

Sri Dev Suman University, Badshahithaul (Tehri Garhwal)

M.A/M.Sc. Mathematics Course Structure

(Semester System)

(With effect from the academic year 2018-19 onwards)

Semester – I		Paper Code
Paper- I	Discrete Structures	MM-101
Paper- II	Abstract Algebra- I	MM-102
Paper- III	Complex Analysis	MM-103
Paper- IV	Operations Research -I	MM-104
Paper-V	Viva- Voce	MM-105
Semester- II		
Paper- VI	Abstract Algebra- II	MM-201
Paper- VII	Differential Equations	MM-202
Paper- VIII	Operations Research- II	MM-203
Paper- IX	Metric Spaces	MM-204
Paper- X	Viva- Voce	MM-205
Semester- III		
Paper- XI	Topology	MM-301
Paper- XII	Differential Geometry	MM-302
Paper- XIII	Real Analysis	MM-303
Choose any one of the following papers:		
Paper- XIV (a)	Calculus of Variations	MM-304(a)
Paper- XIV (b)	Mechanics	MM-304(b)
Paper- XIV (c)	Mathematical Statistics	MM-304(c)
Paper- XV	Viva- Voce	MM-305

Semester-IV

Paper- XVI	Measure and Integration	MM-401
Paper- XVII	Functional Analysis	MM-402
Paper- XVIII	Linear Integral Equations	MM-403

Choose any one of the following papers:

Paper- XIX(a)	Number Theory	MM-404(a)
Paper- XIX(b)	Fuzzy Set Theory	MM-404(b)
Paper- XIX(c)	Fluid Dynamics	MM-404(c)
Paper- XX	Viva-Voce	MM-405

Note: 1. Each paper carries 100 Marks, which includes one internal test of 20 Marks and main examination of 80 Marks.

2. In Semester I and II all papers are compulsory (core).

3. In Semester III, papers XI, XII, XIII and XV are compulsory and XIV paper may be selected any one of the elective papers XIV(a), XIV(b), and XIV(c).

4. In Semester IV, papers XVI, XVII, XVIII and XX are compulsory and XIX paper may be selected any one of the elective papers XIX(a), XIX(b), and XIX(c).

Viva-Voce: In this paper evaluation will be based on the students performance in Viva-Voce, and presentation /seminars on any current topic related to concerned papers of the semester.

SEMESTER- I

PAPER- I

DISCRETE STRUCTURES

- I. Recurrence relations, Linear homogeneous recurrence relations, Non-homogeneous recurrence relations, Solutions of recurrence relations.
- II. Partially ordered sets, Different type of lattices, Sub-lattices, Direct product, Ideal lattice, Modular and distributive lattices.
- III. Boolean algebra, Ideals in Boolean algebra, Boolean rings, Boolean functions, Karnaugh maps, Application of Boolean algebra to switching theory.
- IV. Graphs, Direct graphs, Undirected graphs, Relations and graphs, Path and circuits, Eulerian and Hamiltonian graphs, Planner graphs, Connected graphs.

TEXT/REFERENCE BOOKS

1. Element of Discrete Mathematics: C. I. Liu, Mcgraw Higher Edu. ,2012.
2. Discrete Mathematical Structures: H. G. S. Rao, Galgotia Pub. Pvt. Ltd.
3. Lattice and Boolean Algebra: V. K. Khanna, Vikash Pub. House.
4. Discrete Mathematics: R. Johnsonbaugh , Pearson Edu. Ltd., 2014.

SEMESTER- I

PAPER-II

ABSTRACT ALGEBRA- I

- I. Simple groups, Conjugacy, Normalization, Centre of a group, Class equation of a Group and its consequences, Theorems for finite groups, Cauchy's theorem, Sylow's theorem.
- II. Homomorphism, Endomorphism, Automorphism, Inner automorphism, Kernel of a homomorphism, Fundamental theorem on homomorphism of group, Group of automorphisms , Results on group homomorphism.
- III. Maximal subgroups, Composite series, Jordan-Holder theorem, Solvable groups, Commutator subgroups, Direct products.
- IV. Polynomial rings, Units and associates in polynomial rings, Division and Euclidean algorithm for polynomials, Unique factorization theorem.

