M.Sc.-I (New) Mathematics

SEMESTER-I

Paper-I : REAL ANALYSIS

Unit-I : Definition and existence of Riemann Stieltjes integral, properties of the integral, Integration and differentiation. The fundamental theorem of calculus, integral of vector valued function, rectifiable curves.

Unit-II : Sequences and uniform convergence, Cauchy criterion for uniform convergence, Weierstrass M-test, Abel' s and Dirichlet's tests for uniform convergence, uniform convergence and continuity , uniform convergence and integration, uniform and differentiation, Weierstrass approximation theorem.

Unit-III : Rearrangement of terms of a series, Riemann's theorem. Power series, Uniqueness theorem for power series, Abel's limit theorem, Tauber's first theorem.

Unit-IV : Functions of several variables, linear transformation, derivatives in an open subset of Rn, chain Rule, partial derivatives, interchange of order of differentiation, Derivatives of higher order, Taylor's theorem.

Unit-V : Inverse function theorem. Implicit function theorem, Jacobians, Extremum problems with constraints, Lagrange's multiplier method, Examples on Maxima and Minima, Differentiation of integrals.

References : (1) Apostol T .M., Mathematical Analysis, Narosa Publishing House,New Delhi, 1985. (2) Eurl D.Rainville : Infinite series, The Macmillan Company , New York. (3) Friedman A., Foundations of Modern Analysis, Holt Rinehart and Winston, Inc, New York, 1970. (4) Hewitt E. and Starmberg, Real and Abstract Analysis, Berlin, Springer 1969. (5) Jain P .K. and Gupta V. P., Lebesque Measure and Integration, New Age international (P) Ltd., Published, New Delhi, 1986, (Reprint2000) (6) Gabriel Klambaucer , Mathematical Analysis Marcel Dekkar , Inc.,New York, 1975. (7) Natanson I.P ., Theory of Function of real variables, Vol.-I, Frederick Ungar Publishing Co.1961. (8) Parthasarathy K.R., Introduction to Probability and Measure,Macmillan Company of India, Delhi, 1977. (9) Royden H.L., Real Analysis, Macmillian Pub. Co. Inc., 4th Edition,New York, 1993. (10) R.R.Goldber g : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi - 1970. (11) S e r g e Lang, Analysis I & II, Addison - Wesley Publishing CompanyInc., 1969. (12) S.C.Malik and Savita Arora: Mathematical Analysis, Wiley Fastern Ltd., New Delhi. (13) S.C.Malik and Savita Arora : Mathematical Analysis, New Age International (P.) Ltd.2010, Fourth Edition.4 (14) Shani Narayan : A Course of Mathematical Analysis, S.Chand and Company, New Delhi. (15) White A.J., Real Analysis, an introduction. (16) Karade T .M. and Salunke J.N., Lectures on Advanced Real Analysis, Sonu Nilu Publication, 2004.34 (17) Walter Rudin, Real & Complex Analysis, Tata McGraw Hill Publishing Co. Ltd., New Delhi (18) Robert ,G.Bartle,Donald R.Sherbert:Introduction to Real Analysis Wiley India Edition 2010 (19) B.Chaudhari and D.Somasundarm:

Mathematical Analysis, Narosa Publishing House, New Delhi (20) N.P.Bali ,Real Analysis:Golden Math Series (2011)Publish by Firewall Media (21) Walter Rudin; Principles of Mathematical Analysis, Mc Graw HillBooks Company, Third Edition 1976, international student edition.

Paper-II : ADVANCED ABSTRACT ALGEBRA

Unit I : Normal Subgroups and quotient groups, Isomorphism theorems, Automorphisms, Conjugacy and G-sets, Normal series, Solvable groups, Nilpotent groups.

Unit II : Permutation groups, cyclic decomposition, Alternating group An, Simplicity of An, structure theorems of groups, Direct products, Finitely generated abelian groups, invariants of a finite abelian group, Sylow theorems, Groups of order p2, pq.

