Rani Durgavati University, Jabalpur
Department of Mathematics & Computer Science

Entrance examination syllabus for Ph.D./ M.Phil. Mathematics
2018 onwards

Maximum marks = 100

Instructions to Paper setter/ Examiner :

(i) Entrance test question paper will have two sections A & B, each consisting of 50 objective type compulsory questions. In all there will be total 100 questions.
(ii) Section-A will represent "**Research Methodology**", whereas Section-B will represent "**Mathematics**".
(iii) Each question will carry 1 mark.
(iv) Each objective type question has to be framed with four optional answers viz. a), b), c), d) with single choice.
(v) No negative marking has to be done.
(vi) The paper setter is requested to please submit the key along with the question paper.

(Section – A)
Subject -- Research Methodology

Scientific Process : Meaning and Definition, a brief history of scientific process

Introduction of Research Methodology : Meaning of research, objectives of research, types of research, significance of research, problems encountered by researchers in India.

Research Problems : Definition, necessity and techniques of defining research problems. Formulation of research problem, Objectives of research problem.

Research Design : Meaning, need and features of good research design. Types of Research Designs. Basic principles of Experimental Designs, Design of experiments.

Sampling Techniques : Census and sample surveys, characteristics of good sample design. Different types of sampling techniques, Simple Random, Stratified and systematic sampling.

Data Collection : Primary and secondary data. Methods of collecting primary and secondary data. Various of measures of characterization of data. Distributions.

10.07.2018 10/7/18 10.7.18

10/07/18 10/7/18 10/7/18

Rani Durgavati University, Jabalpur
Department of Mathematics & Computer Science

(Section – B)
Subject -- Mathematics

1. **Real Analysis:** Elementary set theory , Real number system as a complete ordered field. Sequences and series, convergence, limsup, liminf, Bolzano Weierstrass theorem , Heine Borel theorem, Continuity, Uniform continuity, Differentiability. Sequence and series of functions, point-wise and uniform convergence, Riemann sums and Riemann integral, Lebesgue outer measure, Measurable sets, Regularity. Measurable functions. Non- measurable sets. integration of Non- negative functions.
2. **Complex Analysis:** Algebra of complex numbers, Power series, transcendental functions such as exponential, trigonometric and hyperbolic functions, Analytic functions, Cauchy- Riemann equations. Complex integration, Cauchy – Goursat theorem, Cauchy integral formula, Morera's theorem, Cauchy's inequality, Liouville's theorem, The fundamental theorem of algebra, Taylor's theorem. The maximum modulus principle, Schwartz lemma, Laurent series, Evalution of integrals.
3. **Linear Algebra:** Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformation, Algebra of matrices, rank and determinant of matrices, linear equations, Eigen values of eigenvectors, Cayley- Hamilton theorem, Matrix representation of linear transformations, change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms, Inner product spaces, orthonormal basis.
4. **Algebra :** Groups, subgroups, Normal subgroup, quotient group, homomorphisms, cyclic groups, permutation groups, cayley's theorem, class equations, Sylow theorems, Normal and Subnormal series, Composition series, Solvable group, Nilpotent group. Rings, Ideals , Prime and Maximal ideals, quotient rings, unique factorization domain, Principal deal domain, Euclidean domain. Polynomial rings and irreducibility criteria, Fields, Finite fields, fields extentions, Modules , sub modules, Direct sum of sub modules, R-homomorphism, Quotient module, Finitely generated module, cyclic module.
5. **Topology :** Topological spaces, Basis, Standard topology and Lower limit topology on real line , Sub- basis, Order topology, Product topology and Box topology, Subspace topology, Closed sets and lmit points, continuous functions, Homeomorphism , Pasting lemma, Metric topology, Metrizable space, Comb space, Topologists sin curve, component and path component, Locally connected and locally path connected space, Compact space.
6. **Functional Analysis :** convergence, completeness and Baire's Theorem, Cantors intersection Theorem , Continuous mappings, Uniformly continuous mapping, Spaces of continuous functions, Cauchy, Minkowski and Holder inequalities, Normed linear

10.07.2018 10/7/18 10/7/18

spaces, Equivalence of norms, Banach space, Continuous linear transformations, Functionals and their extensions, related lemma, Hahn Banach theorem , conjugates of normed linear spaces, Open mapping theorem, Projections on Banach spaces, Closed graph theorem, Conjugate of an operator, Parallelogram law, Schwartz inequality and polarization identity, Hilbert space,Orthogonal compliments in Hilbert spaces, Orthonormal sets, Complete separable Hilbert space, conjugate space of Hilbert space. .

7. **Advanced Discrete Mathematics:** Algebraic System : Definition and Examples, Some simple Algebraic System and General properties, Homomorphism and isomorphism, congruence relation, semigroups and Monoids, Definition and Examples, Homomorphism of semigroups and Monoids, Natural Homomorphism, subsemigroups and submonoids, Lattices: Definition and Examples, Principle of Duality, Some properties of Lattices, Lattices as Algebraic System, Sublattices, Direct product and Homomorphism ,Lattices Homomorphism, Some special Lattices, e.g. Complete, Complemented and Distributive lattices. Boolean Algebra: Definition and Examples.

8. **Ordinary Differential Equations and Partial Differential Equations:** Existance and uniqueness of solutions of intial value problems for first order ordinary differential Equations, Singular solutions of first order ODEs, System of first order ODEs, General theory of homogeneous and non- homogeneous linear ODEs, variation of parameters, sturm-Liouville boundary value problem. Green's function, Langrange 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, Method of separation of variables for Laplace, Heat and wave equations.

9. **Fundamental of Computers:** Sequential and linked representations, Trees, Binary tree- search tree implementation, B-tree (concept only), Hashing- open and closed, Sorting: sort, shell sort, quick –sort, heap sort and their analysis, Database system- Role of database system, database system architecture, Introduction to relational algebra and relational calculus, SQL-0 basis features including views, integrity constraints, Database design –normalization up to BCNF. Operating system- user interface, processor management, I/O management, memory management, concurrency and security, network and distributed system.

10. **Numerical Analysis:** Numerical solutions of Algebraic equations, Method of iteration and Newton – Raphson method, Rate of Convergence, solution of systems of linear algebraic equations using Gauss elimination and Gauss- seidel methods, Finite differences , Langrange, Harmite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using picard, Euler, modified and Runge – kutta methods.

10.07.2018 10/7/18 10/7/18 10/7/18 10/07/18