GITAM SCHOOL OF SCIENCE

PhD Entrance Test Syllabus

PhD in Science: Mathematics

Differential Equations:

Ordinary 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, system of first order ordinary differential equations, homogenous and non-homogeneous linear ordinary differential equations, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential equations: Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients.

Complex Analysis:

Analytic functions and harmonic functions, Cauchy-Riemann equations, sufficient conditions. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, uniform convergence of series, Taylor and Laurent series representations, singularities, zeros and poles, Applications of Taylor and Laurent series. Residue theorem, calculus of residues.

Real Analysis:

Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals.

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Linear Algebra:

Matrices: Systems of linear equations, rank, nullity, rank-nullity theorem, inverse, determinant, eigenvalues, eigenvectors.

Finite Dimensional Vector Spaces: Linear independence of vectors, basis, dimension, linear transformations, matrix representation, range space, null space, rank-nullity theorem.

Abstract Algebra:

Groups: Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems.

Rings and Fields: Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain. Polynomial rings and irreducibility criteria. Fields, finite fields, field extensions.

Statistics and Probability Theory:

Probability, conditional probability, independent events, total probability and Baye's theorem. Random Variable, Probability density function, distribution function, mathematical expectation, variance, Discrete Distributions –Binomial, Poisson, negative binomial, geometric distribution. Continuous Distribution - Normal, exponential, uniform distribution. Characteristic functions. Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case).