M.A./M.Sc.(Previous) Mathematics

Examination – 2013

Paper – I

ALGEBRA

Duration of Paper : 3:00 hours **Max. Marks:** 100

Note : The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Groups: Law of isomorphism. Direct products of groups. Theorems related to composition series. Jordan-Holder theorem. Definition of P-Group H-Conjugate Cauchy's theorems for finite Abelian and finite group. Sylow's theorems for abelian groups, solvable groups. \

Unit 2: Rings and Fields of Extension: Theorems on endomorphism of an abelian group. Direct product of rings. Polynomials rings, Factorisation in integral domain. Theorems related to finite and infinite extension of field. Minimal, Polynomials, Splitting field. Theorems on roots and coefficients of polynomial separable and inseparable extensions.

Unit 3: Canonical Forms: Jordan Matrix, Jordan canonical form, Some decomposition theorems. Jordan normal forms. Definition and examples of linear algebra. Linear transformations. Kernel and range space of a linear mapping Rank and nullity, Singular and non-singular mapping or transformations. Invariance and Reducibility.

Unit 4: Galois Theory: Monomorphism and their Linear Independence. Arten theorem on automorphism, Normal extensions and Fundamental theorem of Galois theory, Radical extensions and solvability by Radicals. Constructions by Ruler and Compass Ring with Chain conditions. Hilbert's Bases theorem. Artinian rings.

Unit 5: Linear transformations and system of linear equations. Quotient transformations. Inner product. Inner product spaces. Algebra of linear operators. Matrix representation of linear operators. Dual spaces. Unitary and normal operators. Matrices of linear transformations with respect of different bases.

BOOKS RECOMMENDED

Surjeet Singh and Qazi Zammeruddin: Modern Algebra

Aggarwal, R.S.: Modern Algebra

Shanti Narain: Abstract Algebra

Raisinghania, N.D. : Modern Algebra

Kofman, Kunj, Linear Algebra

M.A./M.Sc.(Previous) Mathematics

Examination – 2013

Paper – II

ANALYSIS

Duration of Paper : 3:00 hours **Max. Marks:** 100

Note : The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Sequences and their convergence, Cantors' theory of real numbers. Power sets. Discontinuous functions: their types and properties, Henie Borel Theorem, Examples of non-differentiable functions, Continuity and differentiability of function of more than one variable.

Unit 2: Jacobians, Uniform Convergence of series and products, Weierstrass's M - Test. Continuity and uniform convergence. Uniform convergence and integration. Uniform convergence and differentiation.

Unit 3: Definition of measure, Definition of Lebesgue outer measure, Measure of sets, Non-measurable sets, Exterior and interior measure of linear sets and their simple properties, Measurable functions. Definition of Lebesgue Integral of a bounded measurable function, Comparison of Lebesgue and Riemann Integral.

Unit 4: Lebesgue theorem of bounded convergence, Egoroff's theorem. Lebesgue Integral of unbounded function, Elementary properties of Integrals, Definition and simple properties of function of bounded variation and absolutely continuous functions. Definition of Reimann-Stieltjes Integral.

Unit 5: The Lebesgue set, Integration by parts, The second mean value theorem, The Lebesgue class Lp, Schwarz's inequality, Holder's inequality, Holder's inequality for sums, Minkowskis's inequality. Integration of a function of Lp, mean convergence for the function of the class Lp.

BOOKS RECOMMENDED

Philips, E.G.: A Course of Analysis

Rudin, W.: Principles of Mathematical Analysis, ed.3, McGraw Hill, International Student Edition, 1976

Shanti Narayan: Mathematical Analysis

Royden, H.L.: Real Analysis

E.C. Titchmarsh: The Theory of Functions

I.P. Natanson: Theory of Functions of Real Variable

M.A./M.Sc.(Previous) Mathematics

Examination – 2013

Paper – III

DIFFERENTIAL EQUATIONS AND HYDRODYNAMICS

Duration of Paper : 3:00 hours **Max. Marks:** 100

Note : The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1 : Classification of second order partial differential equations, solutions of Laplace, Wave and Heat conduction equations, Fourier series with application to simple boundary value problems on wave and heat conduction equations.

Unit 2 : Kinematics of fluids in motion, Lagrange's and Euler's methods, Stream lines and path lines, Velocity potential. Vorticity vector, Equation of continuity in orthogonal curvilinear, Cartesian, spherical polar and cylindrical coordinates, Boundary surface condition.

Unit 3 : Euler's equations of motion, Bernoulli's equation, Impulsive motion, Two dimensional motion, complex potential. Motion of a circular cylinder in perfect liquid and motion of liquid past through a circular cylinder.

Unit 4 : Source, sinks and doublet; and their images in two dimensions. Motion of Sphere in perfect liquid and Motion of liquid past sphere. Milne Thomson circle theorem. Theorem of Blasius.

Unit 5 : Viscosity, Navier-stoke's, equations of motion for viscous incompressible flow. Dynamical similarity, Dimensional analysis. P-Buckimgham theorem. Physical importance of non-dimensional parameters. Renold's number, Prandtl number. Mach number, Froude Number, Nusselt number. Some exact solutions of N-S. equations, Plane Couette flow. Plane Poisseulle flow, Generalized plane Couette flow, Haigan-Poisseulle flow through circular pipe.

BOOKS RECOMMENDED

Chaturvedi, J.C. and Ray, M.: Differential Equations
Bansal, J.L. and Dharmi, H.S.: Differential Equations Vol. II, An Elementary Treatise Differential Equations.
Arnold, V.I.: Ordinary Differential Equations, MIT Press, Cambridge, 1981
Scheter, M.: Modern Methods in Partial Differential Equations, Wiley Eastern, Delhi, 1985.
Bansi Lal: Theoretical Hydrodynamics
Milne-Thomson: Theoretical Hydrodynamics
Ray, M.: A Text Book of Fluid Dynamics
Chorlton, F.: Text Book of Fluid Dynamics
Bansal, J.L. : Viscous Fluid Dynamics

M.A./M.Sc.(Previous) Mathematics

Examination – 2013

Paper - IV

Special Functions and Integral Transforms

Duration of Paper : 3:00 hours **Max. Marks:** 100

Note : The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Hypergeometric functions: Definition of the Hypergeometric series and function. Properties of hypergeometric functions. Integral formula for hypergeometric series, Linear transformations, Contiguous function relations.

Unit 2: Linear relations between the solutions of hypergeometric differential equation. Kummer's confluent hypergeometric function. Elementary properties of generalized hypergeometric function ${}_pF_q$.

Unit 3 : Legendre Polynomials and Bessel Functions: Legendre's differential equation and its series solution, Generating Function of Legendre's polynomials $P_n(x)$, Orthogonality, Laplace's First and Second Integral for $P_n(x)$, Rodrignue's formula, Recurrence Relations.

Bessel's equation and its solution; Bessel function of the first kind, Generating function for $J_n(x)$, Recurrence relations, Integral representations for $J_n(x)$, Addition formula for the Bessel functions, Orthogonality.

Unit 4 : Classical Orthogonal polynomials: Generating function and other properties associated with Hermite, laguerre Polynomials.

Unit 5 : Fourier sine and consine transforms, Fourier transforms and its properties, Hankel and Mellin transform and their properties.