Unit III : Ideals, Homomorphism, Sum and direct sum of ideals, Maximal and prime ideals, Nilpotent and Nil ideals, Zorn's lemma. Unit IV : Unique factorization domain, Principle ideal domain, Euclidean domain, Polynomial rings over UFD.

Unit V : Modules- Definition and examples, Sub modules and direct sums, R-homomorphism and quotient modules, completely reducible modules, free modules.

Reference :

1) I.N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975. 2) M. Artin, Algebra, Pretice-Hall of India, 1991. 3) P.M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982,1989,1991.

4) N. Jacobson, Basic Algebra, Vols. I & II, W.H. Freeman, 1980. 5) S. Lang, Algebra, 3rd edition, Addison – Wesley, 1993. 6) I.S. Luthar and I.B.S. Passi, Algebra, Vol. I-Groups, Vol. II – Rings, Narosa Publishing House. 7) D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw-Hill, International Edition, 1997. 8) K.B. Datta, Matrix and Linear Algebra, Pretice Hall of India Pvt. Ltd., New Delhi, 2000. 9) S.K. Jain, A.Gunawadena and P.B. Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer – Verlag), 2001. 10) S. Kumarsena, Linear Algebra, a Geometric Approach, Pretice Hall of India, 2000. 11) Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999. 12) I. Stewart, Galois Theory, 2nd Edition, Chapman and Hall, 1989. 13) J.P. Escofier, Galois Theory, GTM Vol.204, Springer, 2001. 14) T.Y. Lam, Lectures on Modules and Rings. GTM Vol.189, Springer Verlag, 1999. 15) D.S. Passman, A Course in Ring Theory, Wadsworth and Brooks/ Cole Advanced Books and Softwares, Pacific Groves, California, 1991. 16) J.A. Gallian, Contemporary Abstract Algebra, Narosa Publication. 17) A.R. Vashistha, Modern Algebra, Krishna Prakashan Media (P) Ltd. 18) V.K. Khanna and Bhambri, a Course in Abstract Algebra, Vikas Publication, House (P) Ltd. (2010). 19) John B. Fraleigh, a First Course in Abstract Algebra (Seventh Edition). 20) Abstract Algebra (Third Edition) By David S. Dummit, Richard M. Foote, Wilay India Edition. 21) Basic Abstract Algebra, P .B.Bhattacharya, S.K.Jani, S.R.Nagpaul.

Paper-III : COMPLEX ANALYSIS

Unit-I : Complex Integration : Power Series representation of analytic functions, Cauchy' s integral formula, higher order derivatives, Cauchy' s inequality , Zeros of Analytic function, Liouvilles theorem, Fundamental theorem of algebra.

Unit-II : Taylor's theorem, Maximum Modulus theorem, Morera's theorem, Counting of zeros, open Mapping theorem, CauchyGoursat theorem, Schwarz's lemma.

Unit-III : Singularities, Isolated singularities, classification of isolated singularities, Laurent's series development, CasortiWierstrass theorem, Argument principle, Rouches theorem.

Unit-IV : Residue, Cauchy's residue theorem, Evaluation of integration by using residue theorem, Branches of many valued function (Specially arg z, log z, z), Hadamard's three circle theorem, Spaces of continuous functions, spaces of analytic functions, Hurwitz theorem.

Unit-V : Analytic continuation, uniqueness of direct analytic continuation, uniqueness of analytic continuation along a curve, power series method of analytic continuation, Schwartz reflection theorem, Weierstrass factorization principle.

