BIHAR MATHEMATICAL SOCIETY

Syllabus for Talent Nurture Programme (TNP)

Bihar Mathematical Society has been conducting Talent Nurture Programme in

Mathematics. The Syllabus of TNP Training for Level 2 of Class B.Sc and M. Sc as well as higher level Competitive Examinations are as Follows:

PAPER – I

1.Linear Algebra:

Foundation Stage-Vector spaces over R and C, linear dependence and independence, subspaces, bases, dimension; linear transformations, rank and nullity, matrix of a linear transformation.

Second stage-Algebra of Matrices; row and column reduction, echelon form, congruence and similarity; rank of a matrix; inverse of a matrix; solution of system of linear equations; eigenvalues and eigenvectors, characteristic polynomial, Cayley-Hamilton theorem, symmetric, skew-symmetric, Hermitian, skew-Hermitian, orthogonal and unitary matrices and their eigenvalues.

2.Calculus:

Foundation Stage-Calculus: functions, limits, continuity, differentiability, indeterminate forms, mean value theorem, Tangent and Normal,Taylor's theorem with remainders, maxima and minima, asymptotes;curvature,curve tracing;

Second stage-functions of two or three variables: limits, continuity, partial derivatives, maxima and minima, Lagrange's method of multipliers, Beta and Gamma functions,Jacobian.

Fundamental theorem of integral calculus, indefinite integrals; definite integrals; double and triple integrals; areas, surface and volumes.

3. Theory of equations:

Foundation Stage-Nanumbers,Integers,Rationals,Real and Complex Numbers,Division Algorithm,Greatest Common Divisors,Polynomials,Division Algoritm Derivative,Integral,Rational,Real and Complex roots of a polynomial relation between roots and coefficients,repeated roots,elementary symmetric function.

(4) Analytic Geometry:

Foundation Stage- Straight Line,Pair of straight lines, Circle, Parabola, Ellipse and Hyperbola,Polar equation of conics.

Cartesian and polar coordinates in three dimensions, second degree equations in three variables, reduction to canonical forms, ; plane, straight lines, shortest distance between two skew lines,

Second stage-.sphere, cone, cylinder, paraboloid, ellipsoid, hyperboloid of one and two sheets and their properties.

(5) Ordinary Differential Equations:

Foundation Stage-Formulation of differential equations; equations of first order and first degree, integrating factor; orthogonal trajectory; equations of first order but not of first degree, Clairaut's equation, singular solution. Second and higher order linear equations with constant coefficients, complementary function, particular integral and general solution.

Second stage-Second order linear equations with variable coefficients, Euler-Cauchy equation; determination of complete solution. Application to initial value problems for second order linear equations with constant coefficients.

(6) Vector Analysis and Vector Calculus:

Foundation Stage-Scalar and vector fields, Dot and Cross Product of two and three vectors.

Second stage-differentiation of vector field of a scalar variable; gradient, divergence and curl in cartesian and cylindrical coordinates; higher order derivatives; vector identities and vector equations. Gauss and Stokes' theorems, Green's identities. Scalar and vector fields, gradient, divergence, curl, line integrals, surface integrals, Green, Stokes and Gauss theorems.

7.Topology: Foundation Stage-Metric space and their basic properties,open sphere,open set,Neighbourhoods,closed set,Accumulation point,closure and interior,convergence of sequence in a metric space and their properties,Cauchy sequence and complete metric space,continous mappings.

Second stage- Definition and examples of topological space,closed set,closure,Dense subset,Neighbouredhoods,Accumulation point,Derived set,Bases and sub-spaces.Compactness and their basic properties.Continuity functions and homomorphism,Seperation axiom T0, T1, T2 spaces their characteristics and basic properties,connectendness.

Paper- II

1.Algebra:

Foundation Stage-Groups, subgroups, cyclic groups, cosets, Lagrange's Theorem, normal subgroups, quotient groups, homomorphism of groups, basic isomorphism theorems.Rings, subrings and ideals, homomorphisms of rings; integral domain.

Second stage-permutation groups, Cayley's theorem. Rings, subrings and ideals, homomorphisms of rings; integral domains, principal ideal domains,

(2) Real Analysis:

Foundation Stage-Real number system as an ordered field with least upper bound property; sequences, limit of a sequence, Cauchy sequence, completeness of real line; series and its convergence, absolute and conditional convergence of series of real and complex terms, rearrangement of series. Continuity and uniform continuity of functions, properties of continuous functions on compact sets. Riemann integral,

Second stage-improper integrals; fundamental theorems of integral calculus. Uniform convergence, continuity, differentiability and integrability for sequences and series of functions; partial derivatives of functions of several (two or three) variables, maxima and minima.

(3) Complex Analysis:

Foundation Stage-Analytic functions, Cauchy-Riemann equations, Cauchy's theorem, Cauchy's integral formula,Liouville's theorem,Taylor's series; Laurent's series.

Second stage- singularities; isolated singularity,meromorphic function,Schwartz lemma,Cauchy's residue theorem;Rauche,s theorem,fundamental theorem of algebra, contour integration. power series representation of an analytic function.

(4) Operation Research:

Foundation Stage-Linear programming problems, basic solution, basic feasible solution and optimal solution; graphical method,convex set, Simplex method of solutions;

Second stage-duality. Big-M Method,Two phase method,Transportation and assignment problems,Game theory,Sequencing Replacement model,Queing theory.

(5) Partial differential equations:

Second stage-Family of surfaces in three dimensions and formulation of partial differential equations; solution of quasi-linear partial differential equations of the first order, Cauchy's method of characteristics; Linear partial differential equations of the second order with constant coefficients,Charpit method .

(6) Numerical Analysis:

Foundation Stage-Newton's (forward and backward) interpolation, Lagrange's interpolation. - Numerical methods: solution of algebraic and transcendental equations of one variable by bisection, Regula-Falsi and Newton-Raphson methods;

Second stage-Solution of system of linear equations by Gaussian elimination and Gauss-Jordan (direct), Gauss-Seidel(iterative), Numerical integration: Trapezoidal rule, Simpson's rules, Gaussian quadrature

formula. Numerical solution of ordinary differential equations: Euler and Runge Kutta-methods. Picard's method

(7) Fluid Dynamics:

Second stage- Equation of continuity; Euler's equation of motion for inviscid flow; Stream-lines, path of a particle; Potential flow; Two-dimensional and axisymmetric motion; Sources and sinks, vortex motion; Navier-Stokes equation for a viscous fluid.

8.Functional Analysis:

Foundation Stage-Normed linear space and Banach space their definition,properties and examples,competiopn of a normed linear space.

Second stage-Inner product space and Hilbert space and their properties and examples,Cauchy Schwartz inequality.parallelogram law and polarization identity,Hahn-Banach theorem on real linear space,complex linear space and normed linear space.