BOOKS RECOMMENDED

Sneddon, I.N.: Use of Integral Transforms
Rainville, E.D.: Special Functions, Macmillan and Co., New York 1960.
Sneddon, J.N.: Special Functions of Mathematical Physics and Chemistry, Oliver and Byod, 1961.
Watson, G.N.: A Treatise on the Theory of Bessel Functions, Cambridge University Press, 1931
Labedye, N.N.: Special Functions and their Applications, Dover, 1972.
Saxena, R.K. and Gokhroo, D.C.; Special Functions, Jaipur Publishing House.

M.A./M.Sc.(Previous) Mathematics

Examination - 2013

Paper - V

Analytical Dynamics and Numerical Analysis

Duration of Paper : 3 Hours **Max. Marks: 100**

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1 : Motion in two dimensions under impulsive forces. Conservation of linear and angular momentum under finite and impulsive forces.

Unit 2 : Lagrange's equations for finite as well as impulsive forces. Normal co-ordinates and normal modes of vibration. Motion in three dimensions. Euler's dynamical equation for the motion of a rigid body and problems related to no external forces.

Unit 3 : Calculus of variations; Linear functionals, Minimal functional theorem, general variation of a functional. Euler-Lagrange equation, Various fundamental problems including isoperimetric problems of calculus of variations. Variational Methods of solving Boundary value problems in ordinary and partial differential equations.

Unit 4 : Hamilton's canonical equations of motion. Hamilton's principle and principle of least action canonical transformations. Poisson brackets and their properties. General equations of motion in terms of Poisson brackets. Lagrange's brackets and their properties.

Unit 5 : Various methods of solving ordinary differential equations, Euler's method, Picard's method, Runge-Kutta method. Milne's method. Methods of solution of partial differential equations. Iteration methods.

BOOKS RECOMMENDED

Loney, S.L.: An Elementary Treatise on the Dynamics of a Partice and Rigid Bodies, Cambridge University Press.
Ray,M.: Dynamics of Rigid Bodies, Students Friends and Co.
Smart, E.H.: Advanced Dynamics, Vol.II, Macmillan
Gupta, P.P.: Dynamics of Rigid Bodies II, Jaiprakash Nath, Agra
Soarborough, James, B.: Numberical Analysis
Freeman, H.: Finite Differences and Mathemaics for Acturial Students
Richardson,H.C.: Calculus of Finite Differences
Elsgotts, L.E.: Calculus of Variations
Bansal, J.L.: Dynamics of a Rigid Body, Jaipur Publishing Co.,
Saxena, H.C.: Finite Differences and Numerical Analysis.

M.A./M.Sc.(Final) Mathematics

Examination 2014

Paper – I

COMPLEX ANALYSIS AND TOPOLOGY

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1 : Conformal transformations Schwarz Christoffel transformation, Principle of maximum and minimum modulus, Principle of Argument. Schwartzs' lemma, Rouche's theorem, Fundamental theorem of Algebra.

Unit 2 : Expansions of a meromorphic function, Mittag-Leffer's theorem, Analytic continuation. Taylor's and Laurent's theorem. Poles and Singularities. Theory of residues. Contour integration.

Unit 3 : Harmonic Functions: Definition, Basic Properties, Maximum Principle (First Version), and (second Version), Minimum Principle, Harmonic functions on a disc, Harnack's inequqality and theorem, subharmonic and superharmonic functions and maximum principle (3^{rd} and 4^{th} versions).

Univalent Functions: Definition and examples, Theorems on univalent functions, Bieberbach Conjecture.

Unit 4 : Definition of topological spaces by using open sets, Characterization in terms of closed sets and interior closure and neighborhood operators, Frontier of a set, Sub-space. Bases and sub-bases, dense subsets. Connected spaces.

Unit 5 : Continuous functions, closed and open functions. Homomorphism, First and Second axioms of countability. Separable spaces. Lindeloff spaces. T_0, T_1 and T_2 spaces. Regular and normal spaces.

BOOKS RECOMMENDED

Shanti Narayan: Theory of Functions of z Complex Variable

Jain, R.N.: Functions of Complex Variable.

Phillips, E.G.: Functions of a Complex Variable with Applications.

Ahifors, L.V.: Complex Analysis, McGraw Hill, Koga-Kusha. Int. Student ed., 1979.

Kelley, J.L.: General Topology, Affiliated, East-Est Press.

Pervin, W.J. Foundation of General Topology, Acad. Press.

Chauhan, J.P. Complx Analysis (2006) Kedar Nath Ram Nath.

Mathows, J.H.; Howell, R.W. Complex Analysis,

Narosa Publishing House (2006).

M.A./M.Sc.(Final) Mathematics

Examination - 2014

Paper – II

Differential Geometry and Tensor Analysis

Duration of Paper : 3 Hours **Max.Marks: 100**

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Curves in Space: Definition of unit tangent vector, tangent line, Normal line and Normal plane. Contact of a curve and a surface. Equation of osculating plane. Fundamental unit vectors, equations of fundamental planes. Curvature, Torsion and skew curvature vectors. Serret-Frenet formulae and their applications.

Unit 2: Definition and properties of the osculating circle and osculating spheres. Bertrand curves and their properties. Involute and evolute of space curves. Envelope of family of surfaces. Ruled surfaces: Definition and properties of developable and skew surfaces.

Unit 3: Parametric representation of a surface. First and Second fundamental forms and magnitudes of various surfaces. Orthogonal trajectories. Definition and Differential equation of lines of curvature (Excluding theorms). Definition and equation of curvature and torsion of asymptotic lines. Beltrami-Enneper Theorem. Fundamental equations of Surface Theory: Gauss equations, Gauss Characteristic equatiions, Weingarten equations and Mainardi-Codazai equations.

Unit 4 : Geodesics: General differential equation of various standard surfaces. Notations and definitions of contravariant and covariant tensors of first and second order. Mixed tensors, higher order tensors. Contraction and Quotient law for tensors. Symmetric and skew symmetric tensors. Metric [Fundamental] tensor, conjugate metric tensors. Definitions and properties of first and second kind of Christoffel's symbols.

Unit 5 : Laws of transformation of Christoffel's symbols. Covariant derivatives of contravariant and covariant tensors of first and second orders. Laws of covariant differentiation. Ricci's Theorem. Definition and properties of Riemann-Christoffel's tensor. Definition and properties of covariant curvature tensor. Contraction of Riemann-Christoffel Tensor-Ricci tensor.

BOOKS RECOMMENDED:

Bansal, J.l. and Sharma, P.R.: Differential Geometry: Jaipur Publishing House (2004).
Thorpe, J.A.: Introduction to Differential Geometry, Springer-verlag.
Slemberg, S.: Lectures on Differential Geometry, P.H.I. (1964).
Docarmo, M.: Differential Geometry of Curves and surfaces, P.H.I. (1976).
Bansal, J.L.: Tensor Analysis, Jaipur Publishing House, (2004).
Gupta, P.P. and Malik, G.S.: Three Dimensional Differential Geometry, Pragati Prakashan, Meerut.

M.A./M.Sc.(Final) Mathematics
Examination 2014
PAPER – III
FUNCTIONAL ANALYSIS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Metric Spaces: Definition and Examples of Metric Spaces, Open and Closed Sets, Neighborhoods Interior, Limit and isolated points, subspace of a metric space, product spaces. Completeness: Convergent sequences, complete spaces, Dense Sets and Separable spaces, Baire's Category theorem. Compactness: Compact Spaces and Sets, Sequential compactness, Heine-Borel theorem, Equivalence of compactness and sequential compactness, continuous mappings.

Unit 2: Normed spaces and their properties. Banach Spaces. Quotient spaces of Banach Space, Finite dimensional normed spaces and subspaces, Linear operators, Linear Operators and functionals on finite dimensional spaces, Normed Spaces of Operators – Dual space: Space B (x,y), Completeness theorem.

