M.A./M.Sc. Sem.I to IV Prospectus No. 2011129

संत गाडगे बाबा अमरावती विद्यापीठ

SANT GADGE BABA AMRAVATI UNIVERSITY

विज्ञान विद्याशाखा
(FACULTY OF SCIENCE)

अभ्यासक्रमिका
विज्ञान पारंगत परिक्षा (गणित)
सत्र - १ ते सत्र - ४

PROSPECTUS
OF
MASTER OF SCIENCE EXAMINATION
Semester -I & III Winter 2010,
Semester -II & IV, Summer 2011

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Syllabus Prescribed for
M.A./M.Sc. Part-I & Part-II
Semester I to IV (Mathematics)

M.A./M.Sc. Part-I (Mathematics)

M.A./M.Sc. Part-I -Semester I :
Compulsory Papers

Paper - 1 MTH1 Real Analysis
Paper - 1 MTH2 Advanced Abstract Algebra-I
Paper - 1 MTH3 Comples Analysis-I
Paper - 1 MTH4 Topology-I

Optional Papers : Choose Any One.

Paper - 1 MTH5 i) Differential Geometry-I OR
Paper - 1 MTH6 ii) Advanced Discrete Mathematics-I OR
Paper - 1 MTH7 iii) Differential and Integral Equations-I

M.A./M.Sc. Part-I -Semester II :
Compulsory Papers

Paper - 2 MTH1 Measure and Integration Theory
Paper - 2 MTH2 Advanced Abstract Algebra-II
Paper - 2 MTH3 Comples Analysis-II
Paper - 2 MTH4 Topology-II

Optional Papers : Choose Any One.

Paper - 2 MTH5 Rienannian Geometry OR
Paper - 2 MTH6 Advanced Discrete Mathematics-II OR
Paper - 2 MTH7 Differential and Integral Equations-II

M.A./ M.Sc.-I (MATHEMATICS)
SEMESTER-I
1 MTH-1 : REAL ANALYSIS

Unit-I : Definition and existance of Riemann Stieltjes integral, properties of the integral, Integration and differentiation. The fundamental theorem of calculas, integral of Vector-valued function, rectifiable curves.

Unit-II : 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-III : 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 convergence and differentiation,

Weierstrass approximation theorem.

Unit-IV : Functions of several variables, linear tranformation, derivatives in an open subset of R^n , Chain Rule, partial derivatives, interchange of order of differentiation. Derivatives of higher order, Taylor's theorem.

Unit-V : Inverse function theorem. Implicite function theorem, Jacobians, Extremum problems with constraints, Lagranges multiplier method, Differentiation of integrals.

Text Book :

(1) Walter Rudin; Principles of Mathematical Analysis, Mc Graw Hill Books Company, Third Edition 1976, international student edition.

References :

(1) Apostol T.M., Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.
(2) Eurl D.Rainville : Infinite series, The Macmillan Eompany, 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, (Reprint 2000)
(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 Analysisi, Macmillian Pub. Co. Inc., 4th Edition, New York, 1993.
(10) R.R.Goldberg : Real Analysis, Oxford & I.B.H. Publishing Co., New Delhi - 1970.
(11) Serge Lang, Analysis I & II, Addison - Wesley Publishing Company Inc., 1969.
(12) S.C.Malik : Mathematical Analysis, Wiley Fastern Ltd., New Delhi.
(13) Shani Narayan : A Course of Mathematical Analysis, S.Chand and Company, New Delhi.
(14) White A.J., Real Analysis, an introduction.
(15) Karade T.M. and Salunke J.N., Lectures on Advanced Real Analysis, Sonu Nilu Publication, 2004.

(16) Walter Rudin, Real & Complex Analysis, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

M.A./ M.Sc.-I

Semester-I

1MTH-2 : Advanced Abstract Algebra-i

Unit-I : Automorphisms, conjugacy and G-Sets. Normal series, solvable groups, Nilpotent groups.

Unit-II : Sylow's theorems, group of order P^2, pq, Canonical forms, similarity of linear transformations, invarient subspace, Reduction to triangular forms, Nilpotent transformations, Index of nilpotency, invarient of a nilpotent transformation.

Unit-III : Cyclic modules, simple modules, Shur's lemma, free module.

Unit-IV : Noetherian and Artiniam Module and rings.

Unit-V : Hilbert basics theorem, Wedderburn Artin theorem, uniform modules, Noether Lasker theorem.

Text Book :

Basic Abstract Algebra, P.B.Bhattacharya, S.K.Jani, S.R.Nagpaul.

References :

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 (also published by Hindustan Publishing Company).
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 (Vol.I-1996, Vol.II-1999)
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, Prentice Hall of India Pvt.Ltd., New Delhi, 2000.
9) S.K.Jain, A. Gunawardena and P.B.Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.
10) S.Kumarsena, Linear Algebra, A Geometric Approach, Prentice-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.

M.A./ M.Sc.-I

SEMESTER-I

1MTH-3 : COMPLEX ANALYSIS - I

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, Cauchy-Goursal theorem, Schwarz's lemna.

Unit-III : Singularities, Isolated singularities, classification of isolated singularities, Laurents series development, Casorti-Wierstrass 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^a), Bilinear transformation, Hadamard's three circle theorem.

Unit-V : Spaces of continuous functions, spaces of analytic functions, Hurwitz theorem, Riemann mapping theorem, Wierstrass factorization theorem.

Text Book :

Functions of one complex variable - J.B.Conway, Springer-Verlag International Students Edition, Narosa Publishing House, 1980.

Reference :

1) H.A.Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2) Liang-Shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones & Barlett Publishers. International London, 1996.
3) L.V.Ahlfors, Complex Analysis, McGraw Hill, 1979.
4) S.Lang, Complex Analysis, Addison Wesley, 1977.
5) D.Sarason, Complex Function Theory, Hindustan Book, Agency, Delhi, 1994.
6) Mark J. Ablowitz and A.S.Fokar, Complex Variables : Introduction & Applications, Cambridge University Press, South Asian Edition, 1998.

7) E.Hille, Analytic Function Theory (2 Vols), Gonn & co. 1959.
8) W.H.J.Fuchs, Topics in the Theory of Functions of one complex variable, D.Van Nostrand Co., 1967.
9) C.Caratheodory, Theory of Functions (2 Vols), Chelsea Publishing Company, 1964.
10) M.Heins, Complex Function Theory, Academic Press, 1968.
11) Walter Rudin, Real & Complex Analysis, McGraw Hill Book Co., 1966.
12) S.Saks & A.Zygmund, Analytic Functions, Monografie, Matematyczne, 1952.
13) E.C.Titchmarsh, The Theory of Functions, Oxford University Press, London.
14) W.A.Veech, A secord course in Complex Analysis, W.A.Benjamin, 1967.
15) S.Ponnusamy, Foundation of Complex Analysis, Narosa Publishing House, 1997.

