VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY BALLARI - 583105.

Department of Studies in Mathematics

Entrance examination syllabus for Ph. D. Programme (2021-22)

(Entrance syllabus is approved in BOS dated on 28.01.2020)

Part A: Research Methodology (40 Marks)

UNIT-1

Research Methodology: Meaning, characteristics and types, Steps of research, Methods of research, Research Ethics, Paper, article, workshop, seminar, conference and symposium, Thesis writing: its characteristics and format.

UNIT- 2

Reading Comprehension: A passage to be set with questions to be answered. **Communication:** Nature, characteristics, types, barriers and effective classroom communication.

UNIT- 3

Logical Reasoning: Understanding the structure of arguments, Evaluating and distinguishing deductive and inductive reasoning. **Verbal Analogies:** Word analogy-Applied analogy, Verbal classification. **Reasoning Logical Diagrams:** Simple diagrammatic relationship, multi• diagrammatic relationship, Venn diagram Analytical Reasoning.

UNIT- 4

Data Interpretation: Sources, acquisition and interpretation of data; Quantitative and qualitative data Graphical representation and mapping of data.

Information and Communication Technology (ICT): ICT: meaning, advantages, disadvantages and uses General abbreviations and terminology, Basics of internet and e-mailing.

Part B: Core Syllabus – Mathematics (60 Marks)

UNIT-5

Analysis: Elementary set theory, finite, countable and uncountable sets Real number system as a complete ordered field, Archimedean property, supremum, infimum. 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. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as example.

UNIT- 6

Linear Algebra: Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations. Eigenvalues and eigenvectors, Cayley-Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms.

Topology: Basis, dense sets, subspace and product topology, separation axioms, connectedness and compactness.

UNIT- 7

Complex Analysis: Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformations.

UNIT- 8

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

UNIT- 9

Ordinary Differential Equations (ODEs): Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs): 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, Method of separation of variables for Laplace, Heat and Wave equations.

UNIT- 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, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Linear Integral Equations: Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

Note:

1. Ph.D. Entrance test is for 100 Marks (1 mark each) and MCQ type.
2. Research methodology (Part A) carries 40 marks and core subject (Part B) carries 60 marks.
3. Ten multiple choice questions from each unit.
4. Each question carries one mark.