SYLLABUS

MATHEMATICS

M.A./M.Sc. (Previous) Examination 2016

M.A./M.Sc. (Final) Examination 2017

JAI NARAIN VYAS UNIVERSITY
JODHPUR
## FACULTY OF THE DEPARTMENT AND THEIR RESEARCH/TEACHING INTEREST

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name/Designation</th>
<th>Academic Qualification</th>
<th>Field of Specialization</th>
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<tr>
<td></td>
<td><strong>Professor</strong></td>
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<tr>
<td>01.</td>
<td>Dr. Chena Ram (Head)</td>
<td>M.Sc., Ph.D.</td>
<td>Special Functions, Fractional Calculus, Statistical Distributions.</td>
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<tr>
<td>02.</td>
<td>Dr. R.K. Yadav</td>
<td>M.Sc., Ph.D.</td>
<td>Special Functions, Integral Transforms, Fractional Calculus, Complex Analysis.</td>
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<tr>
<td>03.</td>
<td>Dr. Jeta Ram</td>
<td>M.Sc., Ph.D.</td>
<td>Integral Transform, Fractional Calculus, Special Functions</td>
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<td></td>
<td><strong>Associate Professor</strong></td>
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<tr>
<td>04.</td>
<td>Dr. R.K. Gupta</td>
<td>M.Sc., Ph.D.</td>
<td>Special Functions, Fractional Calculus, Integral Transforms</td>
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<tr>
<td>05.</td>
<td>Dr. Vijay Mehta</td>
<td>M.Sc., Ph.D.</td>
<td>Fluid Dynamics and M.H.D.</td>
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<td>06.</td>
<td>Dr. Aiyub Khan</td>
<td>M.Sc., Ph.D.</td>
<td>Computational Fluid Dynamics</td>
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<td><strong>Assistant Professor</strong></td>
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<tr>
<td>07.</td>
<td>Dr. Ramdayal Pankaj</td>
<td>M.Sc. Ph.D.</td>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>08.</td>
<td>Mr. Madan Ial</td>
<td>M.Sc., B.Ed.</td>
<td>Operations Research</td>
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MASTER OF SCIENCE

General Information for Students

The examination for the degree of Master of Science will consist of two examinations: (i) The Previous Examination, and (ii) The Final Examination.

The subject of examination shall be one of the following:


The examination will be through theory papers/practicals. Pass marks for the previous and final examination are 36% of the aggregate marks in all the theory papers and practicals and not less than 25% marks in an individual theory paper. A candidate is required to pass in the written and the practical examinations separately.

Successful candidates will be placed in the following division on the basis of the total marks obtained in previous and final examinations taken together.

First division 60%; Second division 48% and Third division 36%. No student will be permitted to register himself/herself simultaneously for more than one post-graduate course.

ATTENDANCE

1. For all regular candidates in the faculties of Arts, Education and Social Sciences, Science, Law and Commerce the minimum attendance requirement should be that a candidate should have attended atleast 70% of the lectures delivered and tutorials held taken together from the date of her/his admission.

2. The shortage of attendance upto the limits specified below may be condoned.
   (i) Upto 3% of the total (a) Lectures delivered and tutorials held (taken together), and (b) Practicals or Practicals and Sessionals subject-wise condonable by the Dean/Director/Principal on the recommendation of the Department concerned.
   (ii) Upto 6% including (i) above by the Syndicate on the recommendation of the Dean/Director/Principal.
   (iii) Upto 5% attendance in all subjects/papers/practicals and sessionals (taken together) by the Vice-Chancellor in special cases, on the recommendation of the Dean/Director/Principal.

3. The N.C.C. cadets sent out to parades and camps and such students who are deputed by the University to take part in games, athletics or cultural activities may, for purpose of attendance, be treated as present for the days of their absence in connection with the aforesaid activities and that period shall be added to their total attendance subject to the maximum of 20 days.
4. Advantage of fraction while calculating the attendance, shall be given to the candidate.

**EXAMINATION AND TEACHING SCHEME**

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

<table>
<thead>
<tr>
<th>Nomenclature/Paper</th>
<th>Periods/week</th>
<th>Exam Hours</th>
<th>Max.Marks</th>
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<tbody>
<tr>
<td><strong>M.Sc. (Previous)</strong></td>
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<tr>
<td>I  Algebra</td>
<td>6</td>
<td>3</td>
<td>100</td>
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<tr>
<td>II Analysis</td>
<td>6</td>
<td>3</td>
<td>100</td>
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<tr>
<td>III Differential Equations and Hydrodynamics</td>
<td>6</td>
<td>3</td>
<td>100</td>
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<tr>
<td>IV Special Functions and Integral Transforms</td>
<td>6</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>V  Analytical Dynamics and Numerical Analysis</td>
<td>6</td>
<td>3</td>
<td>100</td>
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| **M.Sc. (Final)**                        |              |            |           |
| I  Complex Analysis and Topology         | 6            | 3          | 100       |
| II Differential Geometry and Tensor Analysis | 6          | 3          | 100       |
| III Functional Analysis                   | 6            | 3          | 100       |
| IV and V (i) to (x)*                     | 6 (each)     | 3          | 100 (each) |
| *Electives                               |              |            |           |


