M.A./M.Sc. (Final)
Mathematics
PAPER-I
FUNCTIONAL ANALYSIS

Normed linear spaces. Banach spaces and examples Quotient space of normed linear spaces and its completeness. equivalent norms. Riesz Lemma. basic properties of finite dimensional normed linear spaces and compactness. Weak convergence and bounded linear transformations normed linear spaces of bounded linear transformations, dual spaces with examples. Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorem. Hahn-Banach theorem for real linear spaces. Reflexive spaces. Weak sequential compactness. Compact operators ,The closed Range Theorem.

Iinner product spaces. Hilbert spaces. Urthononnal sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity. Structure of Hilbert spaces. Projection theorem. Riesz representation theorem. Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces. Self-adjoint operators, Positive, projection. normal and unitary operators. Abstract variational boundary value problem and Riemannian coordinates. Geodesic form of the linear element, Parallelism of a Vector of constant and variable magnitude.

M.A./M.Sc. (Final)
Mathematics
PAPER II
DYNAMICS OF RIGID BODIES & ANALYTICAL DYNAMICS

Moment of inertia & product of inertia, D'Alemberts Principle, Motion of a rigid body in two dimensions under finite and impulsive forces. Kinetic energy and moment of momentum in two dimensions. Conservation of energy and momentum.

Equations of motion and their applications in three dimensions. Motion of a system of particles. Equations of motion in most general form. Momentum of a rigid body. Euler's equations of motion. Moment of momentum about instantaneous axis. Kineticenergy of a rigid body.

Generalized coordinates, Holonomic and Nonholonomic systems, Scleronomic and Rheonomic systems Generalized Potential, Lagrange's equations of first kind Lagrange'equations of second kind, Energy equations for conservative fields.

Hamilton's variables, Hamilton canonical equations, Cyclic coordinates, Routh's equations.

Hamilton's Principle, Principle of least action, Hamilton-Jacobi equation, Jacobi theorem, Method of separation of variables, Lagrange Brackets, Poisson Brackets, Invariance of Lagrange Brackets and Poisson Brackets under canonical transformations.

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M.A./M.Sc. (Final)
Mathematics
PAPER-III
OPERATIONS RESEARCH

Operations Research and its scope. Necessity of Operations Research in Industry. Linear Programming- Simplex method, Theory of the simplex method, Duality and sensitivity Analysis.

Other Algorithms for Linear Programming- Dual simplex method, Parametric Linear Programming, Upper Bound Technique, Interior Point Algorithm, Linear Goal Programming.

Transport and Assignment Problems. Problems of sequencing n jobs on 2 machines, 2 jobs on m machines.

Network Analysis- Shortest path problem, Minimum spanning tree problem, Maximum flow problem, Minimum cost flow problem, Network simplex method. Project planning and control with PERT-CPM.

Game Theory- Two-Person zero-sum Games, Games with mixed strategies. Graphical solution. Solution by Linear Programming.

Integer Programming- Branch and Bound Technique.

Nonlinear Programming- One and Multivariable. Unconstrained Optimization. Kuhn-Tucker conditions for constrained optimization. Quadratic Programming.

M.A./M.Sc. (Final)
Mathematics
PAPER-IV (Optional)

Any one of the following papers-

M.A./M.Sc. (Final)
Mathematics
PAPER-IV (A)
PROGRAMING IN JAVA

Introduction of Java, difference between java and C++, Features of Java, Security, Portability, Evolution of Java and its effect on internet, Garbage collection, JVM and byte code.

Object oriented programming, Robust, Multithreaded Architecture, concept of OOP's, control statements, data types, operators, loops, introduction to classes, subclasses, base classes, derived classes, arrays, nested loops, string.

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Constructors and its types, declaring objects, introduction to methods with parameters and return value.

Inheritance and its types, interface, abstract class, method overriding, use of final with inheritance, packages.

Exception handling, types of exception, use of try and catch, built-in functions, string handling, multi-threading, file handling.

M.A./M.Sc. (Final)
Mathematics
PAPER-IV (B)
ADVANCED FUNCTIONAL ANALYSIS

Definition and example of topological vector spaces. Convex and absorbing sets and their properties. Minkowski's functional subspace, product space and quotient space of a topological vector space.

Locally convex topological vector spaces, Normable and metrizable topological vector spaces, complete topological vector spaces and Frechet spaces.

