SYLLABUS

MATHEMATICS

(ANNUAL SCHEME)

(ONLY FOR PRIVATE STUDENTS)

M.Sc./M.A. (Final) Examination 2020

JAI NARAIN VYAS UNIVERSITY
JODHPUR

FACULTY OF THE DEPARTMENT AND THEIR RESEARCH/TEACHING INTEREST

Sr. No.	Name/Designation	Academic Qualification	Field of Specialization
	Professor		
01.	Dr. Chena Ram	M.Sc., Ph.D.	Special Functions, Fractional Calculus, Statistical Distributions.
02.	Dr. R.K.Yadav **(Head)**	M.Sc., Ph.D.	Special Functions, Integral Transforms, Fractional Calculus, Complex Analysis.
03.	Dr. Jeta Ram	M.Sc., Ph.D.	Integral Transform, Fractional Calculus, Special Functions
04.	Dr. R.K.Gupta	M.Sc., Ph.D.	Special Functions, Fractional Calculus, Integral Transforms
05.	Dr. Vijay Mehta	M.Sc., Ph.D.	Fluid Dynamics and M.H.D.
06.	Dr. Aiyub Khan	M.Sc., Ph.D.	Computational Fluid Dynamics
	Assistant Professor		
07.	Dr. Ramdayal Pankaj	M.Sc., Ph.D.	Applied Mathematics
08.	Mr. Madan lal	M.Sc.	
09.	Dr. Meena Kumari Gurjar	M.Sc., Ph.D.	Special Functions, Fractional Calculus and Operation Research

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:

Mathematics, Statistics, Physics, Electronics, Chemistry, Zoology, Geology, Botany and Home Science.

The examination will be through theory papers/practical. Pass marks for the previous and final examination are 36% of the aggregate marks in all the theory papers and practical 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 at least 75% of the lectures delivered and tutorials held taken together from the date of her/his admission.
2. The shortage of attendance up to the limits specified below may be condoned.
   - (i) Up to 3% of the total (a) Lectures delivered and tutorials held (taken together), and (b) Practical or Practical and Sessionals subject-wise condonable by the Dean/Director/Principal on the recommendation of the Department concerned.
   - (ii) Up to 6% including (i) above by the Syndicate on the recommendation of the Dean/Director/Principal.
   - (iii) Up to 5% attendance in all subjects/papers/practical 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.Sc./ M.A. (Previous / Final)

Nomenclature/Paper	Periods/week	Exam Hours	Max.Marks
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)*			
*Electives	6 (each)	3	100 (each)

***Elective (Optional) Paper IV and V of M.Sc. (Final) Mathematics.**

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	GROUP B
1. Magnetofluid Dynamics	1. Generalized Functions
2. Linear Operators in Hilbert Space	2. Fundamental of Operations Research
3. Laminar Viscous Flow Theory	3. Integral Equations and Boundary Value Problems
4. Theory of Lie Algebras	4. Advanced Numerical Analysis
5. Biomathematics	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.

M.Sc./M.A.(Final) Mathematics
Examination 2020
Paper – I

COMPLEX ANALYSIS AND TOPOLOGY

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

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.

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 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.

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

1. Shanti Narayan: Theory of Functions of Complex Variable; S. Chand & Co., New Delhi.
2. Mathews, J.H.: Howell, R.W. Complex analysis, Jones and Bartlet, India (2011).
3. Chouhan, J.P. Complex Analysis, (2006), Kedar Nath Ram Nath.
4. H.K. Pathak: Complex Analysis; Shiksha Sahitya, Prakashan, Meerut (2011).
5. B.D. Gupta: Topology; Kedar Nath Ram Nath; Delhi; Meerut.
6. Colin Adams and Robert Franzosa: Introduction to Topology; Dorling Kindersley India Pvt. Ltd., Pearson Prentice Hall (2009), Delhi.

Paper – II

Differential Geometry and Tensor Analysis

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

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.

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.

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.

PAPER – III

FUNCTIONAL ANALYSIS

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

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.
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, 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).

PAPER – IV

GROUP – A

1. MAGNETO FLUID DYNAMICS

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

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.

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.

GROUP – A

2. LINEAR OPERATIONS IN HILBERT SPACE

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

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.
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 $\boldsymbol{L}_1^2$.

Unit 2: Linear functionals. The theories of F Riesz. A criterion for the closure in H of given system of vectors. A Lemma 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.

GROUP - A

3. LAMINAR VISCOUS FLOW THEORY

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

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.
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.

GROUP - A

4. THEORY OF LIE ALGEBRAS

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

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.

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.

Group – A

5. BIOMATHEMATICS

Duration of Paper : 03 Hours **Max. Marks: 100**

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.

Unit 1: Population growth, single spair time depend models, application to mathematical opidemiology, 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:

Rubinov, S.L. : Introduction to Mathematical Biology.

Kapoor, J.N.: Mathematical Models in Biology and Medicines.

Murry, R.D.: Population Dynamics

Saxena, V.P.: Introduction to Biomaths, Wiley-Eastern.

PAPER - V

GROUP – B

1. GENERALIZED FUNCTIONS

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

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.

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.

GROUP – B

2. FUNDAMENTAL OF OPERATIONS RESEARCH

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

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.

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.

GROUP – B

3. INTEGRAL EQUATIONS AND BOUNDARY VALUE PROBLEMS

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

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.

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 2: Singular Integral equation. Solution of Abel's integral equation. General form of Abel Singular integral equation. Weakly Singular Kernel. Hilbert – Schmidt theory by symmetric kernels. Riesz – Fischer theorem. Hilbert – Schmidt theorem. Hilbert's theorem..

Unit 3: Schmidt's solution of the non-homogeneous fredholm integral equation of second kind. Homogeneous Fredholm integral equations. Eigen values and Eigen functions. Fredholm integral equations with degenerate kernels.

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.

Unit 5: Integral transform method: Some special types of integral equations. Application of Laplace Transform to determine the solution of Volterra integral equation with convolution type kernels. Application of Fourier transform to determine the solutions of singular integral equations. Integro-differential equation.

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.
Pundir, S.K. and Pundir, R. Integral equations and Boundary Value Problems, Pragati Prakashan, Meerut (U.P.)
Chandramouli, A.B.: Integral Equations with Boundary Value Problems, Shiksha Sahitya Prakashan, Meerut (U.P.)

GROUP – B

4. ADVANCED NUMERICAL ANALYSIS

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

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.
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.

Eigen value 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.