Elective paper have been divided into two groups A and B and a student has to opt one paper from each of the following groups (A and B):

**GROUP A**

1. Magnetofluid Dynamics
2. Linear Operators in Hilbert Space
3. Laminar Viscous Flow Theory
4. Theory of Lie Algebras
5. Biomathematics

**GROUP B**

1. Generalized Functions
2. Fundamental of Operations Research
3. Integral Equations and Boundary Value Problems
4. Advanced Numerical Analysis
5. Probability and Statistical Distributions

Not more than 33% of the total admitted students of M.A./M.Sc. (Final) Mathematics will be allowed in any elective paper.

Selection of these elective papers will be strictly on merit, obtained in M.A./M.Sc. (Previous) Mathematics Examinations.
Note: Each theory paper is divided into three parts i.e. Section – A, Section – B and Section – C

**Section A:** Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry 2.

**Section B:** Will consist of 10 questions. Two questions from each unit will be set and students will answer one question from each unit. Answer of each question shall be limited up to 250 words. Each question will carry 7.

**Section C:** Will consist of total 05 questions one from each unit. Students will answer any 03 questions and answer of each question shall be limited up to 500 words. Each question will carry 15.

**Paper – I**

**ALGEBRA**

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

**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.


**BOOKS RECOMMENDED**

Surjeet Singh and Qazi Zammeruddin: Modern Algebra  
Aggarwal, R.S.: Modern Algebra  
Shanti Narain: Abstract Algebra; S. Chand & Co., New Delhi
Paper – II

ANALYSIS

Duration of Paper : 3:00 hours

Max. Marks: 100


Unit 3: Definitions of measure, Lebesgue outer measure, Measure of sets, Non-measurable sets, Exterior and interior measure of 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 $L^p$, Schwarz’s inequality, Holder’s inequality, Holder’s inequality for sums, Minkowski’s inequality. Integration of a function of $L^p$, mean convergence for the function of the class $L^p$.

BOOKS RECOMMENDED

Shanti Narayan: Mathematical Analysis; S. Chand & Co., New Delhi.
H.K. Pathak: Real Analysis; Shiksha Sahitya Prakashan; Meerut.
Jain, P.K. and Gupta, V.P. Lebesgue Measure and Integration, New Age Int. (P) Ltd., New Delhi.

**Paper – III**

**DIFFERENTIAL EQUATIONS AND HYDRODYNAMICS**

**Duration of Paper**: 3:00 hours

**Max. Marks**: 100

**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.


**BOOKS RECOMMENDED**


Milne-Thomson: Theoretical Hydrodynamics

Special Functions and Integral Transforms

Duration of Paper : 3:00 hours


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 \(P_n(x)\), Rodrigue’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 cosine transforms, Fourier transforms and its properties, Hankel and Mellin transform and their properties.

BOOKS RECOMMENDED


Paper - V

Analytical Dynamics and Numerical Analysis

Duration of Paper : 3 Hours                          Max. Marks: 100

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 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.


BOOKS RECOMMENDED


Gupta, P.P.: Dynamics of Rigid Bodies II, Jaiprakash Nath, Agra

Soarborough, James, B.: Numerical Analysis

Freeman, H.: Finite Differences and Mathematics for Actuarial 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.,


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

**Examination 2017**

**Note:** Each theory paper is divided in three parts i.e. Section – A, Section – B and Section – C

**Section A:** Will consist of 10 compulsory questions. There will be two questions from each unit and answer of each question shall be limited up to 30 words. Each question will carry 2.

**Section B:** Will consist of 10 questions. Two questions from each unit will be set and students will answer one question from each Unit. Answer of each question shall be limited up to 250 words. Each question will carry 7.

**Section – C:** Will consist of total 05 questions one from each unit. Students will answer any 03 questions and answer of each question shall be limited up to 500 words. Each question will carry 15.

**Paper – I**

**COMPLEX ANALYSIS AND TOPOLOGY**

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

**Unit 1:** Conformal transformations, bilinear transformation, cross ratios and some special transformations. Taylor’s and Laurent’s theorem, Poles and Singularities. Theory of residues. Contour integration.

**Unit 2:** Principle of maximum and minimum modulus; principle of argument, Schwarz’s lemma, Rouche’s theorem, Fundamental theorem of Algebra; Meromorphic function, Mittag-Leffler’s theorem, Analytic continuation, definition and illustrations.

**Unit 3:** Harmonic Functions; Definition, Basic Properties, Maximum Principle (First Version), and (second Version), Minimum Principle, Harmonic functions on a disc, Harnack’s inequality and theorem, subharmonic and superharmonic functions and maximum principle (3rd and 4th 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.

