ENTRANCE TESTS SYLLABUS FOR Ph.D.
(Part A: Research Methodology-Mathematics and Statistics Both)

Note: The Ph.D. Entrance test for Ph.D. in Mathematics and Statistics consists of two parts:

- **Part A:** Research Methodology and
- **Part B:** Subject-Specific Knowledge.
- The Syllabus for Research Methodology is common to Mathematics and Statistics.

UNIT-I

Origin of Research, objectives of research, motivation and necessity of research, Steps in Research, types of research, research approaches, significance and relevance of research, conditions for good research and criteria of good research, Action Research, Interdisciplinary, Multidisciplinary.

UNIT-II

What is Research Problem?, selection of research problem for research, formulation of the selected research problems, choosing the research area, identification of research problem and solving research problems, pure and applied research, data collection, data analysis, conclusion. Documentation, report writing.

UNIT-III

Literature review, review of published article and books in the field of research work undertaken, Importance of Literature review in defining a problem, including literature in research proposal, survey and peer review process, identifying gap areas from literature review; Major Research areas, Journals, Conferences and Status of Research in the field of Sciences.

UNIT-IV

Philosophy and Ethics, Introduction to Philosophy: definition, nature, scope, concept, branches Ethics: definition, moral philosophy, nature of moral judgment and reactions. Scientific Conduct, Research ethics, research Intellectual honesty and research integrity. Copyright, scientific misconduct: falsification, fabrication, and Plagiarism.

UNIT-V

What is Computer, Basic Applications of Computer; Components of Computer System, Central Processing Unit (CPU), Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information, Connecting keyboard, mouse, monitor and printer to CPU and checking power supply. Introduction of Internet, use of WWW, using search engines and advanced search tools, Email, MS-Word, MS-Excel, Power Point and online journals.

DR. VIJAY KUMAR
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ENTRANCE TEST SYLLABUS FOR Ph.D. (MATHEMATICS)
(Part B: Subject-Specific Knowledge)

Note: The Ph.D. Entrance test for Ph.D. in Mathematics consists of two parts:

- **Part A:** Research Methodology and
- **Part B:** Subject-Specific Knowledge.
- The Syllabus for Research Methodology is common to Mathematics and Statistics.

UNIT-I

Functional Analysis: Normed linear spaces, Banach spaces, Subspaces, Quotient spaces of normed linear space and completeness, Bounded linear functional Dual spaces, Continuous and bounded linear operators and their basic properties, Inner product spaces and their basic properties, Hilbert spaces, Hilbert adjoint operators.

Analysis and Measure Theory: Functions of Bounded Variation, Riemann- Stieltjes integrals, Pointwise convergence and uniform convergence, topological spaces, Continuous functions and homeomorphism, Separation axioms T0, T1, T2, T3, T4; Compactness, Connectedness, Measurable set, Lebesgue's outer and inner measure and its properties, σ-algebra of measurable sets, Measurable space and a measure space, Lebesgue Integration of a simple measurable function on R and its properties.

UNIT-II

Algebra: Maximal subgroups, Commutator subgroups, Composition series, normal series, Solvable groups, Solvable subgroups, Nilpotent groups, Sylow's theorems, Canonical forms, Extension Fields, Algebraic and transcendental extensions, Splitting Field, Automorphisms of extensions, Galois group, Modules.

Complex Analysis: Conformal Mapping, Analyticity of power series, Analytic continuation, Natural boundary, Maximum-modulus theorem.

UNIT-III

Differential, Partial Differential and Integral Equations: Series solution of differential equations of second order with variable coefficients, Hypergeometric function, Legendre's functions, Bessel's functions, Integral equations, Linear and non-linear partial differential equations of order one, Linear partial differential equations with variable coefficients, method of separation of variables.

Mechanics: Rigid bodies as system of particles, Kinetic energy and angular momentum of rigid body rotating about its fixed point, Dynamical systems and its classification, generalized coordinates, Lagrangian approach to solve dynamical problems, Hamiltonian approach and its applications in dynamical system.

UNIT-IV

Differential Geometry of Manifolds: Tensors and their properties, Differentiable manifold, Torsion, Curvature, Lie derivative, Riemannian Manifold, Riemannian connection, Riemannian curvature tensor and Ricci tensor, Exterior product, Submanifolds and Hypersurfaces.

Number Theory: The function τ and σ, Euler's $\emptyset -$ function, Moebius μ-function, Divisibility, Greatest common divisor, Linear Diophantine Equation, Chinese remainder theorem, Binary and Decimal Representation of Integers, Congruences and Cryptography, Complete residue system and Reduced residue system.

UNIT-V

Fluid Dynamics: Fluid motion, Kinds of motion, Streamlines, Path lines, Streak lines, Velocity potential, Vorticity vector, Vortex lines, Boundary surface, Euler's and Lagrange's equation of motion, Newton's law of viscosity, General motion of a fluid elements, Navier-Stokes equations of motion.

Operations Research: Inventory Control, Sequencing Problems, Network drawing and analysis, PERT and CPM, Non-Linear Programming.

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