Paper-I
Research Methodology
Full Marks : 100

1. What is Research? Types of Research. What is a problem ? Objective of a Research. Hypothesis. Significance of a Research Work. What is Methodology? Various styles of Reference writing. Preparation of a Thesis. Plagarisation.
2. Features of science, Requirements for the Success as a Researcher, Research Methods: Discovery and verification, Choosing a Problem, Concept Formation, Resources are Converted into Properties, Observation and Theory, Analysis, simulations, and experiments
3. Library-Searching of Reviews of AMS. What are the various types of classifications with numbers (AMS, MSC etc.) Review of Literature (Library+Internet).
4. Impact factor: How to find, Impact factor of various Journals of Mathematics, ISSN No, ISBN No.,
5. Patent : Definition, History, Applications, How to get it.
6. Computer Applications-Knowledge of Word, Excel, Internet(Papers from Google searching etc.), Mathematica , Latex
7. C-program: Basic numerical programs,
8. Matlab: Basic numerical programs , Methods of image processing, And other Mathematical calculations,

Paper - 2
General Mathematics
Full Marks- 100

1. Real number system as a complete ordered field, Archimedean property, Supremum, Infimum, Limit of a sequence, Convergent and Divergent of sequences , Limit superior and limit inferior, Cauchy sequence, Convergence and Divergence of Series, Rearrangements of series, Alternating series, Tests for absolute convergence, Limits of a function on the real line.

2. Metric spaces, Limits in metric spaces, Functions continuous at a point on the real line, Functions continuous on a metric space, Open sets, Closed sets, Connected sets, Bounded sets and totally bounded sets, Complete metric spaces, Compact spaces, Continuous functions on compact metric spaces, Uniform continuity.

3. Derivatives, Rolles theorem, Mean Value theorem, Riemann Integral, Existence of Riemann integral, Fundamental theorem of Calculus, Improper integrals, Length of open sets and closed sets, Inner and outer measure, Measurable sets, Measurable functions, Existence of the Lebesgue integral for bounded functions, Lebesgue integral for unbounded functions, Lebesgue dominated convergence theorem, Fatou's lemma, Definition of Fourier series, The (C, 1) summability of Fourier series, Convergence of Fourier series, Riemann-Lebesgue theorem.

4. Complex Numbers, Function's of Complex variable, Limits, Continuity, Derivatives, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Convergence of sequences and series of complex numbers, Power series, Contours, Contour Integrals, Antiderivatives, Cauchy-

Goursat theorem, Cauchy integral formula, Liouville's theorem and the Fundamental theorem of Algebra, Maximum Modulus Principle.

5. Taylor series, Laurent series, Residues, Cauchy's Residue theorem, The three types of isolated singular points, Zeros of Analytic functions, Poles, Evaluation of Improper integrals by using residues, Argument Principle, Rouche's theorem.

6. Existence and uniqueness of solution's of initial value problems for first order ordinary differential equations, Singular solutions of first order ordinary differential equations, System of first order ODE's, General theory of homogeneous and non-homogeneous linear second order ODE's , Variation of parameters, Sturm- Liouville boundary value problem, Sturm comparison theorem, Sturm separation theorem, Green's function.

7. Lagrange and Charpit methods for solving first order PDE's, Cauchy problem for first order PDE's, Classification of second order PDE's, Canonical forms, Method of separation of variables for Laplace, Heat and Wave equations.

8. Variation of functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema, Laplace transform, Inverse Laplace transform, Fourier transform and inverse Fourier transform.

Paper – 3(Special Paper)

Full marks 100

(Scholars may choose any one from the papers below)

1. Fuzzy Set and Fuzzy Topology

1. Fuzzy set I- Characteristic function and definition of fuzzy sets , Fuzzy point, α - level set, convex fuzzy sets , basic operations on fuzzy sets
2. Fuzzy set – 2: Cartesian products , algebraic products , bounded sum and difference , t – norms and t conforms, quasi coincidence of two fuzzy subsets
3. Generalization and variants of fuzzy sets: L fuzzy sets, interval valued fuzzy sets, Type 2 fuzzy sets, intuitionistic fuzzy sets and set operation of intuitionistic fuzzy sets , The Zadeh's extension principal and Rough set theory
4. Fuzzy arithmetic: Fuzzy \numbers , triangular fuzzy numbers , Fuzzy numbers describing 'large', Fuzzy numbers in the set of integers , Arithmetic operation on interval and fuzzy numbers
5. Fuzzy relation and fuzzy graph: Fuzzy relations on fuzzy sets, composition of fuzzy relations , Max min and min max composition , basic properties of fuzzy relations

6. Fuzzy order: Fuzzy pre order and fuzzy order relations, fuzzy equivalence relation, fuzzy compatibility relations , fuzzy graph, fuzzy similarity relations , examples of different fuzzy relations

7. Fuzzy functions: Fuzzy functions on fuzzy sets, image and inverse image of fuzzy sets and some basic theorem on fuzzy functions and introduction of fuzzy Topology

8. Fuzzy Matrix : Sum , multiplication of two fuzzy matrices , Idempotent fuzzy matrix and their properties.

9. Fuzzy Topology : Chang's definition, and Lowen's definition, lower semi continuous function, fuzzy closure, fuzzy interior, induced fuzzy topological space .