Reference:

1) S. Ponnusamy, Foundation of Complex Analysis, Narosa Publishing House, 1967. 2) H. S. Kasana, Complex variables: Theory and Application, PHI Learning Pvt. Ltd., New Delhi. 3) Schaum's outline series Complex Analysis, Tata McGraw Hill Education Pvt. Ltd., New Delhi (2010). 4) J. N. Sharma, Complex Variables, Pragati Publication. 5) A. R. Vashistha, Complex Variables, Krishna Publication. 6) Murray R. Spiegel, Seymour Lipschutz, Jon J. Schiller, Dennis Spellman., Schaum's outline series Complex Analysis, Tata McGraw Hill Education Pvt. Ltd., 3rd Edition, New Delhi 2010. 7) Walter Rudin, Real & Complex Analysis, McGraw Hill Book Co., 1966. 8) J. Ward Brown, Ruel V. Churchill, Complex variables and Application, McGraw Hill International Edition (2009). 9) H. A. Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990. 10) Liang-Shin Hahn & Bernhard Epstein, Classical Complex Analysis, Jones & Berlett Publishers. International London, 1996. 11) L. V. Ahlfors, Complex Analysis, McGraw Hill, 1979. 12) S. Lang, Complex Analysis, Addison Wesley, 1977.1998. 13) D. Sarason, Complex Function Theory, Hindustan Book, Agency, Delhi, 1994. 14) Mark J. Ablowitz and A. S. Fokar, Complex variables: Introduction & Application, Cambridge University Press, South Asian Edition, 56. 15) E. Hille, Analytic Function Theory (2 Vols), Gonn & Co. 1959. 16) W. H. J. Fuchs, Topics in the Theory of Function of Complex Variable, D. Van Nostrand Co., 1967. 17) C. Carathedory, Theory of Functions (2 Vols), Chelsea Publishing Company, 1964. 18) M. Heins, Complex Function Theory, Academic Press, 1968. 19) S. Saks & A. Zygmund, Analytic Functions, Monografie, Matematyczne, 1952. 20) E. C. Titchmarsh, the Theory of Functions, Oxford University Press, London. 21) W. A. Veech, A Second Course in Complex Analysis, W. A. Benjamin, 1967. 22) Complex variables and Applications,

Jams Ward Brown, Ruel V. Churchill, McGraw Hill International Edition (2009). 23) Dennis G. Zill, Patrick D. Shanhan Jones and Burtlett, A First Course in Complex Analysis with application (Second edition) Publisher (2010). 24) John Mathew and Howell, Complex Analysis for Mathematician and Engineers. 25) Functions of one complex variable - J.B.Conway , Springer Verlag International Students Edition, Narosa Publishing House, 1980.

Paper-IV : TOPOLOGY –I

Unit-I : Cardinal and Ordinal Numbers : Equipolent sets, cardinalnumbers, order types, ordinal numbers, Axiom of choice.

Unit-II : Topological Spaces : Definition and examples of topologicalspaces. Open sets and Limit points. Closed sets and closure. operators and neighbourhoods. Bases and Relative Topologies. Unit-III : Connectedness, Compactness and Continuity : Connected sets and components, compact and countably compact spaces. Continuous functions. Homeomorphisms. Arcwise connectivity . Unit-IV : Seperation and Countability Axioms : T0, T1 & T2 spaces. T spaces and sequences. First and Second axiom spaces, separability .

Unit-V : Seperation and Countability Axioms (Contd.) : Regular and normal spaces, Completely regular spaces.

References : (1) Foundations of General T opology by W illiam J. Pervin. Publisher : Academic Press

7 8 (2) Theory and Problems of Set Theory and Related T opics by Semour Lipshutz Publisher: Schaum Publishing Co., New York. (3) J.R. Munkres, Topology : A First CoursePublishers Prentice Hall of India. (4) K.D.Joshi, Introduction to General Topology, Publisher , Wiley Eastern Ltd. (5) By R.S.Aggarwal A Text Book on Topology, Publisher : S.Chand & Company . (6) J.N. Sharma, General and Algebric Topology, Krishna prakashan

Paper-V : DIFFERENTIAL GEOMETRY (OPTIONAL)

Unit-I : Local Intrinsic properties of a surface, Definition of surface, curves on a surface, surfaces of Revolution, Helicoids, Metric, Direction Coefficients.

Unit-II : Families of curves, Isometric correspondence, Intrinsic properties, Geodesics, Canonical Geodesic Equation, Normal Properties, Geodesic Existance theorems, Geodesic parallels.

