Pre Ph.D. Course work

Paper I- Research Methodology

Unit-I

Meaning of Research, Research Philosophy, Importance of research methodology in research. Choosing the appropriate methodology, Selection of a research topic and problem, Review of Literature, Searching related research papers, survey articles, Scope for future work with historical notes. Being acquainted with review of published articles and books in the field of research work undertaken, Impact factor of a journal, Indexing.

Unit-II

Research approaches and Related Tools, Mathematical Research Projects, Criteria for good Research, Knowledge of useful softwares: Latex Beamer etc. Accuracy and Stability in Numerical Computing, Problem-Solving in Mat Lab.

Unit-III

Writing skills and presentations in scientific seminars; oral/ poster presentations, preparing a survey article, research paper, Ph.D. thesis, dissertation, correcting galley proofs, writing comments and preparing summary and abstract of a manuscript.

Unit-IV

Numerical integration and differentiation, solution of initial value problems, solution of boundary value problems, partial differential equations, Finite difference method: Explicit and implicit schemes, Crank-Nicolson schemes, consistence, stability and convergence.

Recommended books:

1. Research Methodology, Methods & Techniques: C.R.Kothari, Vishwa Prakashan.
2. P. Saravanavel-Research Methodology (Kitab Mahal, Allahabad, 1987)
3. Research Methods: A Process of Inquiry: Graziano, A.M. Raulin, M.L. Pearson Publications.
4. How to write a Thesis: Murray, R. Tata McGraw Hill

5. Latex: Leslie Lamport
6. Numerical Methods for engineering and Scientific computations.

Paper II- Pre Ph.D. Mathematics

Unit I- Analysis

Theory of Univalent Functions: The Riemann Mapping Theorem, Univalent Functions, Area Theorem, Bieberbach's Theorem, Koebe One-Quarter Theorem, Growth and Distortion Theorems, Coefficient Estimates and Bieberbach Conjecture, Convex and Star like functions.

Entire Functions: Order and type of the derivative of entire functions, Zeros of functions of finite order, rate of growth and distribution of zeroes.

Special Functions: Generalized hyper geometric functions and their convergence, Bessel Functions, Theta functions.

Analytic Number Theory: Arithmetic Functions and Dirichlet multiplications, The Mobius function, Liouville's Function, Euler's summation formula.

Unit II- Algebra

Canonical forms, triangular form, nilpotent transformations, Jordan canonical form, rational canonical form, Unitary and normal operators, forms on inner product spaces, positive form, spectral theory.

Unit III- Geometry & Approximation Theory

Trans-Sasakian manifold: Introduction, Trans-Sasakian manifolds, 3-dimensional trans-Sasakian manifolds, 3- dimensional η-Einstein Trans- Sasakian manifolds, Sasakian manifolds, Some curvature properties of Sasakian manifolds, Kenmotsu manifolds.

Semi-Riemannoan Geometry: Semi-Euclidean spaces, Semi-Riemannian metric, Lorentzian metric, Semi-Riemannian manifolds, Light like manifolds, Curvature tensor, Ricci tensor, Scalar curvature, LP-Sasakian manifold, η-Einstein LP-Sasakian manifolds, Conformally flat LP-Sasakian manifold, LP-Sasakian manifolds with η-paraller Ricci tensor.

(k, μ)- Contact and K-contact manifolds: (k, μ)- nullity distribution, (k, μ)-contact metric manifold, Character of k and μ on (k, μ)-contact metric manifold,

Curvature tensor, Ricci-tensor and scalar curvature of (k, μ)-contact manifolds, Generalized (k, μ)-contact manifolds, Some curvature properties of K-contact manifolds, sectional curvature of K-contact manifolds, Locally symmetric K-contact manifolds.

Approximation Theory:

Types of approximation Theory: Types of approximation, wirestrass theorem of Approximation theory, Jackson Theorems Lagrange Interpolation, Hermite Interpolation, Hermite Fejer Interpolation, Lacunary Interpolation, (0,2) Interpolation on the finite interval, the unit circle, the infinite-interval and their convergence, SPLINE theory, and Quadrature formulas.

Unit IV- Applied Fluid Mechanics & (Discrete Mathematics or Astrophysics)

Applied Fluid Mechanics:

Flow through Porus Medium: Porus medium, porosity, effective porosity, structure and packing, porosity measurement, permeability, seepage velocity, equation of continuity, Darcy's law, Brinkman equation, Hydrodynamic Boundary Conditions.

Atmospheric Diffusion and Air Pollution: Various sources and types of pollutants in the atmospheric environment, Reynolds averaging, atmospheric diffusion, types of boundary conditions for modeling, dispersion, solution of diffusion equation for instantaneous and continuous source.

Discrete Mathematics:

Mathematical logic vs. Automatic theorem proving, Lattice theory and theorems, Boolean algebra and logic circuits related to real life models, Graph theory: Various models like coloring graphs, connectivity, networks and related algorithms, Languages and Automata theory: Language recognizers and problem solving models using Automata and Turing Machine, Algorithms and Analysis.

Operation Research:

Linear programming, Inventory control and related models, Transportation, Queuing Theory: Various Constraints and models, Assignment models, Network analysis: CPM, PERT models.

or

Astrophysics and Astrobiology:

Uses and application of various techniques of molecular spectroscopy, Application of Computational techniques: ab initio methods, Quantum chemical methods etc., Introduction and usages of Gaussian program, Physics and Chemistry of Interstellar medium, comets, Meteors, Meteorites and other Celestial bodies, Comets as a source of Pre-biotic organic molecules or the early earth, Introduction to Astrobiology and Space exploration, The early Earth and origin of life, Basic Techniques in Astrobiology: Formation of pre-biotic molecules and reaction mechanisms, search of extraterrestrial intelligence.