Unit 3: Fundamental Theorems for Normed and Banach Spaces: Zorn's lemma, Hahn-Banach theorem, Hahn-Banach theorem for complex vector spaces and normed spaces, Reflexive operator, Definitions of strong and weak convergences, Lemma for weak convergence, Lemma for weak convergence for the space l^p, strong and weak convergence theorem, Open mapping theorem, Closed graph theorem, Convergence of sequences of operators and functionals.

Unit 4: Inner spaces; Hilbert Spaces: Definitions of Inner Product space, Orthogonality, Euclidean Space R^n, unitary space C^n, Space L^2 [a,b], Hilbert sequence space l^2, space l^p and space C[a,b]; Properties of inner product spaces, Orthonormal sets and sequences, Representation of functionals on Hilbert spaces, Hilbert-Adjoint operator.

Unit 5: Spectral theory of Linear Operators in Normed spaces and of Bounded Self-Adjoint Linear Operators: Definitions: Eigenvalues, Eigevectors, eigenspaces, spectrum and, resolvent set of a matrix; Theorems: Eigenvalues of an operator, closed spectrum theorem, representation theorem. Hilbert – Adjoint operator, Eigenvalue and eigenvector theorem, Norm Theorem, Theorem on product of positive operators, monotone sequence, positive square root, projection, product of projections.

BOOKS RECOMMENDED

1. Kreyszig, E. Introductory Functional Analysis with Applications, John Wiley & Sons (1978).
2. Somasundaram, D.A. First Course in Functional Analysis, Narosa Publishing House, Delhi (2006).
3. Taylor, A.E. Introduction to Functional; Analysis, John Wiley & Sons (1958).
4. Choudhary, B. and Nanda, S. Functional Analysis with Applications, Wiley Eastern Limited, Delhi (1989).
5. Rudin, W. Functional Analysis, Tata McGraw-Hill Publ. Co. Ltd., Delhi (1977).
6. Jain, P.K. and Ahmad, Khalil, Metric Spaces, Narosa Publishing House (1996).
7. Copson, E.T. Metric Spaces, Universal Book Stal, Delhi (1989).
8. Berberian, S. Introduction to Hilbert Space, Oxford University Press, Oxford (1961).
9. Edwards, R.E. Functional Analysis Theory and Applications, Dover Publications, Inc. (1995).

M.A./M.Sc.(Final) Mathematics

Examination 2013

PAPER – IV & V

(Any two of the following electives, choosing one from each group given on Page No. 3)

(i) INTEGRAL EQUATIONS AND BOUNDARY VALUE PROBLEMS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Linear integral equations of the first and second kind of Fredholm and Volterra. Types, Solution by successive substitution and successive approximations, solution of integral equation by Resolvent Kernel.

Unit 2: Able's problems, Method of Fredholm determinant's Solutions equatioin with separable Kernels, the Fredholm alternative. Hilbert-Schmidt theory by symmetric. Kernels characteristics numbers and eigen functions, Singular integral equations.

Unit 3: Approximate methods of solving integral equations replacing the Kernel by a degenerate Kernel, the Budow Galerking method, Approximate methods for finding characteristic numbers. Ritz method, method of traces and Kallogg's method.

Unit 4: Applications of Fredholm theory in free vibrations of an Elastic String, constrained vibrations of an elastic strings, Auxiliary theorems on Harmonic functions, Logarithmic potential of a double layer.

Fredholm's solution of Dirichiet's and Newmann's problems. Boundary value problems, Separation of variables.

Unit 5: Application of the Hilbert-Schmidt theory, Boundary problems for ordinary linear differential equations, Vibration problems, Flow of heat in a Bar, Wave equation, Diffusion equation and use of integral transforms.

BOOKS RECOMMENDED

W.V.Lovaitt: Linear Integral Equation, Dover Publications, 1950.

Krasnov, Kiselev and MakrankoL Problem and Exercises in Integral Equations, Translated by G. Yankovsky, Mir Publishers, Moscow, 1971.

Mikhlim, S.G.: Integral Equations, Pergamon, Oxford, 1957

Triconi, F.D.: Integral Equations, Interscience, New York, 1957.

(ii) LINEAR OPERATIONS IN HILBERT SPACE

Duration of Paper : 3 Hours **Max. Marks : 100**

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Linear spaces. The scalar product, Hilbert space, Linear manifolds and subspaces. The distance from a point to a subm space, Projection of a vector on a subspace. Orthogonalization of a sequence of vectors Complete orthonormal systems. The space L^2 and complete orthonormal system in Ll^2.

Unit 2: Linear functionals. The theories of F Riesz. A criterion for the closure in H of given system of vectors. A Lamma concerning convex functionals Bounded linear operators. Bilinear functions. The general form of a Bilinear functional adjoint operators. Weak convergence in H weak compactness.

Unit 3: A criterion for the boundedness of an operator, Linear operators in a separable space. Complete continuous operators. A criterion for complete continuity of an operator. Sequence of bounded Linear Operators. Definition of a projection operator. Properties of projection operators. Operations involving projection operators, Monotone sequences of projection operators.

Unit 4: The aperture of two linear manifolds. Unitary operators Isometric operators. The Fourier-Plan-Cherel operator. Closed operators. The general definition of an adjoint operator. Eigen vectors. Invariant subspaces and reducibility of linear operators. Symmetric operators. Isometric and unitary operators.

Unit 5: The concept of the spectrum. The resolvent conjugation operators. The graph of an operator. Matrix representation of unbounded symmetric operators. The operation of multiplication by the independent variable

BOOKS RECOMMENDED

Akhiezer, N.I. and Glazman, I.M.: Theory of Linear Operation in Hilberts Space.

Translated from the Russian by Merlyind Nestell, Vingar Pub. Co., New York.

(iii) GENERALIZED FUNCTIONS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Definition and simple properties of generalized functions, Functional and generalized functions.

Unit 2: Differentiation and integration of generalized functions, Regularization of functions of algebraic singularities.

Unit 3: Associated functions, Convolution of generalized functions, Elementary solutions of differential equations with constant coefficient.

Unit 4: Fourier Transforms of generalized functions. Fourier transform of test function, Fourier transforms of generalized functions of one and several variables. Fourier transform and differential equations.

Unit 5: Particular type of generalized functions: Generalized functions concentrated on smooth monifolds of lower dimension. Generalized functions associated with Quadratic form. Homogeneous functions Arbitrary functions raised to a power.

BOOKS RECOMMENDED

Gellifand, I.M. and Shilvo, G.C.: Generalized functions, Vol. I. Acad. Press. 1964.

Fredman, A.: Generalized Functions and Partial Differential Equations,

Prentice Hall. Inc., Englewood Cliffs, N.J., U.S.A., 1963.

(iv) MAGNETO FLUID DYNAMICS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Fundamental Equations of MFD:

(i) Electromagnetic field equations: Charge conservation equation. Maxwell's equations, constitutive equations, Generalized Ohm's law.

(ii) Fluid dynamics field equations: Equation of State, Equations of motion, Equation of energy.

(iii) MFD approximations, Magnetic field equation Magnetic Reynolds number, MFD equations for special cases. Alfven's theorem, Magnetic energy, Electromagnetic stresses, force-free magnetic fields.

Unit 2: Basic equations for MHD flow, MHD boundary conditions, MHD flow between parallel plates. Hartmann flow. Hydromagnetic Couette flow (Velocity and temperature distributions). MHD flow in a tube of rectangular cross-section, MHD pipe flow.