TEXT/REFERENCE BOOKS

1. Contemporary Abstract Algebra: Joseph A. Gallian, Narosa Pub. House P. Ltd.
2. A First course in Abstract Algebra: John. B. Fraleigh, Pearson Edu. Inc. , 2003.
3. Abstract Algebra: V.K. Khanna and S.K. Bhambri, Vikash Pub. House P. Ltd.
4. Topics in Algebra: I. N. Herstein, John Wiley & Sons, New York.

SEMESTER-I

PAPER-III

COMPLEX ANALYSIS

- I. Power series of analytic functions, Convergence of power series, Radius of convergence, Taylor's and Laurent's series, Residue and poles, Singularities, Classification of singularities.

- II. Residues, Residue at infinity, Cauchy residue theorem, Applications of residue theorem in evaluation of improper real integrals.
- III. Conformal mapping: properties, Mobius transformation, Elementary examples.
- IV. Maximum modulus theorem, Mittag-Leffler theorem, Rouché's theorem, Analytic continuation.

TEXT/REFERENCE BOOKS

1. Complex Analysis : J.W. Brown and R. V. Churchill, Mc Graw-Hill.
2. Complex Analysis : B. Chaudhary, New Age Int.
3. Complex Analysis : H. S. Kasana, PHI Learning.
4. Foundation of Complex Analysis : S. Ponnusamy, Narosa Pub.

SEMESTER-I

PAPER –IV OPERATIONS RESEARCH –I

- I. An introduction to operations research, Methodology of Operations Research. Features of Operations Research problems, Different models in Operations Research, Opportunities and shortcomings of Operations Research approach.
- II. Dual simplex method, Revised simplex method, Sensitivity analysis.
- III. Assignment and Transportation problems.
- IV. Theory of games, Integer linear programming.

TEXT/REFERENCE BOOKS

1. Operations Research: Kanti Swarup, P.K. Gupta & Man Mohan, S. Chand.
2. Operations Research: Theory and Applications: J.K. Sharma, Trinity Press, 2016.
3. Operations Research: H.A. Taha, Prentice Hall, 2011.
4. Operations Research: R. Bronson, Mc Graw Hill, 1982.

SEMESTER-I

PAPER-V VIVA-VOCE

SEMESTER-II

PAPER-VI ABSTRACT ALGEBRA-II

- I. Embedding of rings, Ring of residue classes, Fundamental theorem on homomorphism of ring, Prime and maximal ideals.
- II. Euclidean ring, Properties of Euclidean ring, Module, Sub-module, Module homomorphism, Linear sum and direct sum of sub-module
- III. Extension fields, Simple field extension, Algebraic field extension, Minimal polynomial, Roots of polynomials, Multiple roots, Splitting field.
- IV. Automorphism of field, Fixed field, Normal extension, Galois group and its examples, Construction with straightedge and compass.

TEXT/REFERENCE BOOKS

1. Contemporary Abstract Algebra : Joseph A. Gallian, Narosa Pub. House P. Ltd.
2. A First course in Abstract Algebra : John. B. Fraleigh, Pearson Edu. Inc. , 2003.
3. Abstract Algebra : V.K. Khanna and S.K. Bhambri, Vikash Pub. House P. Ltd.
4. Topics in Algebra : I. N. Herstein, John Wiley & Sons, New York.

SEMESTER-II

PAPER –VII

DIFFERENTIAL EQUATIONS

- I. Ordinary differential equations: Qualitative properties of solution, Oscillation, Wronskian, Sturm separation and comparison theorem, Picard iteration methods, Uniqueness and existence theorem.
- II. Ordinary points, Regular and singular points, Frobenius series solution for Legendre's and Bessel's differential equations with generating functions.
- III. Classification of PDE of 2nd order and canonical forms, Concept of separation of variable solution.
- IV. Solution of heat diffusion, Laplace and wave equations, Non-linear partial differential equation of second order.

TEXT/REFERENCE BOOKS

1. Differential equation with Applications and Historical notes: G.F. Simmons, CRC Press, Taylor & Francis Group.
2. A Course in ODE : B. Rai, D.P. Chaudhary & H.I. Freedman, Alpha Sci. Int. Ltd.
3. Advanced Differential Equations: M.D. Raisinghania, S. Chand Pvt. Ltd., 2008.

