation of a matrix. Cayley Hamilton theorem and its use in finding inverse of a matrix.

Definition and examples of vector spaces. Subspaces. Sum and direct sum of subspaces. Linear span. Linear dependence, independence, and their basic properties. Basis. Finite dimensional vector spaces, existence theorem for bases, invariance of the number of elements of a basis set, dimension, existence of complementary subspace of a finite dimensional vector space, dimension of sums of subspaces, quotient space and its dimension.

Linear transformations and their representation as matrices, the Algebra of linear transformations, the rank nullity theorem, change of basis, dual space, bidual space and natural isomorphism, adjoint of a linear transformation, eigen values and eigen vectors for a linear transformation, diagonalisation, bilinear, quadratic, and Hermitian forms.

Inner product spaces- Cauchy- Schwarz inequality, orthogonal vectors, orthogonal complements, orthonormal sets and, bases, Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalization process.

Unit 8. Abstract Algebra : Definition of a group with examples and simple properties, Sub groups, Cyclic groups, Coset decomposition, Lagrange's theorem, Fermat's, and Euler's theorems. Homomorphism and isomorphism. Normal subgroups. Quotient groups.

The fundamental theorem of homomorphism. Permutation groups. Even and odd permutations, rings, sub-rings, integral domains, and fields. Characteristics of ring. Group - Automorphisms, inner automorphism. Automorphism groups. Conjugacy relation and centraliser, normaliser. counting principle and the class equation of a finite group, Cauchy's theorem and Sylow's theorems for finite abelian groups and non-abelian groups.

Ring theory- Ring homomorphism. Ideals and Quotient Rings, field of quotients of an integral domain, Euclidean rings, polynomial rings, polynomials over the rational field, polynomial rings over commutative rings, unique factorization domain.

Unit 9. Discrete Mathematics

Boolean functions- separable and combinatorial normal forms (canonical and end canonical), theorem relations - bipartite relations, inverse relations, conjugate relations, equivalence relations, equivalence classes and division of sets.

Partially ordered set, partially ordered set, completely ordered set, Hemukh diagram, Maximum and last elements, First and last elements,

Lattice- Definition and examples, Dual lattice, Bounded lattice, Distributive complementary lattice.

Graph- Definition and types of subgraphs, locomotion, path, and circuit, connected and unconnected graphs, path, and circuit connected and unconnected, graphs circuit.

Tree and its attributes, fixed tree, bivariate tree, parent tree, caste, and emptiness of graph, Kuskal and I's algorithm.

Matrix representation of graphs, incidence, and adjacency matrices, cutsets and their properties, planar graphs (definition), Kuratovsky bigraphs Unit.

Unit 10.

Differentiation & Integration : Function, limit and continuity, differentiation, successive differentiation, application of derivatives, integration, fundamental theorem on integration, definite integration differential equation.

Calculus : Leibnitz theorem. Maclaurin and Taylor series expansions. Linear equations and equations reducible to the linear form. Exact differential equations. Linear differential equations with constant coefficients. Homogeneous linear ordinary differential equations. Linear differential equations of second order.

Unit 11. Advanced Calculus : Advanced Calculus of a sequence. Theorems on limits of sequences. Bounded and monotonic sequences. Cauchy's convergence criterion. Series of non-negative terms. Comparison tests. Cauchy's integral test. Ratio tests. Raabe's, logarithmic, de Morgan and Bertrand's tests (without proofs). Alternating series. Leibnitz's theorem. Absolute and conditional convergence. Continuity of single variable, Sequential continuity. Properties of continuous functions. Uniform continuity. Chain, rule of differentiability. Mean value theorems and their geometrical interpretations. Darboux's intermediate value theorem for derivatives. Limit and continuity of functions of two variables. Partial differentiation. Change of variables. Euler's theorem on homogeneous functions. Taylor's theorem for functions of two variables. Jacobians. Envelopes. Evolutes. Maxima, minima, and saddle points of functions of two variables. Lagrange's multiplier method. Indeterminate forms. Beta and Gamma functions. Double and triple integrals. Dirichlet's integrals. Change N of order of integration in double integrals.

Unit 12. Differential Equations : Series solutions of differential equations Power series method, Bessel and Legendre equations, Bessel's & Legendre's functions, and their properties. recurrence and generating relations, Orthogonality of functions. Sturm-Liouville problem. Orthogonality of eigen-functions. Reality of eigen-values.

* Laplace Transformation-Linearity of the Laplace transformation. Existence theorem for Laplace transforms. Laplace transforms of derivatives and integrals. Shifting theorems. Differentiation and integration of transforms. Inverse Laplace transforms. Convolution theorem. Application of Laplace transformation in solving linear differential equations with constant coefficients.

Partial differential equations of first order. Lagrange's solution. Some special types of equations, which can be solved easily by methods other than the general method. Charpit's general method of solution.

Partial differential equations of second & higher orders. Classification of linear partial differential equations of second order. Homogeneous and non- homogeneous equations with constant coefficients. Partial differential equation reducible to equations with constant coefficients.