Unit 3: MHD flow in an annular channel, MHD flow between two rotating coaxial cylinders, MHD boundary layer approximations. Two dimensional MHD boundary layer equations for flow over a plane surface for fluids of large electrical conductivity. MHD boundary lawyer flow past a semi infinite rigid flat plate in an aligned and Transverse magnetic field. Two-dimensional thermal boundary layer equations for flow over a plane surface, Heat transfer in MHD boundary layer flow past a flat plate in an aligned magnetic field.

Unit 4: MHD waves, waves in an infinite fluid of infinite electrical conductivity, Alfven waves. MHD waves in a compressible fluid. Reflection and Refraction of Alfven waves, MHD waves in the presence of dissipative effects. Hydromagnetic shock waves, stationary plane shock waves in the absence of a magnetic field, plane hydromagnetic shock waves, plane shock waves advancing into a stationary gas.

Unit 5: Motion of a charged particle in uniform static electric and magnetic fields. Magnetic moment, Particle drifts in an inhomogeneous magnetic field. Drifts produced by a field of force. MHF Applications. Astrophysical and geophysical applications, MFD ejectors, MFD accelerators, MFD Lubrication, MFD thin Airfoil, MFD Power generation.

BOOKS RECOMMENDED

Bansal, J.L.: Magnetofluiddynamics of Viscous fluids, Jaipur Publishing House, Jaipur, India

Farraro, V.C.A. and Plumpton, C.: Magnetofluidmecbanics Jeffereys, A.; Magnetohydrodynamics

Cowing, T.G.: Magnetohydrodynamics

Cramer, K.R. and Pai S.I.: Magnetofluiddynamics for Engineers and Physicists, Scripta Publishing Company, Washington, D.C., 1973.

Pai, S.I.: Magneto Geodynamics & Plasma Dynamics, Springer-Verlag, New York, 1962.

Shereliff, J.A.: Magnetohydrodynamics, Pergamon Press, London, 1965.

Charlton, P.: Text Book on Fluid Dynamics, CBS Publications, Delhi, 1985.

Rathy, R.K.: An Introduction to fluid dynamics Oxford & IBH Publishing Company, New Delhi, 1976.

(v) LAMINAR VISCOUS FLOW THEORY

Duration of Paper : 3 Hours **Max. Marks : 100**

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Fluid, Continuum hypothesis. Constitutive equation for Newtonian fluids, Navier-stoke's equations for viscous compressible flow. Vorticity and Circulation, Equation to energy. Some exact Solutions; Flow between two concentric rotating cylinders, stagnation in two dimensional flow. Flow due to a plane wall suddenly set in motion (Stoke's first problem). Flow due to an oscillating plane wall (Stoke's first problem).

Unit 2: Temperature distributions in Couette flow, Plane Poissuille flow and Haigen-Poissuille flow in a circular pipe. Theory of very slow motion: Stoke's equation of very slow motion. Stoke's flow past a sphere, stoke's stream function. Oseen equations. Lubrication theory.

Unit 3: Laminar Boundary layers. Two dimensional incompressible boundary layer equations. The boundary layer on a flat plate (Blasuis-Topfer-solution). Similar Solutions of boundary layer equations. Wedge flow, Flow in a convergent channel. Flow in the wake of flat plate. Two dimensional Plane jet flow. Prandtl-Mises transformation and its application to plane jet flow.

Unit 4: Boundary layer separation. Boundary layer on a symmetrically placed cylinder (Blasius series solution) Gortler new series method. Axially symmetrical boundary layer. Mangler's transformation. Three dimensional boundary layers; boundary layer on yawed cylinder. Non-steady boundary layer formation (i) after impulsive start of motion (two dimensional case) and (ii) in accelerated motion.

Unit 5: Karman momentum and kinetic energy integral equations. The Von karman and K Pohlhausen's approximate method for boundary layer over a flat plate.

Thermal boundary layers in two dimensional incompressible flow, Crocco's integrals. Forced convection in a laminar boundary layer on a flat plate. Free convection from a heated vertical plate.

BOOKS RECOMMENDED

Schliching H.: Boundary Layer Theory, McGraw Hill.

Pai, S.I.: Viscous Flow Theory, Vol.I, Laminar Flow, D.Van Nostrand Company, New York, 1956.

Bamal, J.L.: Viscous Fluid Dynamics, Oxford and IBH, 2004.

(vi) FUNDAMENTAL OF OPERATIONS RESEARCH

Duration of Paper : 3 Hours **Max. Marks : 100**

Note: The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Basic concepts of probability. Conditional probability, Bayes' theorem; Basic concepts of Poisson, exponential distributions, Definition, scope and objectives of O.R., Different types of O.R. Models, basic ideas of convex sets Linear programming problems-Simplex Method, two phase method, Duality.

Unit 2: Transportation and assignment problems. Theory of games: Competitive strategies, minimax and maximin criteria, two person zero-sum games with and without saddle point, dominance, fundamental theorem of game.

Unit 3: Inventories: Single item deterministic inventory models with finite and infinite rates of replenishment, economic lot-size model with known demand and its extension allowing backlogging of demand concept of price break, simple probabilistic models.

Unit 4: Replacement problems: Replacement of item that deteriorate, replacement of items that fail completely, group replacement policty, individual replacement policy, mortality tables, staffing problems.

Unit 5: Queing theory-Ques with Poisson input and exponential service time, the queue length, waiting time and busy period in steady state case, model with service in phase, multiserver queueing models.

BOOKS RECOMMENDED

Kanti Swaroop, Gupta, Man Mohan: Operations Research, Sultan Chand and Sons.

Goel and Mittal: Operations Research, Pragati Prakashan

Mittal, K.V.: Optimizadon Methods in O.R. and S. Analysis

Sharma, S.D.: Operations Research

Loomba, N.P.: Linear Programming

Satty, T.L.: Mathematical Methods of Operations Research.

(vii) COMPUTER PROGRAMMING IN C AND FORTRAN
(Only for Non-Computer Science B.Sc. students)

Teaching : 4 Periods (45 minutes each) per week for Theory Paper

2 Periods(45 minutes each) per week for Practical.

Theory Paper	**3 hours duration**	**Max. Marks : 60**
Practical Examination	**3 hours duration**	**Max. Marks : 40**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1 : Computer fundamentals, history of languages, level of languages, algorithms, flowcharts, problem development, types of software's system software, application software, operating system, need of operating system. OS as resource manager, various types of OS like MS Dos, Windows Unix etc. Programming language C: Structure of C Program, identifiers and keywords, data types, constants, arithmetic operations, library functions, expressions, imput/output statements, getchar, putchar, scanf and printf, relational and logical operators, hierarchy of operations and mode of arithmetic operations.

Unit 2 : Transfer of control : if else statement, switch statement, goto statement, iterative statements, while, dowhile, for statements, nested loops, break statements. Array: definition, one dimensional and multidimensional. Functions. Define and accessing function, argument of function, passing argument and array to function, recursion.

Unit 3 : Pointers: Pointer declaration, operation on pointers, pointers to array, array of pointers, passing pointers to a function, user define data types: structures, defining a structure, processing a structure structure and pointers, passing structure to a function. Input/output from file.

Unit 4 : Fortran Programming Preliminaries: Numerical and character constants. Variable names, type specification statements. Arithmetic operations: mode of operation, hierarchy of operations, Unformated and formatted input/output statements. Built in mathematical functions, format specifications. Selective Structure: unconditional and conditional transfer, relation expressions, logical IF, arithmetic IF and nested IF structure statements. DO loops, use of DO statement. Exit from DO loop, CONTINUE statement. Nested DO loops.