SEMESTER-II

PAPER-VIII

OPERATIONS RESEARCH-II

- I. Inventory control, Functional role of inventory control, Classification of EOQ models with shortages and without shortages.
- II. Queuing theory, Characteristics of Queuing system, Probability distribution in Queuing system, Single served queuing model, M/M/1 queuing models, Multiple server queuing models.
- III. Markov chain, Application of Markov analysis, State and transition probabilities, Steady state conditions, Sequencing problems, Processing n jobs through two and three machines.
- IV. Dynamic programming, Dynamic programming under certainty, Non-linear programming methods, Quadratic programming, Kuhn- Tucker conditions.

TEXT/REFERENCE BOOKS

1. Operations Research: Kanti Swarup, P.K. Gupta & Man Mohan, S. Chand.
2. Operations Research: Theory and Applications: J.K. Sharma, Trinity Press, 2016.
3. Operations Research: H.A. Taha, Prentice Hall, 2011.
4. Operations Research: R. Bronson, Mc Graw Hill, 1982.

SEMESTER-II

PAPER-IX

METRIC SPACES

- I. Metric on a set, Pseudo-metrics, Equivalent metrics, Limit point, Closed sets, Adherent point, Dense subsets, Interior of set and its properties, Subspaces, Product spaces.
- II. Convergent sequences, Cauchy sequences, Algebra of convergent sequences, Subsequences, Continuity at a point, Continuity over a space, Algebra of real valued continuous functions in a metric space, Homeomorphism, Isometries, Uniform continuity.
- III. Complete metric spaces, Completeness and continuous mappings, Cantor's Intersection theorem, Contraction mapping theorem, Connectedness in metric space, Properties of connectedness.
- IV. Compact spaces, Compact subsets of the real line, Sequential compactness, Countable compactness, B-W property, B-W property and total boundedness, B-W property and compactness, compactness and uniform continuity, Lebesgue covering Lemma.

TEXT/REFERENCE BOOKS

1. Introduction to Topology and Modern Analysis: G.F. Simmons, Tata Mc Graw-Hill.
2. Metric Spaces: E.T. Copson, Cambridge University Press, 1968.
3. Topology: Robert H. Kasriel, Dover Pub., 2009.
4. Topology of Metric Spaces: S. Kumaresan, Alpha Science Int., 2011.

SEMESTER-II

PAPER-X

VIVA-VOCE

SEMESTER-III

PAPER-XI

TOPOLOGY

- I. Definition and examples of topological spaces, Closed sets, Closure, Dense subsets, Neighborhoods, Interior, Exterior and accumulation points, Bases and sub bases, subspaces, Product spaces and relative topology.
- II. Continuous function, Homeomorphism, Connected and disconnected sets, Components, Locally connected spaces.
- III. Countability axioms, First and second countable spaces, Lindelof's theorem, Separable spaces, Second countable and separability, Separable axioms: $T_0, T_1, T_2, T_3, T_3^{\frac{1}{2}}, T_4$ and their characterizations.
- IV. Compactness, Continuity and compact sets, Basic properties of compactness, Compactness and finite intersection property, Sequentially and countably compact sets, Local compactness, Tychonoff's theorem.

TEXT/REFERENCE BOOKS

1. Topology: A First Course : James R. Munkres, Prentice Hall, Incorporated, 2000.
2. General Topology: J.L. Kelly, Springer, 1975.

3. Topology and Modern Analysis : G.F. Simmons, Tata Mc Graw-Hill.
4. General Topology: Seymour Lipchitz, Schaum Pub. Co.

SEMESTER- III

PAPER- XII

DIFFERENTIAL GEOMETRY

- I. Curves in space, Arc length, Order of contact, Tangent, Normal, Binormal, Osculating, Plane, Serret-Frenet formulae, Curvature and torsion. Osculating circle and osculating sphere, Helix, Bertrand curves.
- II. Behaviour of a curve in the neighbourhood of a point. Concept of a surface, Envelope and developable surface, Parametric curves, Family of the surfaces, Edge of regression, Ruled surfaces, Central points.
- III. Fundamental forms and curvature of surfaces: First fundamental form. Second fundamental form of the surfaces of revolution, Weingarten's equation, Direction coefficients, Family of curves.
- IV. Local non-intrinsic properties of a surface Normal curvature, Principal directions, Principal curvatures, Minimal surface, Lines of curvature. Rodrigues and Monge's theorem, Euler's theorem, Joachimisthal's theorem, Dupin's indicatrix, Third fundamental form.

