MSc. Mathematics Entrance Syllabus

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 t 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 a parameter Continuity, derivability and integrability of an integral of a function of a parameter. Fourier series of half and full intervals.

Complex numbers as ordered pair. Geometric representation of Complex numbers. Stereographic projection. Continuity and differentiability of Complex functions. Analytic functions. Cauchy-Riemann equations. Harmonic functions. Mobius transformations. Fixed point. Cross ratio. Inverse points and critical mappings. Conformal mappings.

Definition and examples of metric spaces. Neighborhood. 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. Baire 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.

Algebra & Linear Algebra

Group – Automorphism, inner automorphisms, automorphism groups, Congjugacy 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 homonorphism, Ideals and Quotient Rings, Field of Quotients of an Integral Domain. Euclidean Rings, polynomial Rings, Polynomials over the Rational Field, Polynomial Rings over Commutaive Rings, Unique factorization domain.

Definition and examples of vector spaces. Subspaces. Sum and direct sum of subspaces. Linear span. Linear dependence, independence and their basic properties. 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 subs pace 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. Eigenvalues and eigenvector of 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.

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