Unit 5 : Arrays: Array variables names and their declaration: DIMENSION, statement, Input/output of array variables by implied DO loop. Function and subroutine: Statement Function, Function subprogram and Subroutine subprogram, unlabled COMMON and labled COMMON statements. EQUIVALENCE statement. Input/output from a sequential file. OPEN, CLOSE,REWIND and BACKSPACE statements.

PRACTICAL

Distribution of Marks:

Two practical (15 marks each): 30 Marks

Practical Record : 05 Marks

Viva-voce : 05 Marks

Total : 40 Marks

Programmes on the following topics:

(1) Sorting a numerical and character string data.
(2) Matrix addition, multiplication and inverse.
(3) Solution of linear algebraic equations (Gauss elimination & Jacobi-Iteration method).
(4) Solution of algebraic and transcendental equations by Bisection, False position, Newton-Raphson and iteration methods.
(5) Numerical solution of ordinary Differential Equation by Euler's methods and Runge-Kutta Methods.
(6) Numerical Integration by Trapegoidal, Simpson's and third, Simpson's three eight rule and Weddle's Rule.
(7) Fitting of curves and tabulating a function.

Note : 1. Each candidate is required to appear in the Practical examination to be conducted by internal and external examiners. External examiner will be appointed as per University rules and internal examiner will be appointed by the Head of the Department.

2. Each candidate has to prepare his/her practical record.

3. Each candidate has to pass in Theory and Practical examinations separately.

(viii) PROBABILITY AND STATISTICAL DISTRIBUTIONS

(Only for Non-Statistics students of B.Sc.Final)

Duration of Paper : 3 Hours **Max.Marks: 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit..

Unit 1: Probability, Random Variables & their probability distribution: Probability: Random Experiment, Statistical Regularity, Algebra of events. Classical, relative frequency and axiomatic approaches of probability. Additive law and Bool's inequalities. Conditional probability. Stochastic independence of events. Multiplicative law of probability and Baye's Theorem.

Random Variable (R.V.): Discrete RV. Probability mass function (p.m.f.). continuous r.v. probability density functions (p.d.f). Cumulative distribution function (c.d.f). and its properties. Two dimensional Random Variable. Joint, marginal and conditional, p.m.f., p.d.f. and c.d.f. Independence of random variable.

Unit 2: Expectation of Random Variable and function of r.v. Theorems on Expectation and inequalities, Moments: Factorial moments, Moments about a point A, Raw moments and Central moments. Measurers of Central tendency, Measures of Dispersion, Measures of Skewness and Kurtosis. Moment generating function (m.g.f.), Cumalant generating function (c.g.f.) and characteristic function (c.f.) of random variables. Product moments and Joint m.g.f. of random variables. Convergence of sequence of random variables; Convergence in law (or in distribution), convergence in probability. Convergence in rth moment.

Unit 3: Discrete Distribution. Discrete Uniform distribution. Bernoulli distribution Binomial distribution. Hypergeometric distribution. Poisson distribution. Geometrical distribution. Negative Binomial Distribution,the Power series distribution. The properties and interrelation of these distribution.

Unit 4:Continuous distributions: Continuous uniform distribution, exponential distribution, Gamma distribution, Beta I and II kind distributions, Cauchy distribution, Normal distribution and Double exponential distribution.

Probability distribution of functions of random variables: Moment generating, cumulative distribution and transformation techniques to find distribution of function of random variables.

Unit 5: Truncated distributions, Compound (or composite) distributions and Sampling distributions:

Truncated distribution: Definition of Truncated distribution, Truncated Binomial, Poisson and Normal distributions.

Compound distributions: Definition, practical situation and applications of compound distributions.

Sampling distributions: Random sample, parameter and statistic, standard error, Sampling Distribution of sample mean $\bar{x}$ and variance s^2 from normal population. Chi-square, t and F distributions.

Methods of estimation of parameters: Method of Maximum Likelihood, Method of Moments and Method of Least squares.

BOOKS RECOMMENDED

01. Mathematical Statistics By Parimal Mukhopadhyay (Books and Allied (P.) Ltd.,

02. An Introduction to Probability and Statistics By Vijay K. Rophtgi & A.K. Mod. Ehsanes Saleh.

03. Fundamental of Mathematical Statistics By S.C.Gupta and V.K. Kapoor

(Sultan Chand & Sons).

(ix) THEORY OF LIE ALGEBRAS

Duration of Paper : 3 Hours **Max.Marks: 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit..

Unit 1: Resume of Lie Theory: Local Lie groups. Examples. Local Transformation Group, Examples of Local Transformation group, Examples Representations and Realizations of Lie Algebras.

Unit 2: Representation of Lie Algebras, Realizations of Representations. Representations of $L(O_3)$ G(a,b), the angular momentum operators. Realization of G (a,b) in one and two variables.

Unit 3: Lie theory and Bessel Functions: The representations $Q(w,m_0)$. Recursion relations for the Matrix Elements. Realizations of (w,mo) in two variables, Weisner's Method for Bessel Functions. The reat Euclidean group E3.

Unit 4: Unitary Representations of Lie Groups. Induced Representations of E. The Unitary Representations (p) of E3. The Matrix Elements of (p). The Infinitensimal operators of (p).

Unit 5: Lie Theory and Confluent Hypergeometric Functions: The Representations of $\mathrm{R}\,(w.m.\mu) \uparrow w\mu : w_1\mu \uparrow w_1\mu x \uparrow w_2\mu_2(\lambda.e)x(\lambda',e')I(\lambda',e)(\lambda e)x(\lambda',e'),(e)x((\lambda.e.)$. Differential Equations for the Matrix Elements.

BOOKS RECOMMENDED

Text Books: Willard Miller, Jr. Lie, Theory and Special Functions, Chapter I to 4, - Academic Press, New York and London, 1968.

(x) ADVANCED NUMERICAL ANALYSIS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit..

Unit 1 : Solution of Algebraic and Transcendental Equations: Newton-Raphson method for real multiple roots, for complex roots and for system of non-linear equations; Synthetic Division, Birge-Vieta, Bairstow and Graefre's root squaring methods for polynomial equations.

Unit 2 : Solution of simultaneous Linear Equations and Eigen Value Problems: Direct methods: Gauss-elimination, Gauss-Jordan, Cholesky and Partition method. Iterative Methods: Jacobi iteration, Gauss-seidel iteration and Successive Relaxation method.

Eigenvalue Problems: power method, Jacobi Method and Givin's Method for finding Eigen values of a matrix.

Unit 3 : Curve fitting and Function Approximation: Least square Method, Fitting a straight line, Second Degree Polynomials, Exponential Curves. And Logarithmic Curves. Uniform minimax polynomial approximation, Chebyshev approximations, Chebyshev Expansion, Chebyshev Polynomials. Economization of Power Series.

Unit 4 : Solution of Boundary Value Problem: Finite Difference method. Finite Difference scheme for Linear and Non-Linear Boundary Value Problems. Shooting method. Numerical Solution of boundary value problems of the type $y'' = f(x\, y')$, $y'' = f(x, y, y')$ and $y'' = f(x, y)$.

Unit 5 : Numerical Solution of Partial Differential Equations: Finite difference Approximation to partial derivatives. Solution of Laplace and poisson equations, Solution of one and two-dimensional heat and wave equation by the method of separation of variables. Derivation of Crank-Nicolson method for Parabolic Partial Differential Equation

Books Recommended:

Jain, M.K.,Iyenger, SRK, Jain R.K.:: Numerical Methods for Scientists & Engineering Computations, Wiley Eastern Ltd.,

Jain, M.K. : Numerical Solution of Differential Equations, New Age International.