TEXT/REFERENCE BOOKS

1. Differential Geometry: T.J. Willmore, Dover Pub. Inc., New York.
2. Differential Geometry of Three Dimensions: C.E. Weathrburn, Cambridge Univ. Press.
3. Elements of Differential Geometry: R.S. Millman & G.D. Parket, Prentice Hall.
4. Introduction to Differential Geometry: A. Goetz, Addison Wesley Pub. Co., 970.

SEMESTER-III

PAPER-XIII

REAL ANALYSIS

- I. The Riemann Stieltjes Integral: Definition and existence of Riemann-Stieltjes integral, integral, Properties of integrals, Integration and differentiation, Fundamental theorem of calculus, Integration of vector-valued functions.
- II. Sequences and series of functions, Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Uniform convergence and continuity, Uniform convergence and Riemann-Stieltjes integral, Uniform convergence and differentiation, Weierstrass approximation theorem.
- III. Power series, Algebra of power series, Uniqueness theorem for power series, Abel's theorem, Taylor's theorem.
- IV. Functions of several variables, Concept of functions of two variables, Continuity, Partial derivatives, Differentiability, Change of variables, The inverse function theorem, The implicit function theorem, Chain rule.

TEXT/REFERENCE BOOKS

1. Mathematical Analysis: S.C. Malik and Savita Arora, New Age Int. 1992.
2. Mathematical Analysis: T.M. Apostol, Pearson Edu. , Taiwan Ltd., 1974.
3. Real analysis: H.L. Royden, Pearson, 2017.

Choose any one of the following papers:

SEMESTER-III

PAPER-XIV(a) CALCULUS OF VARIATIONS

- I. Variation of functional, Continuity and differentiability of functional, Necessary condition for an extremum, Euler's equation, Variational problems in parametric form, Functional depending on higher order derivatives and variational problems with subsidiary condition.
- II. The isoperimetric problem, Invariance of Euler's equation under coordinate transformation, General variational of functional, Variable end point problems, Transversality condition transversal theorem, Weierstrass-Endmann corner condition.
- III. Sufficient condition for extremum: Second variation, Legendre's and Jacobi's necessary condition, Canonical transformation, Noether's theorem, The principle of least action, Conservation law, Hamilton Jacobi's equations.
- IV. Transformation of ODE and PDE into functionals and their solutions by Ritze, Galerkin, Collocation and Kantrovtch methods.

TEXT/REFERENCE BOOKS

1. Calculus of Variation: Gelfrand and Fomin, Dover Pub. Inc., New York.
2. Calculus of Variation: Elsgolt , University Press of the Pacific, 2003.
3. Calculus of Variation: A.S.Gupta, PHI Learning Pvt. Ltd.

SEMESTER- III

PAPER –XIV(b) MECHANICS

- I. Conservation of linear and angular momentum under finite and impulsive forces, Conservation of energy.
- II. Generalized coordinates, Lagrange's equations of motion, Small oscillations.
- III. Hamiltonian's canonical equations, Hamilton's principle and principle of least action.
- IV. Euler's equations of motion, Kinetic energy, Eulerian angles, Instantaneous axis of rotation.

TEXT/REFERENCE BOOKS

1. Dynamics- Part II: A.S. Ramsey, Cambridge University Press, 1944.
2. Classical Mechanics: H. Goldstein, Pearson Education.
3. A Text Book on Dynamics: Ray and Sharma, S. Chand Ltd., 2005.
4. Dynamics of Rigid Body: S.L. Loney, Cambridge University Press.