Linear transformation and linear functionals and their continuity, finite-dimensional topological vector spaces, Linear Varieties and Hyperplanes, Geometric from of Hahn-Banach theorem. Uniform–boundedness principle. Open mapping theorem and closed graph theorem for Frehet spaces. Banach-Alaoglu theorem.

Extreme points and External sets. Krien-Milman's theorem.

Duality, Polar, Bipolar theorem. Baralled and Bornological spaces. Macekey spaces, Semi-reflexive and reflexive topological vector spaces. Montel spaces and Schwarz spaces. Quasi completeness, Inverse limit and inductive limit of locally convex spaces distributions.

M.A./M.Sc. (Final)
Mathematics
PAPER-IV (C)
MAGNETO FLUID DYNAMICS

Maxwell's electromagnetic field equations. Equations of motion of a conducting fluid. Energy Equation. Magneto fluid dynamics approximations. properties of MFD equations. MFD equations for special cases. Magnetic Reynolds number. Boundary conditions. Alfven's theorem. Magnetic body force. Ferraro's law of isorotation.

One dimensional flows- Quasi one dimensional assumptions. Equations of continuity. Equations of motion and energy. Steady flow of inviscid, viscous and heat conducting fluids.

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Viscous flows- Hartmann flows. Hydromagnetic Couette flow. Hydromagantic flow through an annulus. MFD pipe flow. MFD boundary layer approximations. MFD flow past on infinite flat plate. MFD flow past a semi-infinite flat plate. MFD Raleigh problem.

MFD wave phenomena- Electromagnetic waves. gas dynamic waves. Magneto gas dynamic waves. Sub and super Alfvern's waves. Waves of finite amplitude. Normal and oblique MFD shock waves.

MFD Applications- Astrophysical and geophysical applications. MFD ejectors. MFD accelerators. MFD Lubrication. MFD power generation.

M.A./M.Sc. (Final)
Mathematics
PAPER-IV·(D)
FUZZY SETS AND THEIR APPLICATIONS

Fuzzy sets- Basic definition. α–level sets. convex fuzzy sets. Basic operations on fuzzy sets. Types of fuzzy sets. Cartesian product. Algebraic product. Bounded sum and deference. t-norms and t-conorms.

The Extension principle- The Zadeh's extension principle, Image and inverse image of fuzzy sets. Fuzzy numbers. Elements of fuzzy arithmetic.

Fuzzy Relation and Fuzzy Graphs- Fuzzy relations of fuzzy sets. Composition of fuzzy relations, Min-Max composition and its properties. Fuzzy equivalence relations. Fuzzy compatibility relations. fuzzy relation equations. Fuzzy graphs. Similarity relation.

Possibility Theory- Fuzzy measures. Evidence theory. Necessity. Possibility measure, possibility distribution. Possibility theory and fuzzy sets. possibility theory versus probability theory.

Fuzzy Logic- An overview of classical logic, Multivolume logic. fuzzy propositions. Fuzzy quantifiers. Linguistic variables and hedges. Inference from conditional fuzzy propositions, the compositional rule of inference.

Approximate Reasoning- An overview of fuzzy expert system. Fuzzy implications and their selection. Multi conditional approximate reasoning. The role of fuzzy relation equation.

An introduction to fuzzy control—Fuzzy controllers. Fuzzy rule base. Fuzzy inference engine. Fuzzification, Defuzzification and the various defuzzification methods (the centre of area, the centre of maxima and the mean of maxima methods).

Decision Making in Fuzzy Environment- individual decision making. Multiperson decision making. Multicriteria decision making. Multistage decision making. Fuzzy ranking methods. Fuzzy linear programming.

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M.A./M.Sc. (Final)
Mathematics
PAPER-V (Optional)

Any one of the following papers-

M.A./M.Sc. (Final)
Mathematics
PAPER-V(A)
PROGRAMMING WITH VISUAL BASIC

Data type, constants, operators, control statements, loop instructions, arrays, input-output instructions, functions and subroutines, predefined functions, debugging of the program, sequential and random files. Fundamentals of graphics, screen scales, lines and boxes, circles, ellipse and pie charts.