Shastry, S.S.: Introductory Methods of Numerical Analysis, Prentice Hall India Pvt., Ltd.,

Grewal, B.S. : Numerical Methods in Engineering & Science, Khanna Publishers.
Collatz, L.: Numerical Solution of Differential Equations, Tata McGraw-Hill.
D.S. Chouhan: Numerical Methods, JPH.

M.A./M.Sc.(Previous) Statistics

Examination 2013

There will be four theory papers as given below:

Paper I: Special Functions and Matrix Algebra

Paper II: Probability and Sampling Distributions

Paper III: Statistical Inference

Paper IV: Sampling Techniques and Design of Experiments

Each Paper will be of 100 marks.

Practical: The practical examination will be of 8 hours duration spread over two days. It will be conducted by two separate boards of examiners one for Part A and the other for Part B. Each board of examiners shall award marks out of 100. The marks shall be out of 200 for both the parts and shall be consolidated by the tabulators.

The distribution of marks shall be as follows:

Part A: Practical exercises based on

Paper II and III	75 Marks
Record	15 Marks
Viva-voce	10 Marks
Total	**100 Marks**

Part B: Practical exercises based on

Paper IV	75 Marks
Record	15 Marks
Viva-voce	10 Marks
Total	**100 Marks**

For ex-students the total marks obtained in practical exercises and viva-voce will be converted out of 100 marks.

M.A./M.Sc.(Previous) Statistics
Examination 2013

PAPER – I
Special Functions and Matrix Algebra

Duration of Paper : 3 Hours **Max. Marks: 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1 : Definition of hypergeometric series and functions. Properties of hypergeometric functions. Integral representation for the Gaussian hypergeometric function ${}_2F_1(.)$. Linear transformations and contiguous relations for ${}_2F_1(.)$.

Unit 2 : Linear relation between the solutions of hypergeometric differential equation. Kummer's Confluent hypergeometric function. Elementary properties of the generalized hypergeometric function ${}_pF_q(.)$.

Unit 3 : Legendre Polynomials and Bessel functions of first and second kind, their generating functions, orthogonal properties, recurrence relations.

Unit 4 : Definitions, Generating functions, orthogonality, Rodrigue's formula and recurrence relations related to the classical polynomials like: Legendre Polynomials, Hermite Polynomials and Laguerre Polynomials.

Unit 5 : Eigen value problem, Cayley-Hamilton theorem and its application to compute inverse of a matrix; Eigen vectors, Diagonalization of a matrix, sylvester's theorem, linear dependence and independence of vectors. Differentiation and integration of matrices. Computation of Eigen values by iteration (power) method. Deflation of a matrix, Wielandt's Deflation.

BOOKS RECOMMENDED

1. Rainiville, E.D.: Special Functions. Macmillan & Co. New York (1960).
2. Sneddon, I.N.: Special Functions of Mathematical Physics and Chemistry, Oliver and Byod (1961).
3. Labedev, W.N.: Special Functions and their Applications. Dover, (1972).
4. Saxena, R.K. and Gokhroo, D.C.: Special Functions, Jaipur Publishing House (2004).
5. Santi Narayan, Matrices. S.Chand & Co.

Paper – II

PROBABILITY AND SAMPLING DISTRIBUTIONS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Axiomatic approach to the theory of probability, Random variable (Discrete and Continuous). Cumulative Probability Distribution Function, Probability mass function, probability density function, Joint conditional and marginal distributions, Mathematical expectation and moments, Chebyshev's and Schwartz's inequalities.

Unit 2: A detailed study of discrete probability distribution such as Bernoulli, Binomial, Poisson, Negative Binomial, Hypergeometric, Geometric and Multinomial distributions, Various properties of these distributions and applications.

Unit 3: Continuous probability Distributions: Normal, Lognormal, Beta type I, Beta type II, exponential, double exponential Gamma and Cauchy distribution, Central and non-central chi-square and F-distributions, Fisher's distributions.

Unit 4: Generating functions (m.g.f., c.g.f. and p.g.f.), characteristic functions, inversion theorem; Convergence in probability, Weak and Strong law of large numbers, Various forms of Central limit theorem.

Unit 5: The measure theoretic approach of probability, set-function, Continuity of set-function, additive set-function, measure, measure space, measurable sets, simple functions, elementary functions, measurable functions, measurability theorem.

BOOKS RECOMMENDED

Parimal Mukhopadhyay: Mathematical Statistics, Pub. Books & Allied (P) Ltd.,

Mood, Graybill and Boes: Introduction to the Theory of Statistics, III Edition

Hogg, K.V. and Craig, A.T.: Introduction to Mathematical Statistics

Loeve, M.: Probability Theory

Pitt, L.R.: Integration, Measure and Probability

Kingman and Taylor: Introduction to Probability and Measure

PAPER III

STATISTICAL INFERENCE

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: The general set-up of Statistical decision problem: Concepts of loss function, risk function, admissible decision function. Bayes estimation, Bayes risk, Bayes rule, minimax principle, minimax estimate.

Unit 2: Point estimation, unbiased and consistent estimators, concept of efficient estimators, Cramer-Rao inequality and its use to obtain UMVU estimators, Examples to show-that C-R bound may not be attained. Definition of Sufficiency through conditional distributions and through factorization theorem. Proof of equivalence of the two definitions, Rao-Black-well theorem, jointly sufficient statistics.

Unit 3: Methods of estimation: Maximum likelihood, Method of moments. Parametric Interval estimation: Confidence intervals, one sided confidence interval, Pivotal quantity. Sampling from the Normal distributions. C.I. for mean and variance. C.I. for difference in means. Methods of finding confidence intervals: Pivotal quantity methods, statistical method, large samples, confidence intervals.

Unit 4: Bivariate Normal distribution and its properties. Linear Models: Linear statistical models under normality and non-normality assumptions, point estimation, Gauss-Markov theorem, Tests of hypothesis concerning the parameters of linear regression model.

Unit 5: Testing of hypothesis: Critical region, level of significance, power function, Neyman-pearson Lemma, Large and small tests. The X^2-test for goodness of fit. X^2-test for independence in contingency tables. The Fisher-Irwin test for 2x2 table Non-parametric tests: Sign, run, median, Kolmogorov-Smirnov tests, Wilcoxon signed rank test, Mann-Whitney U-test (Only test procedures and their applications).

BOOKS RECOMMENDED

Kendall, M.G. and Stuart, A: Advanced Theory of Statistics, Vol. I,II

Mukhopadhayay, P.: Mathematical Statistics, Pub. Books & Allied (P.Ltd.,)

Mood, A.M., Graybill and Boes: Introduction to Theory of Statistics, III Ed.

Rotagi, V.K.: Statistics Inference (Wiley and Sons).

PAPER IV

SAMPLING TECHNIQUES AND DESIGN OF EXPERIMENTS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Simple Random Sampling: Estimation of proportions for k(>2) classes, Inverse sampling, Quantitative and Qualitative characteristics, estimation of the sample size. Sampling with varying probabilities with replacement; Sampling with pps: cumulative and Lahiri's methods, estimation of population mean, its variance and estimation of variance.

Unit 2: Stratified Random Sampling; Effects of deviation from optimum allocation, estimation of proportions, post-stratification, inaccuracy in strata sizes construction of strata, combined and separate ratio estimators, their variances and estimation of variances. Linear regression estimation with pre assigned and estimated.