SEMESTER-III

PAPER-XIV(c)**MATHEMATICAL STATISTICS**

- I. Some standard discrete and continuous univariate distributions: Binomial, Poisson, Normal, Gamma and Beta distributions.
- II. Methods of estimation. Properties of estimators. Confidence intervals. Tests of hypotheses: most powerful and uniformly most powerful tests, Likelihood ratio tests. Analysis of discrete data and chi-square test of goodness of fit. Large sample tests.
- III. Multivariate normal distribution, Wishart distribution and their properties. Distribution of quadratic forms. Inference for parameters, partial and multiple correlation coefficients and related tests. Data reduction techniques: Principle component analysis, Discriminant analysis, Cluster analysis, Canonical correlation.
- IV. Concepts of sampling, Simple random sampling, stratified sampling and systematic sampling. Probability proportional to size sampling. Ratio and regression methods.

TEXT/REFERENCE BOOKS

1. Fundamental of Mathematical Statistics : S.C. Gupta and V.K. Kapoor, S. Chand.
2. Advanced Theory of Statistics :M.G. Kandall.
3. A first Course on Mathematical Statistics: C.E.Weatherburn, Cambridge Univ. Press, 1968.

SEMESTER-III**PAPER-XV****VIVA-VOCE****SEMESTER –IV****PAPER-XVI****MEASURE AND INTEGRATION**

- I. Lebesgue outer measure, Measure of open and closed sets, Borel sets, Measurable sets, Measure of cantor's ternary set, Non-measurable sets.
- II. Measurable functions, Algebra of measurable functions, Step functions, Characteristics function, Simple functions, Convergence in measure, Egoroff's theorem, Reisz-Fisher theorem.
- II. Lebesgue Integral and their properties, General Lebesgue integrals, Lebesgue integrals for unbounded functions, Convergence theorem, Fatou Lemma.
- III. Functions of bounded variations, Absolutely continuity, Variation function, Jordan-decomposition theorem, Indefinite integral and its characterization, Differentiation of an integral, Lebesgue differentiation theorem.

TEXT/REFERENCE BOOKS

1. Real Analysis: H.L. Royden, Pearson, 2017.
2. Measure and Integration: S.K. Berberian, The Macmillan Company, 1965.
3. Lebesgue Measure and Integration: P.K. Jain and V.P. Gupta, Wiley, 1986.
4. Measure Theory and Integration: G. De. Barra, Horwood, 2003.

SEMESTER-IV

PAPER- XVII

FUNCTIONAL ANALYSIS

- I. Normed linear spaces, Banach spaces, Subspaces, Quotient Spaces, Equivalent, Norms.
- II Bounded linear Transformation/operators, Hahn-Banach Theorem, Open mapping, Theorem, Closed Graph Theorem, Uniform Boundedness Principle.
- III. Inner Product spaces, Hilbert Spaces, Orthogonality of vectors, Orthogonal complements and projection Theorem, Riesz Representation Theorem, Orthonormal Sets.
- IV. Operators on Hilbert Spaces, Self-adjoint, Normal and unitary operators, Orthogonal projection operators.

TEXT/REFERENCE BOOKS

1. Functional Analysis: P.K. Jain, O.P. Ahuza and Khalil Ahamad, Wiley, 1996.
2. Topology and Modern Analysis: G.F. Simmons, Tata Mc Graw-Hill.
3. Introductory functional Analysis with Applications: E. Kreyszig, Wiley, 1989.
4. Functional Analysis: B.V. Limaye, New Age Int.

SEMESTER -IV.

Paper-XVIII

LINEAR INTEGRAL EQUATIONS

- I. Classification of integral equations, Relation between differential and integral equations, Fredholm integral equations, Fredholm equations of second kind with separable kernels, Eigen values and eigen functions.
- II. Volterra integral equations, Resolvent kernel of Volterra equation, Convolution type kernel, Integral equations with symmetric kernel.
- III. Method of successive approximation for Fredholm and Volterra equations of the second kind.
- IV. Classical Fredholm theory, Singular integral equations, Hilbert type integral equations, Integral equation with Green's function type kernels.

TEXT/REFERENCE BOOKS

1. Integral Equations and Boundary Value Problem : M.D. Raisinghanian, S. Chand.
2. Linear Integral Equations: W. V. Lovit, Dover Pub. Int. New York.
3. Linear Integral Equations: R.P. Kanwal, BirkhauserBoston, 1996.
4. Integral Equations: L. G. Chambers, International Textbook Co., 1976.