1MTH-4 : TOPOLOGY-I

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

Unit-II : Topological Spaces : Definition and examples of topological spaces. 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 : T_0, T_1 & T_2 spaces. T_2 spaces and sequences. First and Second axiom spaces, separability.

Unit-V : Seperation and Countability Axioms (Contd.) : Regular and normal spaces, Urysohn Lemma, Tietze Extension Theorem. Completely regular spaces.

Text Books :

(1) Foundations of General Topology by William J. Pervin. Publisher : Academic Press.

Scope :

Unit-I : Chapter 2
Unit-II : Chapter 3
Unit-III : Chapter 4
Unit-IV : Chapter 5 : From Pg. No. 69 to 87.

Unit-V : Chapter 5 : From Pg.No. 87 to 98.

References Books :

(1) Theory and Problems of Set Theory and Related Topics by Semour Lipshutz, Publisher : SchaumPublishing Co., New York.
(2) Topology : A First Course, by J.R.Munkres, Publishers Prentice Hall of India.
(3) Introduction to General Topology, By K.D.Joshi, Publisher, Wiley Eastern Ltd.
(4) A Text Book on Topology, By R.S.Aggarwal, Publisher : S.Chand & Company.

1MTH-5 :(i) DIFFERENTIAL GEOMETRY-I (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 : 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, Affine Tensors and Tensorial forms, Connexions, covariant differentiation, Absolute derivation of Tensorial forms, Tensor connexions.

Text Books :

"An Introduction to Differential Geometry", By T.J.Wilmore, Oxford University Press (1959)

References :

(1) A course in Differential Geometry by W.Klingenberg (Springer)
(2) Riemannion Geometry and Tensor Calculus by Weatherburn, C.

OR

1MTH5 : (ii) ADVANCED DISCRETE MATHEMATICS -I (OPTIONAL)

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. Sub-semigroups 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.

1MTH5 : (iii) DIFFERENTIAL AND INTEGRAL EQUATIONS-I (OPTIONAL)

Unit-I : Existence theorems, Linear equations of arbitrary order, solutions of linear equations, linear system with constant coefficients, operational calculus and solutions of linear differential equations, infinite series solutions.

Unit-II : Solutions of differential equations by definite integrals, Boundary value problems, Green's functions, expansion theorems, non-linear differential equations.

Unit-III : Fourier Transform : Definition, properties, evaluation of Fourier and inverse Fourier transform of functions, Convolution theorem for Fourier transform, Sine and Cosine Fourier transforms, solving differential and integral equation using Fourier transform.

Unit-IV : Mellin Transform : Definition, properties and evaluation of transforms, Convolution theorem for Mellin transform, application to integral equation.

Unit-V : Hankel Transform : Definition, properties and evaluation of Hankel transform, application to integral equation, Finite Hankel transform.

Text Book :

(1) Lassy Andrews, Bhimsen Shivamosgo, Integral Transform for Engineers, Prentice Hall of India (2003).

References :

(1) W.T.Reid, Ordinary Differential Equation, John Wiley and Sons, N.Y. (1971)

(2) E.A.Coddington and N.Levinson, Theory of Ordinary Differential Equations, McGraw Hill, N.Y. (1955)

(3) I.N.Sneddon, The use of Integral Transform, Tata McGraw Hill Publishing Company Ltd.

(4) Zalman Rubinstein, A Course in Ordinary and Partial Differential Equations, Academic Press, N.Y. and London.

SYLLABUS PRESCRIBED FOR M.A./M.Sc.-II

SEMESTER-II

2MTH-1 : 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, uniqueness of Extension, completion of a measure, measure spaces, integration with respect to a measure.

Unit-V : The L^P spaces, convex functions, Jensen's inequality. Holder and Minkowski inequality. Completeness of L^P, convergence in measure. Almost Uniform convergence.

Text Book :

G.de Barra, Measure Theory and Integration. Wiley Eastern Limited, 1981.

References :

(1) Bartle R.G., The Elements of Integration, John Wiley & Sons, Inc., New York, 1966.

(2) Halmos P.R., Measure Theory, Van Nostrand Princeton, 1950.

(3) Hawkins T.G., Lebesgue's Theory of Integration, its origins and Development, Chelsea, New York, 1979.

(4) Inder K. Rana, An Introduction to Measure and Integration, Narosa Publishing House, Delhi, 1997.

(5) Karade T.M., Salunke J.N., Lectures on Advanced Real Analysis, Sonu Nilu Publication, Nagpur, 2004.

(6) Royden H.L., Real Analysis, Macmillan Pub. Co. Inc., 4th Edition, New York, 1993.

SEMESTER-II

2MTH-2 : ADVANCED ABSTRACT ALGEBRA-II

Unit-I : Extension fields, Algebraic and trancendutal extensions, separable and inseparable extensions, normal extensions.

Unit-II : Perfect Fields, Finite fields, primitive elements, algebraically closed fields, automorphism of extensions, Galois extensions, Fundamental theorem of Galois theory, Fundamental theorem of Algebra.

Unit-III : Roots of Unity and cyclotomic polynomials, cyclic extensions, solution of polynomial equations by radicals, Insolvability of the general equations of degree 5 by radicals, Ruler and Compass construction.

Unit-IV : Smith Normal Form over a PID and Rank : Preliminaries, row module, column modul;e and rank, Smith normal form.

Unit-V : Fundamental Structure theorem for finitely generated modules over a PID and its applications to finitely generated abelian groups.

Text Book :

Basic Abstract Algebra, P.B.Bhattacharya, S.K.Jani, S.R.Nagpaul

Reference Books :

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 (also published by Hindustan Publishing Company).

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 (Vol.I-1996, Vol.II-1999)

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, Prentice Hall of India Pvt.Ltd., New Delhi, 2000.

9) S.K.Jain, A. Gunawardena and P.B.Bhattacharya, Basic Linear Algebra with MATLAB, Key College Publishing (Springer-Verlag), 2001.

10) S.Kumarsena, Linear Algebra, A Geometric Approach, Prentice-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.

SEMESTER-II

2MTH-3 : COMPLEX ANALYSIS-II

Unit-I : The Gamma function and its properties, the Riemann Zeta Function, Remann's Functional Equation, Euler's theorem, Mittag-Leffler's Theorem.

Unit-II : Analytic Continuation, uniqueness of direct analytic continuation, uniqueness of analytic continuation along a curve, power series method of analytic continuation.

Unit-III : Schewartz Reflection Principle, monodromy theorem and its consequences, Harmonic functions on a disk, Harnack's inequality, Dirichlet's problem, Green's function.