Unit-III : Geodesic curvature, Gauss-Bonnet Theorem, Gaussian Curvature, Surface of constant curvature, conformal mapping, Geodesic mapping.

Unit-IV : Review of tensor calculus, Vector spaces, the dual space, Tensor product of vector spaces, Transformation formulae, contraction special tensors, Inner product. Associated tensors Exterior Algebra.

Unit-V : Differential manifolds, Tangent vectors, Af fine Tensors and Tensorial forms, Connexions, covariant differentiation, Absolute derivation of Tensorial forms, Tensor connexions.

References : (1) W .Klingenberg (Springer), A course in Differential Geometry (2) Weatherburn, C. Riemannian Geometry and Tensor Calculus (3) T. M. Karade, G.S. Khadekar, Maya S. Bendre, Lectures on General relativity, Sonu-Nilu publication. (4) "An Introduction to Differential Geometry", By T .J.Wilmore, Oxford University Press (1959) (5) D. Somasundaram, Differential Geometry a first course, Narosa Publishing House,2008

Unit-I : Formal Logic : Statements, symbolic representation and Tautologies. Quantifiers, Predicates and validity. Propositional logic.

Unit-II : Semigroups and Monoids : Definitions and examples of semigroups and monoids (including those pertaining to concatenation operation). Homomorphism of semigroups and monoids. Congruence relation and Quotient semigroups. Subsemigroups and submonoids. Direct products. Basic Homomorphism theorem.

Unit-III : Lattice Theory : Lattices are partial ordered sets. Their properties. Lattices as algebraic systems. Sublattices. Direct products and Homomorphisms. Some special lattices, e.g. complete, complemented and distributive lattices.

Unit-IV : Boolean Algebras : Boolean algebra as a lattice. Various Boolean identities. The switching algebra examples. Subalgebras. Direct products and Homomorphisms. Joint irreducible elements.
Unit-V : Boolean Algebras (Continue) :Atoms and minterms. Boolean forms and their equivalence. Minterm Boolean forms. Sum of products. Canonical forms.Minimization of Boolean functions. Applications of Boolean algebra of switching theory .(Using AND, OR and NOT gates). The Karnaugh map method.

References : (1) J.P . Tremblay and R.Manohar , Discrete Mathematical Structure with Application to Computer Science, McGraw Hill Book Co. 1997. (2) Seymour Lipschutz, Finite Mathematics (International Edition 1983).McGraw Hill Book Company . (3) S . Wiitala, Discrete Mathematics - A Unified Approach, McGraw Hill Book Co. (4) J.L. Gersting : Mathematical Structure for Computer Science (3rd Edition), Computer Science Press, New York. (5) C.L.Liu, Elements of Discrete Mathematics, McGraw Hill Book Co.

M.SC.–I (New) Mathematics

SEMESTER-II

Paper-VI : MEASURE AND INTEGRATION THEORY

Unit-I : Lebesgue outer measure, measurable sets, Regularity,Measurable functions, Borel and Lesbesgue measurability.

Unit-II : Integration of Non-negative function, the general integral, integration of series, Riemann and Lebesgue integrals.

Unit-III : The Four derivatives, continuous non-differentiable functions, functions of bounded variation, Lebesgue differentiation theorem, differentiation and integration.

Unit-IV : Measures and outer measures, Extension of a measure,

Unit-V : The uniqueness of Extension, completion of a measure, measure spaces, integration with respect to a measure. spaces, convex functions, Jensen's inequality. Holder and Minkowski inequality. Completeness of convergence in measure. Almost Uniform convergence.