Unit 3: Ratio method of Estimation: Product estimator, Hartley and Ross unbiased ratio type estimation, Quenouille's technique of bias reduction, Multivariate extension. Cluster sampling (Unequal clusters). Estimates of the mean and their variances, sampling with replacement and unequal probabilities.

Unit 4: Concepts of experiments, determination of number of replications, contrasts, Models of analysis of variances, analysis of two-way orthogonal data with m observations per cell, missing plot techniques.

Unit 5: Factorial experiments with factors at two and three levels, complete and partial confounding, split plot design and its analysis, BIBD, construction of simple BIBD.

BOOKS RECOMMENDED

Mukhopadhaya, P.: Theory and Methods of Survey Sampling, Pub. Prentice-Hall of India Pvt. Ltd.,

Sukhatme, P.V. et al.: Sampling Theory of Surveys with Applications

Cochran, W.G.: Sampling Techniques, 3rd ed.

Goon, Gupta and Das Gupta: Fundamentals of Statistics, Vol.II

Joshi, D.D.: Design of Experiments

Goulden: Statistical Methods

PRACTICALS

(A) PRACTICAL EXERCISES BASED ON PAPERS II AND III

1. Fitting of distributions such as:
   Binomial, Poisson, negative binomial, geometric normal, lognormal and exponential distributions.

2. Fitting of curves such as:
   Polynomials, logarithmic and exponential curves

3. Tests of significance based on Barlett-test and Fisher's Z-Transformation.
4. Tests of significance of sample correlation and regression coefficients.
5. Non-parametric tests such as:
   Sign test, run test, median test, Wilcoxon signed rank test, Mannwhitney U-test and Kolmogorov-Smirnov Test.

(B) PRACTICAL EXERCISES BASED ON PAPER – IV

1. Analysis of variance with one-way classifications with single and multiple observations per cell.
2. Analysis of RBD and LSD with missing observations.
3. Analysis of BIBD.
4. Analysis of factorial experiments.
5. Analysis of split plot in RBO
6. Drawing of random samples from finite populations and binomial and normal populations.
7. Estimation of mean and variance in using combined and separate ratio estimators.
8. Gain in precision due to stratification.
9. Estimation of population mean using Linear Regression estimator.
10. Estimation of population mean and variance of sample mean in cluster sampling for equal and unequal probabilities.
11. Estimation of population mean and variance of sample mean and total by ratio product and regression methods of estimation.
12. Drawing of pps samples using cumulative and Lahiri's methods and estimation of population mean and total.

M.A./M.Sc. (Final) Statistics

Examination 2014

There will be two compulsory and two optional papers.

COMPULSORY PAPERS

Paper I: Statistical Inference and Multivariate Analysis

Paper II: Sample Surveys

Paper III:& IV: Optional (Any two of the following):

(i) Operations Research
(ii) Non-parametric Statistical Inference and Sequential Analysis
(iii) Advanced Theory of Design of Experiments
(iv) Stochastic Processes
(v) Mathematical Economics and Econometrics

Each paper will of be 100 marks.

PRACTICALS

The practical examination will be of eight hours (8) duration spread over two days. The distribution of marks will be as follows:

Part (A) (i)	Practical exercises based on Multivariate Analysis, Statistical Inference and Sampling Theory	75 Marks
(ii)	Record	15 Marks
(iii)	Viva-voce	10 Marks
Total		**100 Marks**

For ex-students the total of marks obtained in A (i) and A (iii) will be converted out of 100 marks.

Part B In this part the students will be given a comprehensive theoretical and practical training on computer applications. The distribution of marks will be as follows:

(i)	Writing programs	60 Marks
(ii)	Running programs on Computer	15 Marks
(iii)	Record	15 Marks
(iv)	Viva-voce	10 Marks
	Total	**100 Marks**

For ex-students the total of marks obtained in B (i), B (ii) and B (iv) will converted out of 100 marks.

Total marks for practical including Part A and Part B both = 200 marks.

PAPER I

STATISTICAL INFERENCE AND MULTIVARIATE ANALYSIS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Proof of the properties of maximum likelihood estimators, scoring method. Generalization of Cramer-Rao-Inequality for multi parameter cases, Complete family of probability distributions, Complete statistics and minimal sufficiency, Lehmann-Scheffe theorem on minimum variance and its applications.

Unit 2: Testing of Hypothesis: Composite hypotheses, Generalized likelihood Ratio-Test, Uniformly Most Powerful Test, Monotone likelihood ratio, Unbiasedness, Tests of hypothesis sampling from normal population. Tests for means and variances.

Unit 3: Multivariate normal distribution and its properties, Density function, marginal and conditional distribution, Distribution of quadratic form.

Unit 4: Maximum likelihood estimators of the mean vector and variance, covariance matrix. Null and non-null distributions of partial and multiple correlation coefficient.

Unit 5: Hotelling's T^2 distribution and its properties, Mahalanobis D^2, classification of observations, Wishart distribution.

BOOKS RECOMMENDED

Kendall, M.G. and Stuart, A.: Advanced Statistical Inference, Vol.II

Mood, Grabill and Boes: Introduction to the Theory of Statistics

Anderson, T.W.: An Introduction to Multivariate Statistical Analysis, Second Edition.

PAPER II

SAMPLE SURVEYS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Super Population Models & Model Based Approach: Predictive estimation, p-unbiasedness, e-unbiasedness, Anticipated mean square error, optimality of ratio and regression estimators, Comparison of PPSWR with SRS Double sampling ratio and regression estimators and their variances, cost function. Successive sampling: estimation of mean and its variance (for h = 2).

Unit 2: Concepts of sufficiency, Rao-Blackwelliation, Admissibility and likelihood function in Survey Sampling. Estimator based on distinct units and its variance. Non-existence of uniformly Minimum Variance unbiased estimator. Two stage sampling (equal f.s.u.) estimation of the population mean, its variance and estimate of the variance. Two stage sampling (unequal f.s.u.): Unbiased and biased (excluding ratio estimator) estimators of population mean and their mean square errors.

Unit 3: Ordered estimator: Des Raj's ordered estimator and estimate of the variance (General case), variance of the estimator (for n = 2). Unordered estimator: Murthy's unordered estimator, variance and estimate of the variance. Rao-Hartly Cochran's sampling procedure. Unbiased estimator, its variance and estimate of the variance.

Unit 4: Sampling with unequal probabilities wor: The Narain-Horvitz-Thompson's estimator and its variance, optimal properties of the NHT's estimator, Yates and Grundy's estimate of variance, its non-negativity under Midzuno system of sampling. Small Area Estimation: Direct Estimators, Design based synthetic and composite estimators (under SRSWOR, Stratified Sampling).

Unit 5: Non- sampling errors: Incomplete samples, effects of non-response, Hansen and Hurvitz Technique, Demming's model, Politz and Simon's technique, Randomized response technique, Warner's method.

BOOKS RECOMMENDED

Mukhopadhyay, P.: Theory & Methods of Survey Sampling, Pub., Prentice-Hall of India, New Delhi.

Sukhtme, P.Y. et al.: Sampling Theory of Surveys with Applications.

Cochran, W.G.: Sampling Techniques, III ed.

Murthy, M.N.: Sampling Theory and Methods

Cassel, C.M., Sarndal, C.C. and Wretman, J.H.: Foundations of Inference in Survey Sampling.