Unit-IV : Canonical products, Jensen's formula, Poisson-Jensen formula, The genus and order of an entire function, exponent of convergence, Hadamard's factorization theorem.

Unit-V : The range of an analytic function, Bloch theorem, Little Picards theorem, Schottky's theorem, univalent functions, Bieberbach's conjecture (Statement only), Cobe's "1/4" theorem

Text Book :

Functions of one complex variable - J.B.Conway, Springer-Verlag International Students Edition, Narosa Publishing House, 1980.

References :

1) H.A.Priestly, Introduction to Complex Analysis, Clarendon Press, Oxford, 1990.
2) Liang-Shin Hahn & Bernard Epstein, Classical Complex Analysis, Jones & Barlett Publishers. International London, 1996.
3) L.V.Ahlfors, Complex Analysis, McGraw Hill, 1979.
4) S.Lang, Complex Analysis, Addison Wesley, 1977.
5) D.Sarason, Complex Function Theory, Hindustan Book, Agency, Delhi, 1994.
6) Mark J. Ablowitz and A.S.Fokar, Complex Variables : Introduction & Applications, Cambridge University Press, South Asian Edition, 1998.
7) E.Hille, Analytic Function Theory (2 Vols), Gonn & co. 1959.
8) W.H.J.Fuchs, Topics in the Theory of Functions of one complex variable, D.Van Nostrand Co., 1967.
9) C.Caratheodory, Theory of Functions (2 Vols), Chelsea Publishing Company, 1964.
10) M.Heins, Complex Function Theory, Academic Press, 1968.
11) Walter Rudin, Real & Complex Analysis, McGraw Hill Book Co., 1966.

12) S.Saks & A.Zygmund, Analytic Functions, Monografie, Matematyczne, 1952.
13) E.C.Titchmarsh, The Theory of Functions, Oxford University Press, London.
14) W.A.Veech, A secord course in Complex Analysis, W.A.Benjamin, 1967.
15) S.Ponnusamy, Foundation of Complex Analysis, Narosa Publishing House, 1997.

SEMESTER-II

2MTH-4 : 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.

Text Book :

Foundation of General Topology by William J. Pervin, Publisher : Academic Press.

Reference Books :

(1) Topology : A First Course, by S.R.Munkres, Publisher : Prentice Hall of India.
(2) Introduction to General Topology, by K.D.Joshi, Publishers : Wiley Eastern Ltd.
(3) A Text Book on Topology, By R.S.Aggarwal, Publisher : S.Chand & Co.

SEMESTER-II

2MTH-5 : (i) RIEMANNIAN GEOMETRY (OPTIONAL)

Unit-I : Riemannian metric, metric tensor, christoffel symbol, christoffel symbol of first kind, second kind, properties of christoffel symbols, 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 companents of R_{prmn}.

Unit-IV : Ricci tensor and Einstein tensor, Ricci tensor, curvature invariant, Einstein tensor, the Bianchi identity. Geodesic deviation : Equations of Geodesic deviation.

Unit-V : Riemannian curvature, space of constant curvature, flat space, cartesian tensor.

Reference Books :

(1) Lectures on General Relativity - T.M.Karade, G.S.Khadekar and Maya S.Bendre, Sonu Nilu Publication.

(2) An Introduction in Differential Geometry - T.J.Willmore.

(3) Tensor Calculus - Schild, J.L.Synge.

SEMESTER-II

(ii) : 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 equivalence of 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.
Notions of syntax analysis, polish notations. Conversion of infix expressions to polish notations. The reverse polish notation.

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)

SEMESTER-II

(iii) : DIFFERENTIAL AND INTEGRAL EQUATIONS-II (OPTIONAL)

Unit-I : Fredholm Equations : Some Problems which give rise to integral equations, conversion of ordinary differential equations into integral equations, integro-differential equations.

Unit-II : Degenerated Kernels, Hermitian and symmetric Kernel, the Hilbert-Schmidt theorem, Hermitization and Symmetrization of Kernels, Solutions of integral equations with Green's function type Kernels.

Unit-III : Volterra Integral Equation : Types of Volterra equations, Resolvent Kernel of volterra equations, convolution type Kernel, some miscellaneous type of volterra equations.

Unit-IV : Non-linear Volterra equations, approximate methods, application to Volterra equations with comvolution type Kernels.

Unit-V : Existence and uniqueness of solution using fixed point theorem in case of linear and non-linear Volterra and Freedholm integral equations.

References :

(1) R.P.Kanwal, Linear Integral Equation, Theory and Techniques, Academic Press, N.Y. (1971)

(2) S.G.Mikhlin, Linear Integral Equations, Hindustan Book Agency, (1960)

(3) A.M.Viazwaz, A First course in Integral Equations, World Scientific (1997)

(4) L.I.G. Chambers, Integral Equation : A Short Course, International Text Book Company Ltd. (1976)

(5) Larry Andrews, Bhimsen Shiramoggo, Integral Transform for Engineers, Prentice Hall of India (2003).

SYLLABUS PRESCRIBED FOR
M.A./M.Sc. Part-II (Mathematics)

Semester III Compulsory Papers

3 MTH-1 : Functional Analysis-I

3 MTH-2 : Classical Mechanics

Choose Any three from the following optional papers

3 MTH-3 : (303) General Relativity and Cosmology-I
3 MTH-4 : (304) Fluid Dynamics-I
3 MTH-5 : (305) Operations Research-I
(306) Difference Equations-I
(307) Fuzzy Sets and Applications-I
(308) Wavelet Analysis
(309) Banach Algebras-I
(310) Non-Commulative Rings-I

Semester IV : Compulsory Papers

4 MTH-1 Functional Analysis-II

4 MTH-2 Partial Differential Equations

Choose Any three from the following optional papers

Paper - 4MTH3 i) General Relativity and Cosmology-II
4MTH4 ii) Fluid Dynamics-II
4MTH5 iii) Operations Research-II
iv) Difference Equations-II
v) Fuzzy Sets and Applications-II
vi) Lie Groups
vii) Banach Algebra-II
viii) Non-Commutative Rings-II

SEMESTER-III
3MTH-1 : FUNCTIONALANALYSIS-I

Unit-I : Normal linear spaces, Banach spaces and examples. Quotient spaces of normed linear spaces and its completeness, equivalent norms, Riesz lemma.

Unit-II : Basic Properties of finite dimensional normed linear spaces and compactness. Weak convergence and bounded linear transformations, normed linear spaces of bounded linear transformations, Dual spaces with example.

Unit-III : Boundedness theorem and some of its consequences, open mapping, Hahn Banach theorem for real linear spaces, complex linear spaces and normed linear spaces.