Choose any one of the following papers:

SEMESTER-IV

PAPER- XIX(a)

NUMBER THEORY

- I. The division algorithm, The gcd, The Euclidean algorithm, Diophantine equation $ax + by = c$, The fundamental theorem of arithmetic, The sieve of Eratosthenes, Goldbach conjecture.
- II. The theory of congruences, Binary and decimal representation of integers, Linear congruences and Chinese remainder theorem, Fermat's theorem, Wilson's theorem.
- III. Number theoretic function, Tau and sigma function, the Mobius inversion formula, The greatest integer function, Euler's phi function, Properties of phi function, Euler theorem.
- IV. The order of an integer modulo n , Primitive roots for primes, Composite numbers having primitive roots, The theory of indices, Continued fraction, Approximation of irrationals by rationals.

TEXT/REFERENCE BOOKS

1. Elementary Number Theory: David M. Burton, Mc Graw-Hill.
2. Theory of Numbers: George Andrews, Courier Corporation, 1994.
3. Elementary Number Theory with Applications: Thomas Koshy, Harcourt Acad. Press.
4. Fundamental of Number Theory: William J. Lereque, Dover Pub. Inc. New York.

SEMESTER-IV

PAPER- XIX(b)

FUZZY SET THEORY

- I. Fuzzy sets, Basic definitions, Alpha-cut sets, Convex fuzzy sets, Basic operation on fuzzy sets, Types of fuzzy sets, Cartesian products, Algebraic products, Bounded sum and differences, t-norms and t-corners.
- II. The extension principle, The Zadeh's extension principle, Images and inverse image of fuzzy sets, Fuzzy numbers, Element of fuzzy arithmetic.
- III. Fuzzy relation and fuzzy graphs. Fuzzy relation on fuzzy sets, composition of fuzzy relation, min-max composition and properties, equivalence relations, fuzzy compatibility relation, Fuzzy relation equations.
- IV. Fuzzy logic, An overview of classical logic, Multivalued logic, Fuzzy propositions, Fuzzy qualifiers, Linguistic variables and hedge.

TEXT/REFERENCE BOOKS

1. Fuzzy sets and Fuzzy logic: G.L. Klir and Yuan, World Sci. Pub. Co. Pvt. Ltd.
2. Fuzzy set theory and its Applications: H.J. Zimmermann, Springer, 1991.
3. Fuzzy set theory, Fuzzy logic and their Applications: A.K. Bhargava, S. Chand.
4. First Course on Fuzzy Theory and Applications :Kwang H. Lee, Springer, 2004.

SEMESTER-IV

PAPER- XIX(c)

FLUID DYNAMICS

- I. Kinematics of fluids, Lagrangian and Eulerian methods, Local and individual time rates of change, Equation of continuity, Boundary surface.
- II. Equation of motion of inviscid fluids, Euler's equation of motion, Bernoulli's equation, Lagrange's equation, Conservative field of force, Cauchy's Integral, Helm- Holtz's equation.
- III. Impulsive motion of a fluid, Energy equation of inviscid fluid, General theory of irrotational motion, Connectivity, Flow and circulation, Kelvin's circulation theorem, Stokes's theorem, Permanence of irrotational motions, Green's theorem, Kinetic energy of finite and infinite liquid, Kelvin's minimum energy theorem, Mean value of the velocity potential over a spherical surface.
- IV. Motion in two dimensions, Stream function, Complex potential, Source, Sink, Doublet, Complex potential and images with respect to straight line and circle, Milne- Circle theorem, Blasius theorem.

TEXT/REFERENCE BOOKS

1. Foundation to Fluid Mechanics: S.W. Yuan, Prentice Hall Pvt. Ltd., 1960.
2. Text book of Fluid Dynamics: F. Chorlton, CBS Pub. & Dist. , 2004.
3. Theoretical Hydro Dynamics: Bansi Lal, Skylark Pub., 1999.
4. A text book of Fluid Dynamics: M. Ray & Sharma, S. Chand & Co. Ltd. 2005.

SEMESTER-IV

PAPER-XX

VIVA-VOCE