References :

(1) Bartle R.G ., The Elements of Integration, John Wiley & Sons, Inc.,New York, 1966. (2) G .de Barra, Measure Theory and Integration. Wiley EasternLimited, 1981. (3) Halmos P .R. Measure Theory, Van Nostrand Princeton, 1950. (4) Hawkins T. G., Lebesgue' s Theory of Integration, its origins and Development, Chelsea, New York, 1979. (5) Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, Delhi, 1997. (6) Karade T .M., Salunke J.N., Lectures on Advanced Real Analysis, Sonu Nilu Publication, Nagpur, 2004. (7) Royden H.L., Real Analysis, Macmillan Pub. Co. Inc., 4th Edition,New York, 1993 (8) P.K. Jain and V.K.Gupta, Leabegue Measure and integration

Paper-VII : ADVANCED LINEAR ALGEBRA AND FIELD THEORY

Unit I : Canonical forms: Eigen values and eigenvectors. The minimal polynomial, Diagonalizable and triangular operators, The Jordan form, The rational form.

Unit II : Quadratic forms, Linear transformation, Congruence of matrices, Reduction of real quadratic form, Canonical or Normal form of a real quadratic form, Signature and index of a real quadratic form,Sylvester's law of inertia, Definite and semi-definite real quadratic Forms, Hermition forms.

Unit III : Algebraic extension of fields: Irreducible polynomials and Einstein criterion, Adjunction of roots, Algebraic extension, Algebraically closed fields.

Unit IV : Normal and separable extension: Splitting fields, Normal extension, multiple roots, finite fields, Separable extension.

Unit V : Galois theory and Applications: automorphism groups and fixed fields, Fundamental theorem of Galois theory, Fundamental theorem of algebra, Roots of unity and cyclotomic polynomials, Cyclic extension, Polynomials solvable by radicals, Symmetric functions, Ruler and compass constructions.

Reference: 1) I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975. 2) M. Artin, Algebra, Pretice-Hall of India, 1991. 3) P.M. Cohn, Algebra, Vols. I, II & III, John Wiley & Sons, 1982, 1989, 1991. 4) N. Jacobson, Basic Algebra, Vols. I & II, W.H. Freeman, 1980. 5) S. Lang, Algebra, 3rd edition, Addison – Wesley, 1993. 6) I.S. Luthar and I.B.S. Passi, Algebra, Vol. I-Groups, Vol. II – Rings, Narosa Publishing House. 7) D.S. Malik, J.N. Mordenson, and M.K. Sen, Fundamentals of Abstract Algebra, McGraw-Hill, International Edition, 1997. 8) K.B. Datta, Matrix and Linear Algebra, Pretice Hall of India Pvt. Ltd., New Delhi, 2000. 9) S.K. Jain, A.Gunawadena and P.B. Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer – Verlag), 2001. 10) S. Kumarsena, Linear Algebra, a Geometric Approach, Pretice Hall of India, 2000. 11) Vivek Sahai and Vikas Bist, Algebra, Narosa Publishing House, 1999. 12) I. Stewart, Galois Theory, 2nd Edition, Chapman and Hall, 1989. 13) J.P. Escofier, Galois Theory, GTM Vol.204, Springer, 2001. 14) T.Y. Lam, Lectures on Modules and Rings. GTM Vol.189, Springer Verlag, 1999. 15) D.S. Passman, A Course in Ring Theory, Wadsworth and Brooks/ Cole Advanced Books and Softwares, Pacific Groves, California, 1991.

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16) J.A. Gallian, Contemporary Abstract Algebra, Narosa Publication. 17) A.R. Vashistha, Modern Algebra, Krishna Prakashan Media (P) Ltd. 18) V.K. Khanna and Bhambri, a Cource in Abstract Algebra, Vikas Publication, House (P) Ltd. (2010). 19) John B. Fraleigh, a First Course in Abstract Algebra (Seventh Edition). 20) Abstract Algebra (Third Edition) By David S. Dummit, Richard M. Foote, Wilay India Edition. 21) Matrices by A.R. Vashistha and A. K. Vashistha (Krishna). 22) Basic Abstract Algebra by P.B. Bhattacharya, S.K. Jain, S.R. Nagpaul

Paper-VIII : INTEGRAL EQUATIONS

Unit I : Definition of integral equations, Types of integral equations: Fredholm integral equations of the first and second kind, homogeneous Fredholm integral equations of the second kind, Volterra integral equations of first and second kind, Homogeneous Volterra integral equations of the second kind, special kinds of kernels, symmetric kernels, separable and degenerate kernels, Leibnitz rule, solution of integral equations, solved examples, Method of converting an initial value problem into integral equations, solved examples, method of converting a boundary value problems into a Fredholm integral equations. Solved examples.