Unit-IV : Reflexive Spaces, Weak sequential compactness, compact operators, solvability of linear equations in Banach spaces, the closed graph theorem.

Unit-V : Inner product spaces, Hilbert spaces, orthogonal sets, Bessel's inequality, complete orthogonal sets, Parseval's identity, structure of Hilbert spaces, Projection theorem.

Text Book :

E.Kreyszig, Introductory Functional Analysis with Applications, John Wiley and Sons, New York, 1978.

References :

1) Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1967.

2) G.Bachman and L.Narici, Functional Analysis, Academic Press, 1966.

3) N.Dunford and J.T.Schwartz, Linear Operators, Part-I, Interscience, New York, 1958.

4) R.E.Edwards, Functional Analysis, Holt Rinehart and Winston, New York, 1965.

5) C.Goffman and Pedrick, First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.

6) P.K.Jain, O.P.Ahuja and Khalil Ahmad, Functional Analysis, New Age International (P) Ltd. & Wiley Eastern Ltd., New Delhi, 1997.
7) R.B.Holmes, Geametric Functional Analysis and its Applications, Springer-Verlag, 1975.
8) K.K.Jha, Functional Analysis, Students Friends, 1986.
9) L.V.Kantorovich and G.P.Akilov, Functional Analysis, Pergamon Press, 1982.
10) B.K.Lahiri, Elements of functional Analysis, The World Press pvt.Ltd., Calcutta, 1994.
11) B.Choudhary and Sudarsan Nanda, Functional Analysis with Applications, Wiley Eastern Ltd., 1989.
12) B.V.Limaye, Functional Analysis, Wiley Eastern Ltd.
13) L.A.Lusternik and V.J.Sobolev, Elements of Functional Analysis, Hindustan Publishing Coorporation, New Delhi, 1971.
14) G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company, New York, 1963.
15) A.E.Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.
16) K.Yozida, Functional Analysis, 3rd Edition, Springer Verlag, New York, 1971.
17) J.B.Conway, A Course in Function Analysis, Springer Verlag, New York, 1990.
18) Walter Rudin, Function Analysis, Tata McGraw Hill, Publishing Company Ltd. New Delhi, 1973.
19) A.Wilansky, Function Analysis, Blaisdell Publishing Company, 1964.
20) J.Tinsley Oden & Leszek F., Demkowicz, Applied Functional Analysis, CRC Press Inc., 1996.
21) A.H.Siddiqui, Function Analysis with Applications, Tata McGraw Hill, Publishing Company Ltd. New Delhi.

SEMESTER-III

3MTH-2 : CLASSICAL MECHANICS

Unit-I : Variational principle and Lagranges Equations : Hamilton's principle, some techniques of the calculus of variations. Derivation of Lagrange's Equations from Hamilton's Principle.

Unit-II : Generalised coordinates, Halonomic & Non-holonimic systems, Scleronomic and Rheonomic systems, Generalized potential, Lagranges Equations of first kind and second kind, uniqueness of solution, Energy equations for conservative fields.

Unit-III : Legendre transformations and the Hamilton equations of motion, cyclic coordinates and conservation theorems, Routh's equations, Derivation of Hamilton's equations from a variational principle, the principle of least action..

Unit-IV : Canonical transformations : The equations of Canonical transformation, examples of canonical transformations. Poisson's bracket & other canonical invariants (Lagranges Bracket), Poisson's identity.

Unit-V : The Hamilton-Jacobi Equation for Hamilton's principle function, The harmonic Oscillator problem as an example of the Hamilton-Jacobi method. The Hamilton-Jacobi Equation for Hamilton's characteristic function, Separation of variables in the Hamilton-Jacobi equation.

Text Book :

(1) Classical Mechanics : By H.Goldstein, Second edition, Narosa Publishing House, New Delhi.

(2) Classical Mechanics : By N.C.Rana & P.S.Joag, Tata Mc Graw Hill, 1991.

References :

(1) A.S.Ramsey Dynamics Part-II, the English Language Book Society and Cambridge University Press.

SEMESTER-III

3MTH-3/4/5(i) : GENERAL RELATIVITY AND COSMOLOGY-I (OPTIONAL)

Unit-I : Principle of Equivalence and Mach's, Covariance, Geodesic Principle, Newtonian approximation of relativistic equations of motion, Einstein field equation and Newtonian approximation.

Unit-II : Schwarzs child exterior solution and its isotopic form, planetary orbits, General Relativistic Kepler problem, Advance of Perihelion of a Planet, Bending of Light rays in a gravitational field, Gravitational Red shift in Spectral lines.

Unit-III : Schwarzschild interior solution, Linearisation of field equations, time-independent and spherically symmetric field, The Weyl's solutions to the linearized field equations.

Unit-IV : Eddington's form of the Schwarzschild solution, Einstein's equations for Degenerate metrices, the order m2 equations, Field equations for stationary case.

Unit-V : The Schwarzschild and Kerr solutions, other coordinates, The Kerr solution and Rotation, Distinguished surfaces and the Rotating Black Hole.

References :

(1) Introduction to General Relativity - Ronald Ader, Maurice Bazin, Menahem Schiffer, 2nd Edtion, McGraw Hill Company.

(2) Lectures of Relativity - T.M.Karade, et al Einstein Foundtion International, Nagpur.

(3) Gravitation and Cosmology : Principles and Applications of General Theory of Relativity - Steven Weinberg, John Wiley Publication.

(4) Relativity, Thermodynamics and Cosmology - R.C.Tolman (Oxford Press)

(5) General Relativity and Cosmology - J.V.Narlikar, Macmillan Company of India, 1978.

(6) Mathematical Theory of Relativity - A.S.Eddington, Cambridge University Press, 1965.

SEMESTER-III

(ii) : FLUID DYNAMICS-I (OPTIONAL)

Unit-I : Kinematics of fluid in Motion : Real fluids and ideal fluids. Velocity of a fluid at a point stream lines and pathlines. Steady and unsteady flows. Velocity potential, vorticity vector, local and particles rates of change. Equation of continuity, worked examples. Acceleration of a fluid. Conditions at a rigid boundary, general analysis of fluid motion.

Unit-II Pressure of motion of a fluid : Pressure at a point in a fluid at rest. Pressure at a point in a moving fluid, conditions at a boundary of two inviscid immiscible fluids, Euler's Equation of motion. Bernoulli's equation, worked examples. Discussion of the case of steady motion under conservative body forces, some potential theorem, some special two dimensional flow. Some further aspects of vartex motion.

Unit-III : Sources, sinks and Doublets, images in a rigid infinite plane. Images in a solid spheres. Asci-symmetric flow, Stokes stream function. Some two dimensional flows, meaning of two dimensional flow, use of cylindrical polar coordinate, the stream function, the complex potential for two dimensional, irrotational incompressible flow. Complex velocity potentials for standard two-dimensional flows, uniform stream, line source and link sinks, link system.