The **Books Recommended** will be as follows:

5. B.D. Gupta: Topology; Kedar Nath Ram Nath; Delhi; Meerut.

**Paper – II**

**Differential Geometry and Tensor Analysis**

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

**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 equations, Weingarten equations and Mainardi-Codazai equations.


**BOOKS RECOMMENDED:**


**PAPER – III**

**FUNCTIONAL ANALYSIS**

**Duration of Paper : 3 Hours**

**Max. Marks : 100**

**Unit 1:** Metric Spaces: Definition and Examples of Metric Spaces, Open and Closed Sets, Neighbourhoods 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, Eigenvectors, 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**


PAPER – IV
GROUP – A
1. MAGNETO FLUID DYNAMICS

Duration of Paper : 3 Hours
Max. Marks : 100

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 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 layer 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.


BOOKS RECOMMENDED
Bansal, J.L.: Magnetofluidodynamics of Viscous fluids, Jaipur Publishing House, Jaipur, India
Cowing, T.G.: Magnetohydrodynamics
GROUP – A

2. LINEAR OPERATIONS IN HILBERT SPACE

Duration of Paper : 3 Hours
Max. Marks : 100

Unit 1: Linear spaces. The scalar product, Hilbert space, Linear manifolds and subspaces. The distance from a point to a subspace, 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 $L^2$.


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


GROUP - A

3. LAMINAR VISCOUS FLOW THEORY

Duration of Paper : 3 Hours Max. Marks : 100

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 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


GROUP - A

4. THEORY OF LIE ALGEBRAS

Duration of Paper : 3 Hours  Max.Marks: 100

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 să) 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,m₀). Recursion relations for the Matrix Elements. Realizations of (w,m₀) in two variables, Weisner’s Method for Bessel Functions. The reat Euclidean group E3.


Unit 5: Lie Theory and Confluent Hypergeometric Functions: The Representations of R (w,m,μ) → wμ → w₁μ → w₂μ₂(x(λ, e)I(λ', e')x(λ', e'), e)x((λ, e). Differential Equations for the Matrix Elements.

BOOKS RECOMMENDED

Group – A

5. BIOMATHEMATICS

Duration of Paper : 03 Hours  Max. Marks: 100

Unit 1: Population growth, single spair time depend models, application to mathematical epidemiology, age structured models.

Unit 2: Two and more spair model, Lotka-Voltarra equations, Pary predator models, Equil-solutions.

Unit 3: Biofluid dynamics, Blood flow in large and small blood vessels. Flow in capillaries, Application of Poinsots law, Sedimentation of red blood cells.

Unit 4: Diffusion problem in biology, Diffusion through membrane, transcapillan exchange. Solutions in simple cases.

Unit 5: Engymes Kinetics, Mendalh’s mental theory, Equilibrium solutions.

REFERENCE BOOKS:
Murry, R.D.: Population Dynamics

PAPER - V
GROUP – B

1. GENERALIZED FUNCTIONS

Duration of Paper : 3 Hours
Max. Marks : 100

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 manifolds of lower dimension. Generalized functions associated with Quadratic form. Homogeneous functions Arbitrary functions raised to a power.

BOOKS RECOMMENDED
Fredman, A.: Generalized Functions and Partial Differential Equations,
GROUP – B

2. FUNDAMENTAL OF OPERATIONS RESEARCH

Duration of Paper : 3 Hours
Max. Marks : 100

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 policy, individual replacement policy, mortality tables, staffing problems.

Unit 5: Queing theory-Queues 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 queuing models.

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

Goel and Mittal: Operations Research, Pragati Prakashan

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

Sharma, S.D.: Operations Research

Loomba, N.P.: Linear Programming


GROUP – B

3. INTEGRAL EQUATIONS AND BOUNDARY VALUE PROBLEMS

Duration of Paper : 3 Hours Max. Marks : 100

Unit 1: General concepts of integral equation. 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 4: Classical Fredholm theory and Boundary Value Problems: Fredholm’s equation as limit of a finite system of linear equations. Fredholm’s two fundamental relations. Hadamard’s theorem. Fredholm Fundamental theorems.

Green’s function for Ordinary differential equation. Application of Integral transform in Boundary Value Problems. Applications of Integral Equation.


Books Recommended:
GROUP – B

4. ADVANCED NUMERICAL ANALYSIS

Duration of Paper : 3 Hours
Max. Marks : 100

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 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:**


D.S. Chouhan: Numerical Methods, JPH.

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**GROUP – B**

5. **PROBABILITY AND STATISTICAL DISTRIBUTIONS**  
(Only for Non-Statistics students of B.Sc. Final)

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


**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.

Negative Binomial Distribution, the Power series distribution. The properties and interrelation of these distributions.

**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.

**BOOKS RECOMMENDED**

01. Mathematical Statistics By Parimal Mukhopadhyay (Books and Allied (P.) Ltd.,
03. Fundamental of Mathematical Statistics By S.C.Gupta and V.K. Kapoor (Sultan Chand & Sons).