Unit II : Eigen values and Eigen functions: (a) Solution of homogeneous Fredholm integral equations of the second kind with separable kernels, solved examples based on (a). (b) Solution of Fredholm integral equation of the second kind with separable kernels, Solved examples based on (b).

Unit III : Definition of iterated kernels or functions, definition of resolvent kernels or reciprocal kernel, solution of Fredholm integral equation of the second kind by successive substitutions, solution of Volterra integral equation of the second kind by successive substitutions, Neumann's series, some important theorems, determination of iterated kernels, determination of resolvent kernels for Fredholm integral equations, solution of Fredholm integral equation with the help of resolvent kernels, solution of Fredholm integral equations by method of successive approximation to find solutions up to third order. Solve examples.

Unit IV : Solution of Volterra integral equations of second kind, determination of resolvent kernels for Volterra integral equations, solution of Volterra integral equations with the help of the resolvent kernels, solved examples, Neumann's series, Method of successive approximation for solving Volterra integral equations of second kind, Volterra integral equations of first kind , solution of Volterra integral equations of the first kind, solved examples, some fundamental properties of Eigen values and Eigen functions for symmetric kernels.

Unit V : Applications of integral equations and Green's function to ordinary differential equations, definition of Green's functions, Important theorems, constructions of Green's functions, solved examples, solution of boundary value problems using Green's functions, solved examples, solution of boundary value problems using Green's functions, solved examples, the case of homogeneous and conditions of boundary value problems.

Reference books:

1) Integral equations by Shanti Swaroop, Shiv Raj Singh 2) Linear integral equation, Theory and techniques, Academic press, New York 1971 3) R.P. Kanwal, Linear Integral Equation, Theory and Techniques, Academic Press, N.Y. (1971). 4) S.G. Mikhlin, Linear Integral Equations, Hindustan Book Agency, (1960). 5) A.M. Viazwaz, A First Course in Integral Equations, World Scientific (1997). 6) L.I.G. Chambers, Integral Equation: A Short Course, International Text Book Company Ltd. (1976). 7) Larry Andrews, Bhimsen Shiramoggo, Integral Transform for Engineers, Prentice Hall of India (2003). 8) Integral equations and boundary value problems by M. D. Raisinghania, S. Chand publication

Paper-IX : TOPOLOGY –II

Unit-I : Metric Spaces : Metric Spaces as topological spaces. Topological properties. Hilbert (e2) space. Frechet space. Space of continuous functions.

Unit-II : Complete Metric Spaces : Cauchy sequences, completions, Equivalent conditions, Baire Theorem.

Unit-III : Product Spaces : Finite Products, product invariant properties. Metric Products. Tichonov Topology, Tichonov Theorem.

Unit-IV : Function and Quotient Spaces : Topology of pointwise convergence. Topology of compact convergence. Quotient topology .

Unit-V : Metrization and Paracompactness : Urysohn's metrization theorem, paracompact spaces, Nagata-Smirnov metrization theorem.

Reference Books :

(1) S.R.Munkres, Topology: A First Course, Publisher : Prentice Hall of India. (2) K.D.Joshi Introduction to General Topology , Publishers : WileyEastern Ltd. (3) William J. Pervin Foundation of General Topology, Publisher: Academic Press.

Paper-X : RIEMANNIAN GEOMETRY (OPTIONAL)

Unit-I : Riemannian metric, metric tensor , Christoffel symbol, christoffel symbol of first kind, second kind, properties of Christoffel symbols. Computations of Christoffel's symbols for static and non-static spherically symmetric and R-W spacetimes ,transformation of Christoffel symbols, derivatives of tensor, absolute derivative. Covariant derivatives, divergence, gradient, Laplacian. Unit-II : Parallel Vector Fields : Parallel vector field of constant magnitude, parallel displacement of covariant vector field, parallelism of a vector field of variable magnitude Geodesic : Differential equations of a geodesic, special co-ordinate system : Local cartesians, Riemannian co-ordinates, Normal co-ordinates, Geodesic normal co-ordinates.