Unit-IV : The Milne-Thomsom circle theorem, some application of the circle theorem, extension of the circle theorem, the theorem of Wasins, the use of conformal transformation. Vortex rows, single infinite row of line vortices. The Karnar vortex street.

Unit-V : Elements of Thermodynamics : The equation of state of substance, the first law of Thermodynamics, internel energy of a gas. Specific heat of a gas. Function of state, Entropy, Maxwell's Thermodynamics relation. Iso-thermal Adiabatic and Isentropic Process.

Text Book :

(1) F.Chorlton, Text Book of Fluid Dynamics, CBS Publishers, Delhi, 1985.

References :

(1) Besaint and A.S.Ramsay, A Treatise on Hydrodynamics, Part-II, CBS Publishers, Delhi, 1988.

(2) G.K.Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi, 1994.

(3) H.Schlichting, Boundary Layer Theory, McGraw Hill Book Company, New York, 1971.

(4) M.D.Raisinghania, Fluid Mechanics (With Hydrodynamics), S.Chand and Company Ltd., New Delhi.

(5) L.D.Landen and E.M.Lipschitz, Fluid Mechanics, Pargamon Press, London, 1985.

(6) R.K.Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.

(7) A.D.Young, Boundary Layers, AIAA Education Series, Washington, DC, 1989.

(8) S.W.Yuan, Foundation of Fluid Mechanics, Prentice Hall of India Private Limited, New Delhi, 1976.

SEMESTER-III

(iii) : OPERATION RESEARCH-I (OPTIONAL)

Unit-I : Operation Research & its scope. Necessity of operation research in industry, linear programming. Simplex method. Theory of the simplex method, Duality and sensitivity analysis.

Unit-II : Other algorithms for linear programming-dual simplex method, parametric linear programming, upper bound technique, interior point algorithm, linear goal programming.

Unit-III : Transportation and assignment problems, network analysis, shortest path problem, minimum spanning tree problem, maximum flow problem.

Unit-IV : Minimum cost flow problem, network simplex method, product planning, control with PERT-CPM.

Unit-V : Deterministic and probabilistic dynamic programming.

Text Book :

(1) F.S.Hillier and G.J.Liebermann, Introduction to Operations Research (6th Ed.) Mc Graw Hill International Edition, Industrial Engineering Series, 1995.

(2) Kantiswaroop, P.K.Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.

Reference Books :

1) G.Hadley, Linear Programming, Narosa publishing House, 1995.

2) G.Hadle, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.

3) Mokhtar S.Bazaraa, Hohn J.Jarvis and Hanif D.Sherali, Linear Programming and Network flows, John Wiley & Sons, New York, 1990.

4) H.A.Taha, Operations Research - an Introduction, Macmillan Publishing Company, Inc, New York.

5) S.S.Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.

6) Prem Kumar Gapta and D.S.Hira, Operations Research - An Introduction. Chand & company Ltde, New Delhi.

7) N.S.Kambo, Mathematical Programming Techniques. Affiliated East-West Press Pvt.Ltd., New Delhi, Madras.

SEMESTER-III

(IV) : DIFFERENCE EQUATIONS-I

Unit-I : Introduction : Difference calculus. The difference operator. Generating function and approximate summation.

Unit-II : Linear Difference Equations : First Order Equations, General results for linear equations. Equations with constant coefficients. Applications, Equations with variable coefficients. Non-linear equations that can be linearized.

Unit-III : The Z-transform : Properties, initial and final value theorems, partial sum theorem, convolution theorem. Inverse Z-transforms, solution of difference equation with constant coefficients by Z-transforms.

Unit-IV : Stability Theory : Initial value problems for linear systems. Stability of linear systems. Stability of non-linear system. Chaotic behaviour.

Unit-V : Asymptotic Methods : Introduction, Asymptotic analysis of sums, linear equations, non-linear equations.

Text Book :

Walter G. Kelley and Allan C. Peterson, Difference Equations : An Introduction with Applications, Academic Press, Inc. Harcourt Brace Joranovich Publishers, 1991.

Reference Books :

(1) Calvin Ahlbrandt and Allan C-Peterson, Discrete Hamiltonian systems. Difference Equations. Continued Fractions and Riccati Equations, Kluwer, Boston, 1996.

(2) Saber Elaydi, An Introduction to Difference Equations, Springer, 1999.

(3) Pundir S.K. and Pundir R., Difference Equations, Pragati Prakashan Meerut, 2006.

SEMESTER-III

(V) : FUZZY SETS AND APPLICATIONS-I (OPTIONAL)

Unit-I : Fuzzy sets - basic definitions, a-level sets. Convex fuzzy sets, basic operations on fuzzy sets, cartesian products, Algebraic products, bounded sum and difference t-norms and t-conorms ([1] Cha.1).

Unit-II : The Extension Principle - The Zade's extension principle, image and inverse image of fuzzy sets, Fuzzy numbers and elements of fuzzy arithmetic ([1] Cha.2).

Unit-III : Fuzzy relations and fuzzy graphs - Fuzzy relations fuzzy sets, composition of fuzzy relations. Min-Max composition and its properties, fuzzy equivalence relations, fuzzy computability relations, fuzzy relations equations, fuzzy graphs, similarity relations ([1] Cha.3).

Unit-IV : Possibility theory - fuzzy measures, evidence theory, possibility theory and fuzzy sets ([1] Cha.4).

Unit-V : Fuzzy Logic - An Overview of classical logic, multivalued logics, fuzzy propositions, fuzzy quantifiers ([2] Cha.8, 8.1-8.4).

Text Books :

(1) H.J.Zimmermann, Fuzzy Set Theory and its applications, Allied Publ. Ltd., New Delhi, 1991.

(2) T.Terano, Fuzzy system and its applications, Academic Press, 2001.

Reference Books :

(1) G.J.Klir and B.Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall of India, New Delhi, 1995.

SEMESTER-III

(VI) : WAVELET ANALYSIS (OPTIONAL)

Unit-I : Preliminaries - Linear algebra, Hilbert spaces, Fourier series, Fourier integral and signal processing. [Cha.1 (1.1-1.4)]

Unit-II : Windowed Fourier transform - Motivation and definition, time frequency localization, the reconstruction formula. [Cha.2 (2.1-2.3)]

Unit-III : Continuous Wavelet Transforms - Motivation and definition of Wavelet Transforms, the constructions formula, frequency localization. [Cha.3 (3.1-3.3)]

Unit-IV : Generalized Frames - From resolution of unity to frames, reconstruction formula and consistancy condition, Recursive construction. [Cha.4 (4.1, 4.2, 4.4)]

Unit-V : Discrete Time - Frequency analysis, Shannon sampling theorem, sampling in the time frequency domain, time sampling verses frequency sampling. [Cha.5 (5.1-5.3)]

Text Book :

(1) Gerald Kaiser : A Friendly Guide to Wavelets, Birkhauser, 1994.