M.A./M.Sc. (Final)
Mathematics
PAPER-V(B)
ADVANCED RIEMANNIAN GEOMETRY

Hypersurfaces : Unit normal. Generalised convariant differentiation. Gauss's formulae. Curvature of a curve in a hypersurface. Normal curvature. Mean curvature. Principal normal curvature. Lines of curvature. Conjugate and asymptotic directions. Tensor derivative of the unit normal. Gauss characteristic equation and Mainardi-Codazzi equations. Totally geodesic hypersurfaces.

Subspaces: Unit normals. Gauss's formulae. Change from one set of normals to another. Curvature of a curve in subspace. Conjugate and asymptotic directions. Generalisation of Dupin's theorem. Derived vector of a unit normal. Lines of curvature for a given normal.

Lie derivative: Infinitesimal transformation. The notion of Lie derivative. Lie derivative of metric tensor and connection. Motion and affine motion in Riemannian spaces.

Hypersufaces in Euclidean space: Hyperplanes. Hyperspheres. Central quadric hypersurfaces. Reciprocal quadric hypersurfaces. Conjugate radii. Any hypersurface in Euclidean spaces. Riemannian curvature of a hypershpere. Geodesics in a space of positive constant curvature.

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M.A./M.Sc. (Final)
Mathematics
PAPER-V(C)
GENERAL RELATIVITY AND COSMOLOGY

General Relativity – Transformation of coordinates. Tensors, Algebra of tensors. Symmetric and Skew–symmetric Tensors. Contraction of tensors and quotient laws.

Riemannian metric. Parallel transport. Christoffel symbols. convariant derivatives. Intrinsic derivatives and geodesics. Riemann Christoffel curvature tensor and its symmetry properties, Bianchi identities and Einstein tensor.

Review of the special theory of relativity and Newtonian theory of gravitation. principle of equivalence and general covariance, geodesic principle. Newtonian approximation of relativistic equations of motion. Einstein's field equations and its Newtonian approximation.

Schwarzschild external solution and its isotropic forms. Planetary orbits and analogues of Kepler's Laws in general relativity, Advance of perihelion of a planet. Bending of light rays in a gravitational field. gravitation shift of spectral lines.

Energy-momentum tensor of a perfect fluid, Schwarzschild internal solution, boundary conditions, energy momentum tensor of an electromagnetic field. Einstein-Maxwell equation, Reissner-Nordstrom solution.

Cosmology- Mach's principle. Einstein modified field equations with cosmological term. static Cosmological models of Einstein and De-Sitter, their derivation, properties and comparison with the actual universe.

Hubble's law, cosmological principles, Weyl's postulate, derivation of Robertson-Walker metric, Hubble and deceleration Parameters. Redshift, Redshift versus distance relation, Angular size versus redshift relation and source counts in Robertson-Walker space time.

Friedman models. Fundamental equations of dynamical cosmology. critical density. closed and open universes. Age of the Universe. Matter dominated ear of the universe. Einstein-de-Sitter model. Particle and even horizons.

M.A./M.Sc. (Final)
Mathematics
PAPER-V(D)
APPLICATION OF MATHEMATICS IN FINANCE

Financial Management: An overview. Nature and scope of financial management. Goals of financial management and main decision of financial management. Difference between risk, speculation and gambling.

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Time Value of Money: Interest rate and discount rate. Present value and future value-discrete case as well as continuous compounding case. Annuities and its kinds.

Meaning of returns: Return as Internal Rate of Return (IRR). Numerical methods like Newton-Rapshon method to calculate IRR. Measurement of returns under uncertainity situations.

Meaning of risk: Difference between risk and uncertainty. Types of risks. Measurement of risk. Calculation of security and Portfolio Risk and Return-Morkowitz Omdel. Sharpe's Single Index Model-Systematic risk and Unsystematic Risk. Taylor Series and Bond Valuation. Valuation. Calculation of Duration and Convexity of Bonds.

Financial Derivative: Futures. Forwards. Swaps and Options. Call and Put Option. Call and Put Parity theorem. Pricing of contingent claims through Arbitrage and Arbitrage theorem.

Pricing by Arbitrage: A Single Period Option Pricing Model. Multi Period Pricing Model-Cox-Ross-Rubinstein Model. Bounds on Option Prices.

M.A./M.Sc. (Final)
Mathematics
PAPER-VI
Viva-voce

R. B. Srivastava

13.07.2011

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