Syllabus for Ph.D candidates – Mathematics

Real Analysis: Sequences and series, convergence. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral.

Complex Analysis: Cauchy-Riemann equations, analytic functions, harmonic functions. Conformal mappings, Mobius transformations. Open mapping theorem, Louville's theorem, Rouche's theorem, Morera's theorem. Poles and Singularities, Contour integrals, Cauchy Integral formula. Taylor's series, Laurent's series. Residues, Cauchy Residue theorem.

Linear Algebra: Vector spaces, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices. Eigenvalues and eigenvectors. Matrix representation of linear transformations. Inner product spaces, orthonormal basis, Gram-Schmidt orthogonalization.

Algebra: Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups. Rings, ideals, prime and maximal ideals, quotient rings, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, algebraic extensions, Galois theory, Module theory.

Ordinary Differential Equations: Solution methods for ordinary first order differential equations. General theory of homogenous and non-homogeneous linear ordinary differential equations, variation of parameters, power series methods.

Graph Theory and Combinatorics: Permutations, combinations, pigeon-hole principle, inclusion-exclusion principle. Graphs, Euler and Hamilton graphs, Trees and other special families of graphs. Matching, independent set, coloring, graph isomorphism.