Reference Books :

(1) Eugenio Hernandez & Guido Weiss, A First Course on Wavelets, CRC Press, New York, 1996.

(2) Chui C.K., An Introduction to Wavelets, Academic Press, 1992.

(3) M.W.Wang : Wavelet Transforms & Localization Operators, Berkhauser BVerleg.

SEMESTER-III

(VII) : BANACH ALGEBRAS-I (OPTIONAL)

Unit-I : Definition of Banach Algebra and Examples. Singular and non-singular elements. The abstract index. The spectrum of an element.

Unit-II : The Spectral radius. Gelfund formula. Multiplicative linear functionals and the maximal ideal space. Gleason Kahane Zelazko theorem.

Unit-III : The Gelfand Transforms, the spectral mapping theorem. Isometric Gelfand transform. Maximal ideal spaces for disc algebra and the algebra $1_1(Z)$.

Unit-IV : C* - algebras : Definition and examples, self-adjoint, unitary, normal, positive and projection elements in C* - algebras.

Unit-V : Commutative C* algebras. C* - homomorphisms. Representation of commutative C*-algebras.

Text Book :

M.A.Naimark, Normed Algebras, Groningen, Netherlands, 1972.

Reference Books :

(1) C.E.Rickart, General Theory of Banach Algebras, Von Nostrand, 1960.

(2) T.W.Palmer, Banach Algebras Vol.-I, Cambridge University Press, 1994.

SEMESTER-III

(VIII) : NON COMMUTATIVE RINGS-I (OPTIONAL)

Unit-I : Basic Terminology and examples. Semi simplicity (x1, x2 of [1]).

Unit-II : Structure of Semi simple rings. (x3 of [1]).

Unit-III : The Jacobson Radical (x4 of [1]).

Unit-IV : The prime radical; prime and semi prime rings. Structure of primitive rings; the Density Theorem (x10, x11 of [1]).

Unit-V : Sub-direct products and commutativity theorems. (x12 of [1]).

Text Book :

(1) A First Course in Non-commutative Rings by T.Y.Lam, Springer-Verlag, 1991.

Reference Books :

(1) I.N.Herstein, Non commutative Rings, Carus Monographs of AMS, 1968.

(2) N.Jacobson, Basic Algebra II, WH Freeman, 1989.

(3) D.Passman, A Course in Ring Theory, Wadsworth and Brooks / Cole Pacific Grove Colif, 1991.

(4) Louis H. Rowen, Ring Theory, (Student Edition), Academic Press, 1991.

SYLLABUS PRESCRIBED FOR

M.A./M.Sc.II

SEMESTER-IV

4MTH-1 : FUNCTIONAL ANALYSIS-II

Unit-I : Riesz Representation theorem, adjoint of an operator on a Hilbert space, Reflexivity of Hilbert spaces, self adjoint operators, positive, projection, normal and unitary operators.

Unit-II : Spectral properties of bounded linear operators, basic concepts, further properties of resolvent and spectrum, use of complex analysis in spectral theory.

Unit-III : Compact linear operators on normed spaces, further properties of compact linear operators, spectral properties of compact linear operators on normed spaces.

Unit-IV : Spectral properties of bounded self-adjoint linear operators, further spectral properties of bounded self-adjoint linear operators.

Unit-V : Positive operator, square root of positive operator, projection operators, spectral family.

Text Book :

(1) E.Kreyszig : Introductory functional analysis with applications, John Wiley & Sons, New York, 1978.

References :

1) Serge Lang, Analysis I & II, Addison-Wesley Publishing Company, Inc. 1967.
2) G.Bachman and L.Narici, Functional Analysis, Academic Press, 1966.
3) N.Dunford and J.T.Schwartz, Linear Operators, Part-I, Interscience, New York, 1958.
4) R.E.Edwards, Functional Analysis, Holt Rinehart and Winston, New York, 1965.
5) C.Goffman and Pedrick, First Course in Functional Analysis, Prentice Hall of India, New Delhi, 1987.
6) P.K.Jain, O.P.Ahuja and Khalil Ahmad, Functional Analysis, New Age International (P) Ltd. & Wiley Eastern Ltd., New Delhi, 1997.
7) R.B.Holmes, Geametric Functional Analysis and its Applications, Springer-Verlag, 1975.
8) K.K.Jha, Functional Analysis, Students Friends, 1986.
9) L.V.Kantorovich and G.P.Akilov, Functional Analysis, Pergamon Press, 1982.
10) B.K.Lahiri, Elements of functional Analysis, The World Press pvt.Ltd., Calcutta, 1994.
11) B.Choudhary and Sudarsan Nanda, Functional Analysis with Applications, Wiley Eastern Ltd., 1989.
12) B.V.Limaye, Functional Analysis, Wiley Eastern Ltd.
13) L.A.Lusternik and V.J.Sobolev, Elements of Functional Analysis, Hindustan Publishing Coorporation, New Delhi, 1971.
14) G.F.Simmons, Introduction to Topology and Modern Analysis, McGraw Hill Book Company, New York, 1963.
15) A.E.Taylor, Introduction to Functional Analysis, John Wiley and Sons, New York, 1958.
16) K.Yozida, Functional Analysis, 3rd Edition, Springer Verlag, New York, 1971.
17) J.B.Conway, A Course in Function Analysis, Springer Verlag, New York, 1990.
18) Walter Rudin, Function Analysis, Tata McGraw Hill, Publishing Company Ltd. New Delhi, 1973.
19) A.Wilansky, Function Analysis, Blaisdell Publishing Company, 1964.
20) J.Tinsley Oden & Leszek F., Demkowicz, Applied Functional Analysis, CRC Press Inc., 1996.

21) A.H.Siddiqui, Function Analysis with Applications, Tata McGraw Hill, Publishing Company Ltd. New Delhi.

SEMESTER-IV

4MTH-2 : PARTIAL DIFFERENTIAL EQUATIONS

Unit-I : Four important linear partial differential equations, transport equation - initial value problem, Non homogeneous problem, Laplace equation, Fundamental solution, Mean Value formulas, Properties of harmonic functions, Green's function, Energy methods.

Unit-II : Heat Equation : Fundamental solution, Mean Value formula, Properties of solutions, Energy methods.

Unit-III : Wave Equation : Solution by spherical means, Nonhomogeneous problem, Energy methods.