Calculus of Variations- Variational problems with fixed boundaries - Euler's equation for functionals containing first order derivative and one independent variable. Extremals. Functionals dependent on higher order derivatives. Functionals dependent on more than one independent variable. Variational problems in parametric form. Invariance of Euler's equation under coordinates transformation.

Unit 13. Vector Analysis and Geometry : Magnitude and direction of vector, position vector, two dimensional & three-dimensional vector, scalar & vector products of vector and their properties, moment of couple, 'application of vectors in three-dimensional geometry, to find out the distance between two skew lines. Scalar and vector product of three vectors, Reciprocal vectors, Vector differentiation. Gradient, divergence, and curl. Vector integration. Theorems of Gauss, Green, Stokes. Equation of cone with given base, right circular cone, Equation of cylinder and its properties.

Unit 14. Linear Inequalities and Linear Programming - 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, Chebyshev's Inequality.

Linear Programming; related terminology such as constraints, objective function, optimization, graphical method of solution for problems in two variables, feasible and infeasible regions (bounded or unbounded), feasible and infeasible solutions, optimal feasible solutions

Unit 15. Trigonometry : Angle; Degree measure Radian measure, Relation between degree and radian, Trigonometrical functions, Identities and equations of trigonometrical functions, Properties of triangle, Solution of triangles, Height, and Distances.

Inverse trigonometrical functions: Basic concepts, Properties of Inverse Trigonometric Functions.

Unit 16

Basic Algebra : Algebraic expressions and their factors, linear equations in one and two variables and their applications, sets and operations on them, quadratic equations, symmetric functions of the roots.

Sequence and Series : Sequence and Series. Arithmetic Progression (A. P.). Arithmetic Mean (A.M.) Geometric Progression (G.P.), Geometric mean (G.M.), Relation between A.M. and G.M.

Unit 17. Metric Spaces : Definition and examples of spaces. Neighbourhoods. Limit points. Interior points. Open and closed sets. Closure and interior. Boundary points. Sub-space of a metric space. Cauchy sequences. Completeness. Cantor's intersection theorem. Contraction principle. Real numbers as a complete ordered field, dense subsets, Baier Category theorem, separable, second countable and first countable spaces. Continuous functions, extension theorem, uniform continuity. Compactness, sequential compactness, totally bounded spaces, finite intersection property, continuous functions and compact sets, connectedness.

Unit 18. Real Analysis : Riemann integral. Integrability of continuous and monotonic functions. The fundamental theorem of integral calculus. Mean value theorems of integral calculus. Partial derivation and differentiability of real-valued functions of two variables. Schwarz and the Young's theorem. Implicit function theorem. Improper integrals and their convergence. Comparison tests, Abel's and Dirichlet's tests, Frullani's integral, integral as a function of parameter, continuity, derivability, Fourier series of half & full intervals.

Unit 19. Complex Analysis :

Complex Numbers and Quadratic Equations : Complex numbers, Algebra of complex numbers, The modulus and the conjugate of a complex numbers, Argand plain and polar representation.Quadratic equations. Complex numbers as ordered pairs. Geometric of Complex numbers.

Stereographic projection. Continuity & differentiability of Complex functions, Analytic functions, Cauchy- Riemann equations, harmonic functions. Mobius transformations, fixed points, cross ratio, inverse points and critical mapping, Conformal mapping.

Unit 20. Statistics and Probability

Statistics : Measures of dispersion, Range, Mean deviation, Variance, and standard deviations

Probability : Random experiment, Event, Axiomatic approach to probability, Conditional probability, Multiplication theorem on probability, independent events, Bayes' theorem, Random variables and its probability distributions, Bernoulli trials and Binomial distributions.

उच्च माध्यमिक शिक्षक -शिक्षक चयन परीक्षा
विषय – रसायन

रसायन की परीक्षा के लिए तीन मुख्य भाग है –
भौतिक रसायन ,अकार्बनिक रसायन , कार्बनिक रसायन

[I] भौतिक रसायन –

1.रासायनिक आबंधन –

- होमो- और हेटेरोन्यूक्लियर अणुओं में संरचना और बंधन अणुओं के आकार सहित
- अणु वीएसईपीआर सिद्धांत
- MO और VB सिद्धांत की मूल अवधारणा
- संयुक्त π-electron systems का हकल सिद्धांत

2 रासायनिक ऊष्मागतिकी –

- नियम ,अवस्था और पथ फलन और उनके अनुप्रयोग
- विभिन्न प्रकार की प्रक्रियाओं का ऊष्मागतिकीय विवरण;
- मैक्सवेल के संबंध
- सतत और साम्य की ऊष्मागतिकी में ताप व दाब के मध्य निर्भरता
- ले शतालियर सिद्धांत
- अवस्था परिवर्तन का संक्षिप्त विवरण
- साम्य और अवस्था नियम
- आदर्श और अनादर्श गैसों व विलयन की ऊष्मागतिकी

3 वैद्युत रसायन

- नर्नस्ट समीकरण, रेडॉक्स सिस्टम, इलेक्ट्रोकेमिकल सेल