U.P. HIGHER EDUCATION SERVICES COMMISSION, ALLAHABD

MATHEMATICS

(Subject Code-75)

1. ALGEBRA :

Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's Theorem, Fundamental Theorem of homomorphism, Isomorphism theorems, class equation, Sylow theorems and their applications; Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain, Polynomial rings, Fields, finite fields, field extensions.

2. LINEAR ALGEBRA :

Vector spaces, subspaces, Linear dependence, basis and dimemsion, quotient spaces, Linear transformations, Algebra of linear transformations, kernel, range, isomorphism, Matrix representation of a linear transformation, change of bases, linear functionals, dual spaces, rank, system of linear equations, eigen values and eigen vectors, Cayley – Hamilton Theorem, diagonalization, Hermitian, Skew- Hermitian and Unitary matrices, Finite dimensional inner product spaces, Gram Schmidt-Quadralic forms, reduction and classification of quadratic forms.

3. ANALYSIS :

Finite, countable and uncountable sets, Real number system as a complete field, Archimedean property, Sequence and series of functions, uniform convergence, Riemann integral, improper integrals, monotonic functions, types of discontinuity, functions of bounded variations, Lebesgue measure, measurable functions, Lebesgue integral, functions of several variables, directional derivative, partial derivative and total derivative, maxima and minima, Elements of metric spaces, convergence, continuity, uniform continuity, compactness, connectedness, completeness.

4. COMPLEX ANALYSIS :

Analytic functions, Cauchy - Riemann equations, line integrals, cauchy theorem, Morera's theorem, Liouville's theoren, Cauchy's Integral formula, zeros of analytic functions, Taylor series, Laurent series, Calculus of residues, contour integration, conformal mappings, Mobius transformations.

5. FUNCTIONAL ANALYSIS :

Normed linear spaces, Banach spaces, basic examples of Banach spaces including lnp, lp ($1 \leq p \leq \infty$), Continuous linear operators on normed linear spaces, open mapping theorem, closed graph theorem, Hahn- Banach theorm, Definition and examples of Hilbert spaces, Orthogonal complement of a subspace in a Hilbert space, Orthogonal basis, Gram-Schmidt process, Bessel's inequality, Riesz representation theorem.

6. TOPOLOGY :

Basic concepts of Topology, Continuity, convergence, Homeomorphism, connectedness, compactness, countability, separation axioms, subspaces, product spaces, quotient spaces, Tychonoff's theorem, Urysohn's Metrization theorem.

7. DIFFERENTIAL GEOMETRY :

Space curves - Their curvature and torsion, Serrect - Frennet formulae, First and Second fundamental forms, Gaussian curvatures, Principal directions and principal curvatures, Geodesics.

8. DIFFERENTIAL EQUATIONS :

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ordinary differential equations, general theory of homogeneous and non-homogenous linear ordinary differential equations, variation of parameters, Lagrange and Charpit methods for solving first order partial differential equations, general solution of higher order partial differential equations with constant coefficients, classification of second order partial differential equations, method of separation of variables for Laplace, Heat and Wave equations.

9. CALCULUS OF VARIATIONS AND LINEAR INTEGRAL EQUATIONS :

Linear functionals, variation of a functional, Necessary and sufficient conditions for extrema, Euler-Lagrange equation, Linear integral equations of Fredholm and Volterra type, solution by successive substitutions and successive approximations, solution of equations with separable Kernels.

10. CLASSICAL MECHANICS :

Generalised coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's variational principle and principle of least action, Euler's dynamical equations of the motion of rigid body, theory of small oscillations, Poisson bracket, contact transformation.

11. FLUID MECHANICS :

Equation of continuity in fluid motion, Euler's equation of motion for perfect fluids, Two- dimensional motion, complex potential, source and sink, doublets, motion of sphere in perfect fluid and motion of liquid past a sphere, vorticity, Navier -stokes's equations for viscous flows.

12. LINEAR PROGRAMMING :

Linear programming problem and its formulation, solution of a linear programming problem by graphical method, basic feasible solutions, solution of linear programming problem by simplex method, M-technique, Two-phase method, Dual problem and duality theorem, convex set theory, basic feasible solution of a linear programming problem at vertices of feasible region, balanced and unbalanced transportation problems, u-v method for solving tranportation problem, Hungarian method for solving assignment problems.

13. NUMERICAL ANALYSIS :

Numerical solutions of algebraic equations, Fixed point interaction methods, and Newton-Raphson method, rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Eulaer and Range-Kutta methods.

Note- The syllabus consists 13 units. In the preparation of question paper, it is advisable atleast 03 questions should be asked from each unit.