Unit-IV : Nonlinear first order PDE : Complete integral, new solutions from envelopes, derivation of characteristic ODE, Examples, Boundary conditions, Local solution, Applications.

Unit-V : Calculus of variations, Hamilton's ODE, Legendre transform, Hopf-Lex formula, Weak solutions, uniqueness.

Text Book :

Lawrence C. Evans : Partial Differential Equations, Graduate studies in Mathematics, Vol.19. American Mathematical Society, Providence Rhode Island.

References :

(1) I.M.Sreddon : Elements of Partial Differential Equation, Mc Graw Hill, International Editon.

(2) Phoolan Prasad : Partial Differential equations, New Age and Renuka Ravindram, International Publishers.

SEMESTER-IV

4MTH-3/4/5 (i) : GENERAL RELATIVITY AND COSMOLOGY-II (OPTIONAL)

Unit-I : Einstein Field Equations with Cosmological term, static cosmological models of Einstein and De-sitter, their derivations, properties and comparision with the actual Universe.

Unit-II : Cosmological principle, Hubble's law, Weyls Postulate, Steady State Cosmological models, Derivation of Roberson-Walker Metric, Further Properties.

Unit-III : Hubble and deceleration parameters, Redshift, matter dominated era of the Universe steady state cosmology, Friedmann model. Fundamental Equation of dynamical

Cosmology, Critical density, Closed and open universe, Age of the Universe.

Unit-IV : Relativistic Stellar Structure, A Simple Stellar model - The interior Schwartzchild solution, stellar models and stability.

Unit-V : The field of a charged mass point, Weyl's generalizaton of Riemannian geometry, Weyl's theory of electromagnetism.

References :

(1) Lectures on Relativity : T.M.Karade, et al Einstein Foundation International, Nagpur.

(2) Introduction to General Relativity - Ronald Ader, Maurice Bazin, Menahem, Schiffer.

(3) Mathematical Theory of Relativity : A.S.Eddington, Cambridge University Press, 1965.

(4) Relativity : The General Theory - J.L.Synge, North Holland Publishing Company, 1976.

(5) The Classical Theory of Fields - I.D.Landau and E.M.Lifshitz, Pergamon Press, 1980.

(6) An Introduction to Riemannian Geometry and the Tensor Calculus - C.E. Weatherburn, Cambridge University Press, 1950.

SEMESTER-IV

4MTH-3/4/5 (ii) : FLUID DYNAMICS-II (OPTIONAL)

Unit-I : Gas Dynamics : Compressibility effects in real fluids, the elements of wave motion, one dimensional wave equation, wave equation in two and in three dimensions, spherical waves, progressive and stationary waves, the speed of sound in gas equation of motion of a gas, subsonic, sonic and supersonic flows, isentropic gas flow, Reservoir discharge through a channel of varying section. Investigation of maximum mass flow through a nozzle. Shockwaves, formation of shockwaves, elementary analysis of normal shock waves.

Unit-II : Viscous Flow : Stress components in a real fluid, relation between cartesian components of stress, translation motion of fluid element, the rate of strain quadric and principal stresses. Some further properties of the rate of strain quadric and principal stresses, stress analysis in fluid motion, relation between stress and rate of strain, the coefficient of viscosity and Laminar flow.

Unit-III : The Navier stokes equations of motion of a viscous fluid, some solvable problem in viscous flow, steady motion between parallel planes, steady flow through tube of

uniform circular cross section, steady flow between cocentric rotating cylinders, diffusion of vorticity energy dissipation due to viscosity steady flow past a fixed sphere.

Unit-IV : Magnetohydrodynamics : Nature of Magnetohydrodynamics, Maxwell's electromagnetic field equation, medium at rest, medium in motion, the equation of motion of a conducting fluid rate of flow of charge, simplification of the electromagnetic field equations, the magnetic Renolds number, Alfvens theorem, the magnetic body force, Ferraro's laws of isorotation.

Unit-V : Dynamical similarity, Buckingham p-theorem, Reynold number, Prandt's boundary layer, Boundary layer equations in two dimensions, Blasing solutions, boundary layer thickness, displacement thickness, Karmar integral conditions, seperation of boundary layer flow.

Text Book :

(1) Chorlton, Text Book of Fluid Dynamics, CBS Publishers, Delhi, 1985.

References :

(1) W.H.Besaint and A.S.Ramsay, A Treatise on Hydrodynamics, Part-II, CBS Publishers, Delhi, 1988.

(2) G.K.Batchelor, An Introduction to Fluid Mechanics, Foundation Books, New Delhi, 1994,

(3) H.Schlichting, Boundary Layer Theory, McGraw Hill Book Company, New York, 1971.

(4) M.D.Raisinghania, Fluid Mechanics (With Hydrodynamics) S.Chand and Company Ltd., New Delhi.

(5) L.D.Landen and E.M.Lipschite, Fluid Mechanics, Pargamon Press, London, 1985.

(6) R.K.Rathy, An Introduction to Fluid Dynamics, Oxford and IBH Publishing Company, New Delhi, 1976.

(7) A.D.Young, Boundary Layers, AIAA Education Series, Washington, DC, 1989.

(8) S.W.Yuan, Foundation of Fluid Mechanics, Prentice Hall of India, Private Limited, New Delhi, 1976.

SEMESTER-IV

4MTH-3/4/5 (iii) : OPERATION RESEARCH-II (OPTIONAL)

Unit-I : Game Theory - Two Person, Zero sum games, games with mixed strategies, Graphical solution, solution by linear programming.

Unit-II : Integer Programming : Branch and Bound technique, Queueing theory and sequencing, applications to industrial problems, optimal product mix and activity levels, petroleum refinary operations, blending problems.

Unit-III : Economic Interpretation of dual linear programming problems, input - output analysis, Leontief system, Indecomposable and decomposable economics.

Unit-IV : Non-Linear Programming : One and multi-variable unconstrained optimization. Kuhn-Tucker conditions for constrained optimization.

Unit-V : Quadratic Programming, separable programming, convex programming, non-convex programming.

Text Book :

(1) F.S.Hillier and G.J.Liebermann, Introduction to Operations research (6th Edition), McGraw Hill international edition, Industrial Engineering series, 1995.

(2) Kantiswarup, P.K.Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi.

Reference Books :

1) G.Hadley, Linear Programming, Narosa publishing House, 1995.

2) G.Hadle, Nonlinear and Dynamic Programming, Addison-Wesley, Reading Mass.

3) Mokhtar S.Bazaraa, Hohn J.Jarvis and Hanif D.Sherali, Linear Programming and Network flows, John Wiley & Sons, New York, 1990.

4) H.A.Taha, Operations Research - an Introduction, Macmillan Publishing Company, Inc, New York.