Unit-III : Curvature Tensor : Covariant curvature tensor of Riemann tensor , curvature tensor in Riemannian co-ordinates, properties of curvature tensors, on a cyclic property, number of independent components of R.

Unit-IV : Ricci tensor, curvature invariant, Einstein tensor, Computations of Einstein's tensor for static and non-static spherically symmetric and R-W space times, the Bianchi identity. Geodesic deviation : Equations of Geodesic deviation.

Unit-V : Riemannian curvature, space of constant curvature, flat space, tensor derivatives, dual tensors, intrinsic symmetries and killing vectors.

Reference Books :

(1) T. M. Karade, G .S. Khadekar and Maya S.Bendre, Lectures on General Relativity Sonu Nilu Publication. (2) T .J.Willmore .An Introduction in Differential Geometry (3) J. L. Synge,Tensor Calculus – Schild. (4) C.E. Weatherburn, An introduction to Riemannian geometry and tensor calculus, Cambridge university press, (1963) (5) L.P. Eisenhard, Riemannian geometry, University press Princeton (1926) (6) J.A. Schouten, Ricci Calculus, Springer Verlag, Berlin (7) T.Y. Thomas, Concepts from tensor analysis and differential geometry, Academic press, New York (8) W. Boothby,

Introduction to differentiable manifold and Riemannian geometry, Academic press, 1975 (9) S. Kobayashi and K. Nomizu, Foundations of differential geometry, Vol. I and II Wiley Interscience publisher 1963 (Vol.I), 1969 (Vol. II)

Paper-X : ADVANCED DISCRETE MATHEMATICS-II (OPTIONAL)

Unit-I : Graph Theory : Definition of (undirected) graphs, paths, circuits, cycles and subgraphs. Induced subgraphs. Degree of a vertex. Connectivity planar graphs and their properties. Trees, Euler formula for connected planar graphs. Complete and complete bipartite graphs. Kuratowski' s theorem (statement only) and its use.

Unit-II : Graph Theory (Continue): Spanning trees, cut sets, fundamental cut sets, and cycles. Minimal spanning trees and Kruskal's algorithm. Matrix representations of graphs. Euler 's theorem on the existence of Eulerian paths and circuits. Directed graphs. Indegree and outdegree of a vertex. Weighted undirected graphs. Dijkstra' s algorithm. Strong connectivity and Warshall's algorithm. Directed trees. Search trees. Tree traversals.

Unit-III: Introductory Computability Theory : Finite state machines and their transition table diagrams. Equivalence of finite state machines. Reduced machines. Homomorphism. Finite automata acceptors. Non-deterministic finite automata and equivalenceof its power to that of deterministic finite automata. Moore and Mealy machines.

Unit-IV : Grammers and Languages:Phrase structure grammars. Rewriting rules, Derivations, sentential forms. Language generated by a grammer . Regular , context free and context sensitive grammers and languages. Regular sets, regular expressions and the pumping lemma. Kleen' s theorem.

Unit-V : Turing machine and partial recursive functions. notation. Notions of syntax analysis, polish notations. Conversion of infix expressions to polish notations. The reverse polish

References :

(1) N.Deo, Graph Theory with Applications to Engineering and Computer Sciences, Prentice Hall of India. (2) J.R.Tremblay and R. Manohar , Discrete Mathematical Structure with Application to Computer Science, McGraw Hill Book Co., 1997. (3) J.E. Hopcroft and J.D.Ullman, Introduction to Automata Theory , Language and Computation, Narosa Publishing House. (4) C.L. Liu, Elements of Discrete Mathematics, McGraw Hill Books co. (5) F.H. Harary - Graph Theory , Narosa Publishers, New Delhi (1989) (6) K.R.Parthasarthy , Basic Graph Theory (TMH)