References:

1. H J Zimmermann: Fuzzy Set Theory and its Applications, Allied Publishers Ltd. 1991
2. G J Klir and B Yuan; Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, 1995
3. G Bozaqdziev and M Bojadziev; Fuzzy sets, Fuzzy Logic, Applications, World Sci, 1995
4. N Palaniappan, Fuzzy Topology, Narosa 2006

2. Rough Set Theory

1. Rough Sets : Basic concepts of Rough sets, Approximation of sets, rough equality and rough inclusion of sets, comparison of rough sets, core, reduct, knowledge reduction., Rough membership value.

2. Algebraic and topological representation of rough sets, generalized approximation spaces,

rough sets and Baye's theorem, Various types of Rough sets: Decision theoretic rough set, Bayesian Rough set, Variable precision theoretic rough set.

3. Applications of Rough Sets : Decision making, simplification of decision tables, decision algorithm, the case of Incomplete information,

4. Data mining, Clustering, Indiscernibility in clustering: Problems and statements

5. Rough sets and conflict analysis, concepts of conflict theory and applications.

6. Fuzzy Cognitive map: Basic Concepts and applications

7. Image Processing: Basic Concepts

8. Queuing Theory, Queuing Control, Rough Control Theory and applications

References

1. G.J.Klir and B.Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, 1995.

2. G.Bojadziev and M.Bojadziev, Fuzzy Sets, Fuzzy Logic, Applications, World Sci,1995.

3. Yen and Langani, Fuzzy Logic, Pearson Education, 2003.

4. Z. Pawlak, Rough Sets, Kluwer Academic Publishers,1991.

3. Logic and Set Theory

1st Half

1. Classical logic. First order Logic and Model theory.
2. Study of one or more logics from Modal logic, Topological logic, Intuitionistic logic, Temporal logic etc.

2nd Half

1. Axiomatic set theory: ZFC, Axiom of choice, ordinal and cardinal numbers. Other type of axiomatic set theory.
2. Partial order Set, Trees, Souslin hypothesis, Souslin Tree, Kurepa Tree.

References
1. Meldelson, E.: Int. to Mathematical Logic, 5e. CRC Press, Taylor and Francis Group(2010)
2. Levi, A. : Set Theory, Dover(2006)
3. Cocchiarella, N.B., Freund, M.A.: Modal Logic-An Int. to its Syntax and Semantics. Oxford University Press,(2008).
4. Hughes, G.E., Cresswell, M.J.: A New Introduction to Modal Logic, Routledge, London(1996)
5. Huith and Ryan: Logic In Computer Science : Modelling And Reasoning About Systems, Cambridge University Press(2010)

4. Set Theory and Topology

1st Half

1. Axiomatic set theory: ZFC, Axiom of choice, ordinal and cardinal numbers. Other type of axiomatic set theory.
2. Partial order Set, Trees, Souslin hypothesis, Souslin Tree, Kurepa Tree.

2nd Half

1. Revision of Topology with more critical analysis. Compactness and Paracompactness. Star of a subset with respect to a cover.
2. Functions on a topological space. Ideals and Z-Filters. Completely regular space, The Stone-Cech comactification, realcompact space.

References

1. Meldelson, E.: Int. to Mathematical Logic, 5e. CRC Press, Taylor and Francis Group(2010)
2. Levi, A. : Set Theory, Dover(2006)
3. Engelking, R : General topology, HeldermannVerlag,(1989)
4. Matveev, M.V. : A survey on star covering properties, Preprint, Topology Atlas (1998)
5. Gillman, L, Jerison, M.: Rings of Continuous Functions, Springer-Verlag(1960)

5. SEQUENCE SPACE

1. Linear spaces, linear metric spaces, paranorms, semi-norms, norms, subspaces, dimensionality, factor spaces, basis, dimension, basic facts of normed linear spaces and banach spaces (revision).

2. Sequence spaces, matrix and linear transformations, algebra of matrices, summability, Tauberian theorem.

3. Limitation methods, examples of limitation methods, matrix limitation methods, Norlund and Riesz means,Schur matrices, consistency of matrix methods.

4. Cesaro and Holder matrices, Hausdorff methods, Abel's method.

5. Application: Matrix transformation in sequence spaces, Orlicz and Modular sequence spaces

References

1. Sequence spaces and series, P.K.Kamthan and M.Gupta
2. Elements of functional analysis, I.J.Maddox
3. Lectures on Summability, Alexander Peyerimhoff
4. Regular Matrix transformation, Gordon M.Petersen