5) S.S.Rao, Optimization Theory and Applications, Wiley Eastern Ltd., New Delhi.

6) Prem Kumar Gapta and D.S.Hira, Operations Research - An Introduction. Chand & company Ltde, New Delhi.

7) N.S.Kambo, Mathematical Programming Techniques. Affiliated East-West Press Pvt.Ltd., New Delhi, Madras

SEMESTER-IV

(IV) : DIFFERENCE EQUATIONS-II

Unit-I : The Self-adjoint Second Order Linear Equations : Introduction, Sturmian theory, Green's functions. Disconjugacy, the Riccati equations. Oscillation.

Unit-II : The Sturm-Liouville Problem : Introduction, Finite Fourier analysis, A non-homogeneous problem.:

Unit-III : Discrete Calculation of Variation : Introduction. Necessary conditions. Sufficient conditions and disconjugacy.

Unit-IV : Boundary Value Problems for Non Linear Equations : Introduction, the Lipschitz case. Existence of solutions. Boundary value problems for differential equations.

Unit-V : Partial Differential Equations. Discretization of partial differential equations. Solution of partial differential equations.

Text Book :

Walter G. Kelley and Allan C.Peterson, Difference Equations : An Introduction with Applications, Academic Press, Inc., Harcourt Brace Joranovich Publishers, 1991.

References :

(1) Calvin Ahlbrandt and Allan C. Peterson, Discrete Hamiltonian Systems. Difference Equations, continued Fractions and Riccati Equations : Kluwer, Boston, 1996.

(2) Pundir S.K. and Pundir R., Difference Equations, Pragati Prakashan, Meerut, 2006.

SEMESTER-IV

(V) : FUZZY SETS AND APPLICATIONS-II (OPTIONAL)

Unit-I : Possibility Theory : Fuzzy sets and Possibility Distributions. Possibility and necessity measures. Possibility vs Probability.

Unit-II : Linguistic Variables and hedges. Inference from conditional fuzzy propositions. The compositional rule for inference.

Unit-III : Approximate reasoning - An overview of fuzzy expert system. Fuzzy implications and their selection. Multi conditional approximate reasoning. The role of fuzzy relation equations.

Unit-IV : An Introduction to fuzzy control - fuzzy controllers. Fuzzy rule base. Fuzzy inference engine fuzzification. Defuzzification and the various defuzzification methods (the centre of area, the centre of maxima, and the mean of maxima methods)

Unit-V : Decision making in Fuzzy Environment - Individual decision making. Multiperson decision making. Multicriteria decision making. Multistage decision making. Fuzzy ranking method. Fuzzy linear programming.

Reference Books :

(1) H.J.Zimmermann, Fuzzy set Theory and Its Applications, 2nd revised edition, Allied Publishers Ltd., New Delhi, 1996.

(2) G.J.Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995,

SEMESTER-IV
(VI): LIE GROUPS

Lie Groups : Topics for Review Only : (No question to be set on this topic) Charts and coordinates, analytic structures. Real functions on a manifold. Tangent vectors. The dual vector space. Differentials. Infinitesimal. Transformations and differential forms. Mappings of manifolds. Submanifolds. Product of manifolds.

Unit-I : Topological Groups. The family of nuclei of a topological group. Subgroups and homomorphic images. Connected topological groups.

Unit-II : Local Groups : Lie groups. Local lie groups. Analytic subgroups of a lie group. One dimensional lie groups.

Unit-III : The Commutator of two infinitesimal transformations. The algebra of infinitesimal right translations. Lie groups of transformations.

Unit-IV : The lie algebra of sub-group. One parameter subgroup. Taylor's theorem for Lie groups. The Exponential mapping.

Unit-V : The Exterior algebra of a vector space. The algebra of differential forms. Exterior differentiation. Maurer-Chartan forms. The Maurer Cartan relations. Statement of the lie fundamental theorems. The converses of Lie's first and second theorems.

Text Books :

(1) Lie Groups by P.M.Cohn, Cambridge University Press, 1961.

(2) Introduction to Lie Groups and Lie Algebras by A.S.Sagle and R.E.Walde, Academic Press, 1973.

Reference Books :

(1) Lie Groups and Compact Groups by John F.Price (Cambridge University Press)

(2) Theory of Lie Groups by Claude Cherallay (Princeton University Press)

SEMESTER-IV
(VII) : BANACH ALGEBRAS-II (OPTIONAL)

Unit-I : Sub algebras of C* - algebra and the spectrum. The spectral theorem. The continuous functional calculus. Positive linear functionals and states in C*-algebras. The GNS construction.

Unit-II : Strong and weak operator topologies. Von Newmann Algebras. Monotone Sequence of Operators. Range Projections.

Unit-III : The Commutant. The double commutant theorem. The Kaplansky Density theorem. L^{∞} as Von Newmann Algebra, Maximal Abelian Algebras.

Unit-IV : Abelian Von Newman Algebras. Cycling and Seperating vectors. Representation of Abelian Von Newmann Algebras, the L^{∞} functional calculus. Connectedness of the Unitary group.

Unit-V : The Projection lattice. Kaplansky's formula. The centre of a Von Newmann Algebra. Various types of projections. Centrally orthogonal projections, type decomposition.

Text Book : M.A.Naimark, Normed Algebras, Noordhoff, Groningen, Netherlands, 1972..

Reference Books:

(1) C.E.Ricart, General Theory of Banach Algebras, Von-Nostrand, 1960.

(2) T.W.Palmer, Banach Algebras, Vol.-I, Cambridge University Press, 1994.

SEMESTER-IV
4MTH-3/4/5 (viii) : NON-COMMUTATIVE RINGS-II (OPTIONAL)

Unit-I : Division rings, tensor products and maximal subfields [x13, x15 of [1]].

Unit-II : Polynomials over division rings. [x16 of [1]].

Unit-III : Local rings, Semi local rings [x19, x20 of [1]].

Unit-IV : The theory of idempotents. Central idempotents and block decompositions. [x21, x22 of [1]].

Unit-V : Perfect and semiperfect rings. [x23 of [1]].

Text Book :

T.Y.Lam, A First Course in Non Commutative Rings, Springer-Verlag, 1991.

Reference Books :

(1) I.N.Herstein, Non Commutative Rings, Carns Monographs of AMS, 1968.

(2) N.Jacobson, Basic Algebra-II, W H Freemann, 1989.

(3) D.Passman, A Course in Ring Theory, Wardsworth and Brooks / Cole Pacific Grove Colif, 1991.

(4) Louis H. Rowen, Ring Theory (Student Edition), Academic Press, 1991.

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M.A./M.Sc.Part-I & Part-II (Semester I to IV)
Examinations in Mathematics
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