PAPER III & IV

(i) OPERATIONS RESEARCH

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Definition and scope of OR, different types of OR models, Linear Programming, convex set and basic feasible solutions of a L.P. model, the geometrical and simplex methods, duality theorem, transportation and assignment problems

Unit 2: Inventory control: Elementary inventory models, economic lot size formulae of Harria in case of known demand and its extension allowing shortages, the case of probabilities demand, discrete and continuous cases.

Unit 3: Replacement problems; replacements of items that depreciate, that fail accounting to probability law, elementary life-testing and estimation techniques of Epstein, staffing problems.

Unit 4: Theory of games; fundamental definitions, strategies minimax solution criterion of two person zero sum games with and without saddle point.

Unit 5: Queueing Theory: The queue with poisson and exponential input, Enlaogian, regular and general service times, the queue length, busy period and waiting time (steady state case), transient solution of MMP.

BOOKS RECOMMENDED

Churchman, Ackoff and Arnoff: Introduction to Operations Research

Sasini, Yaspal and Fiedmen: Operations Research Methods and Problems

Saaty, T.L.: Mathematical Methods of Operation Research

Mckimey: Introduction to Theory of Games.

PAPER III & IV

(ii) NON-PARAMETRIC STATISTICAL INFERENCE AND SEQUENTIAL ANALYSIS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Distribution free and non-parametric methods, order statistics, joint distribution of order statistics, marginal distribution of order Statistics, distribution of median and range, exact moments, confidence interval estimates for population quantities.

Unit 2: Exact null distribution of R, moments of the null distribution of R, tests based on 'total number of runs, chi-square goodness of fit test, empirical distribution-function, Kolmogorov-Smirnov one sample test and its merits and demerits.

Unit 3: Ordinary sign test, Wilcoxon signed rank test, Kolmogorov-Smirnov two sample test, median test.

Unit 4: Sequential analysis: Wald's SPR test, properties of SPRT, OC and ASN functions of SPRT.

Unit 5: Applications of SPRT, Testing of mean of a binomial distribution, testing of mean of a normal distribution with known and unknown standard deviations.

BOOKS RECOMMENDED

Seigel, S.: Non-Parametric Statistics for Behavioural Sciences, Mc-Graw Hill.

Wald, A.: Sequential Analysis

Gibbons, J.D.: Non-Parametric Statistical Inference, McGraw Hill.

(iii) ADVANCED THEORY OF DESIGN OF EXPERIMENTS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Theory of linear estimation, B.I.B.D., construction and analysis with and without recovery of interblock in formation.

Unit 2: P.B.I.B.D. Two associate clssses. P.B.I.B.D. Group divisible designs, triangular designs, Latin square type designs.

Unit 3: Confounding in factorial experiments, confounding in more than two blocks, partial confounding, experiments with factors at three levels, asymmetrical factorials designs, confounded asymmetrical factorial, constructions of balanced confounded asymmetrical factorials.

Unit 4: Orthogonal latin squares, construction of orthogonal latin squares, lattice designs, weighing designs, method of estimation, incomplete block designs as weighing designs.

Unit 5: Analysis of covariance for completely randomized design, randomized block designs and latin square design for non-orthogonal data in two-way classifications and with missing observations.

BOOKS RECOMMENDED

Chakrabarti, M.C.: Mathematics of Design of Experimetns

Joshi, D.D.: Design of Experiments, Wiley Eastern

(iv) STOCHASTIC PROCESSES

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: Discrete stochastic processes, convolutions compound distribution, recurrent events, delayed recurrent random walk models, absorbing, reflecting and elastic barriers.

Unit 2: Gambler's ruin problems and limiting diffusion processes, Markoff chains, transition probability, classification of states and chains, irreducible chains.

Unit 3: Spectral resolution of a matrix, evaluation of p(n) discrete branching process.

Unit 4: Continuous stochastic process, Markoff process in continuous times, Poisson Process, Weiner process, Kolmogorov equations random variable techniques.

Unit 5: Homogeneous birth and death process, divergent birth process, the effect of immigration, the general birth and death process.

BOOKS RECOMMENDED

Feller, W.: Introduction to Theory of Probability, Vol. J, Chaps, XI, XV.

Bailey, N.T.J.: Introduction to Stochastic Processes

Takacs, M.: Stochastics Process, Chapts. I and II.

(v) MATHEMATICAL ECONOMICS AND ECONOMETRICS

Duration of Paper : 3 Hours **Max. Marks : 100**

Note : The paper is divided into five Units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit 1: The theory of consumer behavior: Utility and indifference curve analysis. Demand functions, elasticity of demand, income and leisure, linear expenditure system, theory of relealed prefence, composite commodities, situations involving risk, behavior under uncertainty (Henderson and Quandt: Micro Economic Theory, 3rd Ed., Chps. 2 and 3).

Unit 2: The theory of firm, production function, Cobb Douglas functions. CES production functions, Elasticity of substitution; input demands, cost function, Euler's theorem, Duality in production, production under uncertainty (Henderson and Quandt: Micro Economic Theory, Chaps. 4 and 5).

Unit 3: Econometrics: Simple two variable models, ordinary least square estimates, maximum likelihood estimates, Multivariate least square regression.

Unit 4: Important single equation problems, errors in variables. Auto-correlation, multi-collinearity, Heterosced Sticity, Dummy variables.

Unit 5: Simultaneous equation model, need, problem of identification estimation of exactly identified equation, indirect least squares, estimation of over identified equations. Two-Stage least squares (from Unit 3 to 5, Johnston: Econometric Method (II ed.): Chaps. 1 to 3, 5, 6, 7, 8, 9, 10 and 12).

PRACTICALS

List of practical exercise for Part A:

1. Estimation of mean: vector and covariance matrix.
2. Estimation and testing of partial and multiple correlation coefficients.
3. One sample and two sample problems using Hotelling's T^2 statistics.
4. Exercise based on Mahalnobis D^2 Statistics.
5. Exercises based on MLE using Rao's scoring method.
6. Narain-Horvitz-Thompson estimator and its variance.
7. Estimate of the Variance of NHT's estimator due to Horvitz and Thompson Yates and Grundy.
8. Des Raj's ordered and Murthy's unordered estimators and the estimate of their variances.
9. R.H.C. sampling procedures.
10. Double sampling for ratio and regression methods of estimation.
11. Estimation of the mean on the current occasion and its estimate of variance for n = 2.
12. Exercises based on two stage sampling.
13. Exercises based on small area estimation.

Details of Practical Work to be done in Part B:

(i) The following theoretical portions will be taught:
Fortran Preliminaries; classes of data, Type specification statements, implicit statements, Arithmetic operations, substring operations, logical operations, Assignment Statement, unformatted input output statement, STOP and END statements.

Relational Expressions: Logical expression, Arithmetic expressions, GO TO and computed GO TO statements.

Logical IF statements, nested Block IF structure, Repetitive structures, IF loop, DO loop, Nested DO loop, Format directed input and output.

Subscripted variables, Dimension, Statement, Additional data types complex type, Subprogrammes: Functions, Subroutines, Recursion, Call Statement, Common Data and Save Statements, file processings: Opening and closing files, file input and output, input and ouput using Array Name, Do loop and implied Do loop, Programme statement. Pause statement, assigned GO TO statement, Equivalence statement.

(ii) The programmes on the following topics will be run on the computer:

Forming the frequency distribution (Univariate and Bivariate) from the raw data stored in a file.

Calculating the different measures from raw data and grouped data

Fitting the curves using method of least squares

Fitting of distributions

Calculating simple correlation coefficient partial and multiple correlation coefficients, computation of regression equations in two and multivariables.